# Contract Documents

## Downtown Area WWTF
## and Effluent Disposal
## Contract No. 2019-01 and SRF No. 4486
## Town of Orleans, MA

Prepared For

Department of Public Works & Natural Resources

AECOM Technical Services, Inc.

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| Division | Section Number |
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NOTE: Bidders shall check the attached documents with the above list before submitting a bid.

**END OF SECTION**

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February 13, 2020

**ADDENDUM NO. 1**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 1 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 10 pages and 148 pages of attachments for a total of 158 pages.

**ATTACHMENTS**

1. Orleans_MA-2019-01-Bid Form_v2
2. Orleans_MA-2019-01-SubBid Form_v2
3. SECTION 01025, MEASUREMENT AND PAYMENT
4. SECTION 04120, STONE VENEER
5. SECTION 04200, UNIT MASONRY AND ACCESSORIES
6. SECTION 00550, MISCELLANEOUS METALS
7. SECTION 07160, BITUMINOUS DAMPPROOFING
8. SECTION 07610, METAL ROOFING
9. SECTION 07840, FIRESTOPPING
10. SECTION 07900, JOINT SEALANTS
11. SECTION 08500, FIXED WINDOWS
12. SECTION 08550, WINDOWS
13. SECTION 08810, GLASS AND GLAZING
14. SECTION 09300, TILE WORK
15. SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS
16. DRAWING 00 C-108, PAVEMENT PLAN AND ZONING COMPLIANCE
17. DRAWING 99 DI-602, MISC SIGNALS II AND TABLE OF RESPONSIBILITY

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. GENERAL

   A. Non-Mandatory Pre-bid Conference - February 20, 2020 at 1:00 p.m.

   B. Sub-Bid Opening - March 11, 2020 at 10:00 am.

   C. General Bid Opening - March 25, 2020 at 2:00 pm.

2. TABLE OF CONTENTS

   A. Page TOC-1, DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS, add "Section 00420, Form for Sub-Bid".

   B. Page TOC-6, DIVISION 16, ELECTRICAL, delete "Section 16140, Wiring Devices".

   C. Page TOC-6, DIVISION 16, ELECTRICAL, delete "Section 16220, Motors".

3. SECTION 00100, ADVERTISEMENT FOR BIDS

   A. Page 00100-3, Paragraph 6., delete the fourth subparagraph in its entirety and replace with the following new paragraph:

      All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all subbid categories including the categories in which less than three subcontractors were prequalified. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

   B. Page 00100-3, delete Paragraph 11. in its entirety and replace with the following new paragraph:

      11. Bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the category of Sewage Treatment Plant Contractor. An Update Statement form covering the period from the date of the Bidder's most recently filed Contractor Qualification Statement (CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT. The project does not require the Contractor to have MassDOT Highway Division Certification.

4. SECTION 00200, INSTRUCTION TO BIDDERS

   A. Page 00200-2, Article 1.01 – RECEIPT AND OPENING OF BIDS, Paragraph B., delete the last sentence in the third sub-paragraph in its entirety.

   B. Page 00200-2, Article 1.01 – RECEIPT AND OPENING OF BIDS, Paragraph C., delete the fourth subparagraph in in its entirety and replace with the following new paragraph:

      Only Sub-Bids from prequalified Filed Sub-Bid Subcontractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

      - Masonry
      - Miscellaneous Metal Work
      - Roofing and Flashing
      - Metal Windows
      - Glass and Glazing
      - Painting
      - Plumbing
      - Heating, Ventilating and Air Conditioning
      - Electrical Work

Sub-Bids from Prequalified Filed Subcontractors and Other DCAM Certified Sub-Contractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

- Waterproofing and Dampproofing
- Fire Protection
- Tile

C. Page 00200-2, Article 1.01 – RECEIPT AND OPENING OF BIDS, delete Paragraph F. in its entirety and replace with the following new paragraph:

F. A non-mandatory Pre-Bid Conference will be held on February 20, 2020 at 1:00 pm at the Town of Orleans, 19 School Road, Orleans, MA 02653.

D. Page 00200-3, Article 1.03 – PREPARATION OF BID, delete Paragraph C. in its entirety and replace with the following new paragraph:

C. In accordance with M.G.L. Chapter 149 Section 44D-1/2 and 44 D-3/4, the following General Contractors and Filed Subcontractors have been prequalified to submit Bids on this Project:

**General Contractors**

| | |
|---|---|
| C.H. Nickerson & Co., Inc. | MWH Constructors, Inc. |
| Daniel O'Connell's Sons, Inc. | RH White Construction |
| Methuen Construction Company, Inc. | Waterline Industries Corporation |

**Filed Subcontractors**

| Category | Subcontractors |
|---|---|
| Masonry | Costa Brothers Masonry<br>Lighthouse Masonry, Inc.<br>Marmelo Bros. Construction Co., Inc. |
| Miscellaneous Metal Work | C.H. Nickerson & Co., Inc.<br>EDM Construction, Inc.<br>Methuen Construction Company, Inc.<br>SMJ Metal Company, Inc.<br>Waterline Industries Corporation |
| Waterproofing & Dampproofing | P.J. Spillane Company, Inc.<br>The Waterproofing Company, Inc.<br>Any Other DCAM Certified Subcontractor |
| Roofing & Flashing | Greenwood Industries, Inc.<br>Silktown Roofing, Inc.<br>Waterline Industries Corporation |

| Filed Subcontractors | |
|---|---|
| **Category** | **Subcontractors** |
| Metal Windows | A&A Window Products, Inc.<br>Aluminum & Glass Concepts, Inc.<br>G.V.W., Inc.<br>Kapiloff's Glass, Inc. |
| Glass and Glazing | A&A Window Products, Inc.<br>Aluminum & Glass Concepts, Inc.<br>G.V.W., Inc.<br>Kapiloff's Glass, Inc. |
| Tile | Capital Carpet & Flooring Specialists, Inc.<br>Pavilion Floors, Inc.<br>Any Other DCAM Certified Subcontractor |
| Painting | Dandis Contracting<br>John W. Egan Company Co., Inc.<br>Keltic Painting, LLC |
| Fire Protection | Any DCAM Certified Subcontractor |
| Plumbing | Araujo Bros. Plumbing & Heating, Inc.<br>Casey Plumbing & Heating, Inc.<br>Harding & Smith, LLC<br>Waterline Industries Corporation |
| HVAC | General Mechanical Contractors, Inc.<br>Harding & Smith, LLC<br>Waterline Industries Corporation |
| Electrical | Annese Electrical Services<br>Fall River Electrical Associates Co., Inc.<br>Waterline Industries Corporation<br>Wayne J. Griffin Electric, Inc. |

E. Page 01030-5, Article 1.08 - PROGRESS OF WORK, add the following new paragraph:

C. Furnish to the Engineer a “two-week look ahead” that summarizes the anticipated construction activities. The “two-week look ahead” shall be provide to the Engineer on Thursday of every week throughout the duration of the Project.

5. SECTION 00410, FORM OF GENERAL BID

A. Delete “Orleans_MA-2019-01-Bid Form_v1” in its entirety and replace with the attached new “Orleans_MA-2019-01-Bid Form_v2” in both hard copy and Microsoft Excel format.

6. SECTION 00420, FORM OF SUBBID

   B. Delete "Orleans_MA-2019-01-SubBid Form_v1" in its entirety and replace with the attached new "Orleans_MA-2019-01-SubBid Form_v2" in both hard copy and Microsoft Excel format.

7. SECTION 00520, AGREEMENT

   a. Page 00520-2, Paragraph 6., delete the words "…the sum of $9,700 for each consecutive…" and replace with the words "…the sum of $6,700 for each consecutive…".

8. SECTION 01025, MEASUREMENT AND PAYMENT

   A. Delete SECTION 01025, MEASUREMENT AND PAYMENT in its entirety and replace with the attached new section.

9. SECTION 04120, STONE VENEER

   A. Delete SECTION 04120, STONE VENEER in its entirety and replace with the attached new section.

10. SECTION 04200, UNIT MASONRY AND ACCESSORIES

    A. Delete SECTION 04200, UNIT MASONRY AND ACCESSORIES in its entirety and replace with the attached new section.

11. SECTION 00550, MISCELLANEOUS METALS

    A. Delete SECTION 00550, MISCELLANEOUS METALS in its entirety and replace with the attached new section.

12. SECTION 07160, BITUMINOUS DAMPPROOFING

    A. Add new SECTION 07160, BITUMINOUS DAMPPROOFING as attached.

13. SECTION 07610, METAL ROOFING

    A. Delete SECTION 07610, METAL ROOFING in its entirety and replace with the attached new section.

14. SECTION 08500, FIXED WINDOWS

    A. Delete SECTION 08500, FIXED WINDOWS in its entirety and replace with the attached new section.

15. SECTION 08550, WINDOWS

    A. Delete SECTION 08550, WINDOWS in its entirety and replace with the attached new section.

16. SECTION 08810, GLASS AND GLAZING

    A. Delete SECTION 08810, GLASS AND GLAZING in its entirety and replace with the attached new section.

17. SECTION 09300, TILE WORK

    A. Add new SECTION 09300, TILE WORK as attached.

18. SECTION 11350, ULTRAVIOLET DISINFECTION EQUIPMENT

    A. Page 11350-5, Article 2.01 – SYSTEM DESCRIPTION

       1) Paragraph A., delete the words "400 gpm" and replace with the words "240 gpm".

       2) Paragraph A., delete the words "15 mg/L (average), 25 mg/L (maximum) twice a month" and replace with the words "10 mg/L (average), 15 mg/L (maximum) twice a month".

       3) Paragraph A., delete the words "UV Max Influent Fecal Coliform" and replace with the words "UV Max Effluent Fecal Coliform".

       4) Paragraph F.2., delete the paragraph in its entirety and replace with the following new paragraph:

          2. Number of lamps per reactor: As required to meet the design conditions specified herein and with a system dimension that fits within the foot print shown on the drawings.

5) Paragraph G.1., delete the words "…maximum of 14 CFU/100 ml, or equivalent MPN…" and replace with the words "…maximum of 200 CFU/100 ml, or equivalent MPN…".

6) Paragraph G.2., delete the words "…UV dose of 87 mJ/cm2 at peak flow, in effluent with a UV Transmittance of 57% at end of lamp life (EOLL) …" and replace with the words "…UV dose of 45 mJ/cm2 at peak flow, in effluent with a UV Transmittance of 55% at end of lamp life (EOLL) …".

B. Page 11350-6, Article 2.02 – MANUFACTURERS

1) Delete the Article in its entirety and replace with the following new Article:

2.02 - MANUFACTURERS

A. Trojan

B. Wedeco

C. Approved Equal.

C. Page 11350-6, Article 2.03 – UV DISINFECTION EQUIPMENT CONSTRUCTION

1) Delete Paragraph B.6. in its entirety and replace with the following new paragraph:

6. Each UV reactor shall contain high-intensity low-pressure amalgam UV lamps arranged horizontally and parallel to the direction of flow.

2) Delete Paragraph B.9. in its entirety and replace with the following new paragraph:

9. Not Used

3) Delete Paragraph J.2. in its entirety and replace with the following new paragraph:

6. Not Used.

D. Add new SECTION 09300, TILE WORK as attached.

19. SECTION 16050, ELECTRICAL WORK - GENERAL

A. Page 16050-02, Article 1.00, SUBBID REQUIREMENTS, delete Paragraph D. in its entirety and replace with the following new paragraph:

B. Reference Drawings

1. The Work of DIVISION 16, ELECTRICAL for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 10 ED-001 | 10 ED-002 | 10 ED-003 | 10 E-001 |
| 10 E-002 | 10 E-003 | 10 E-004 | 10 E-005 | 10 E-006 | 10 E-007 | 10 E-101 |
| 10 E-102 | 10 E-103 | 10 E-104 | 10 E-201 | 10 E-202 | 10 E-203 | 10 E-204 |
| 10 E-205 | 10 E-206 | 10 E-301 | 10 E-302 | 10 E-303 | 10 E-601 | 10 E-602 |
| 10 E-603 | 10 E-604 | 10 E-605 | 10 E-606 | 10 E-607 | 10 E-608 | 10 E-609 |
| 10 E-610 | 10 E-611 | 10 E-612 | 10 E-613 | 10 E-614 | 10 E-615 | 10 E-616 |
| 10 E-617 | 15 E-101 | 15 E-102 | 15 E-601 | 15 E-602 | 25 E-101 | 30 E-001 |
| 30 E-101 | 30 E-002 | 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 | 10 FA-101 |
| 10 FA-102 | 10 FA-201 | 10 FA-202 | | | | |

2. The Work of DIVISION 16, ELECTRICAL for Alternative A-1is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 20 E-101 | 20 E-102 | 20 E-601 | 20 E-602 |
| 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 | 20 FA-101 | | |

20. SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS

A. Add new SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS as attached

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 00 G-002, INDEX OF DRAWINGS

A. MECHANICAL PROCESS, delete “10 D-107”.

B. MECHANICAL PROCESS, add “10 D-309”.

C. ELECTRICAL, add “10 E-617 WWTF – ELECTRICAL, WIRING SCHEMATICS V”.

2. DRAWING 00 C-104, SITE LAYOUT PLAN - WWTF

A. Add the following spot grades between the Wastewater Treatment Facility / Sequencing Batch Reactor No. 2 and the Equipment Storage Facility:

1) 56.25

2) 56.35

B. Add the following new Note 6.:

6. If Alterative No. A-1 – Equipment Storage Facility is not accepted, all grading, pavement, curbing, site utilities, emergency generator, fencing and the like shall be constructed as shown. All underground utilities shall be terminated 10-feet from the face of the Equipment Storage Facility.

3. DRAWING 00 C-108, PAVEMENT PLAN AND ZONING COMPLIANCE

A. Add new DRAWING 00 C-108 as attached.

B. Delete the words “Mill and Overlay Pavement on Overland Way” with the words “Mill and Overlay 2-inches of Pavement on Overland Way”.

C. Delete the words “Full Depth Pavement at new WWTF. For Additional Information, See Sheet 00 C-104” and replace with the words “Full Depth Pavement at WWTF. For Additional Information See Sheet 00 C-104 and Detail on Sheet 99 C-508”.

4. DRAWING 00 C-109, DRAIN PROFILES

A. Drain Profile 3, Delete the words “32 LF 12” PVC DI” and replace with the words 32 LF 12” DI.

5. DRAWING 00 C-108, PAVEMENT PLAN AND ZONING COMPLIANCE

A. Add new DRAWING 99 DI-602 as attached.

6. DRAWING 00 C-202, SITE PLAN – EFFLUENT DISPOSAL

A. Delete the words “12’ Wide Gravel Access Drive to Wick Distribution Vault and Wicks” and replace with the words “12’ Wide and 18-inch Deep Gravel Access Drive (Mass Highway Spec. M1.03.0 Type A ) to Wick Distribution Vault and Wicks. Gravel Shall Be Compacted to 95% Max. Dry Density.”

7. DRAWING 00 C-203, YARD PIPING PLAN – EFFLUENT DISPOSAL

A. Delete the words “Construct Drop MH On Exist. 12” PVC Drain. Approx. Inv. El. 122.9” and replace with the words “Construct Drop MH On Exist. 12” PVC Drain. Rim 126.0, Inv. In. 122.9, and Inv Out 118.0”

B. Delete the words “Concrete Headwall and Rip-Rap Slope Protection” and replace with the words “Concrete Headwall and Rip-Rap Slope Protection, Inv. 116.0”

8. DRAWING 99 C-502, DETAILS II

   A. Typical Drain Trench Detail, delete the words "Compacted Crushed Stone Bedding Against Ledge, 1-1/2" Max. Stone Size" and replace with the words "Compacted 3/4" Crushed Stone or Processed Glass Aggregate Bedding".

   B. Typical Water Trench Detail, add the following new note:

      3. In lieu Crushed Stone, the Contractor may utilize PGA for bedding.

   C. Gravity Sewer/Force Main Trench Detail, delete the words "Compacted Crushed Stone Bedding Against Existing Materials, 1-1/2" Max. Stone Size" and replace with the words "Compacted 3/4" Crushed Stone or Processed Glass Aggregate Bedding".

9. DRAWING 99 C-503, DETAILS III

   A. Delete the detail "Concrete Thrust Block Bearing Areas for Water Main".

   B. Delete the title "Force Main Thrust Block" and replace with "Sewer Force Main Thrust Block".

10. DRAWING 99 C-505, DETAILS V

   A. Add the following table.

WICK ELEVATIONS (ft., NGVD)

| Wick ID | Approximate Ground | Approximate Water Table | Bottom of 3' Diameter Temporary Casing for Wick Borehole | Bottom of 2' Diameter Temporary Casing | Top of Wick Access Wells | Bottom of Wick Access Wells |
|---|---|---|---|---|---|---|
| 1 | 124.0 | 14.0 | 24.0 | 24.0 | 120.3 | 24.0 |
| 2 | 122.2 | 14.0 | 22.2 | 22.2 | 118.5 | 22.2 |
| 3 | 127.8 | 14.0 | 27.8 | 27.8 | 124.1 | 27.8 |
| 4 | 130.2 | 14.0 | 30.2 | 30.2 | 126.5 | 30.2 |
| 5 | 132.2 | 14.0 | 32.2 | 32.2 | 128.5 | 32.2 |

| Wick ID | Top of Fine and Course Gravel Packs | Bottom of Fine and Course Gravel | Top of 3' Diameter Permanent Steel Casing | Bottom of 3' Diameter Permanent Steel Casing | Top of Removable Grate | Top of Concrete Grading Ring |
|---|---|---|---|---|---|---|
| 1 | 120.0 | 24.0 | 121.0 | 113.0 | 121.0 | 118.0 |
| 2 | 118.2 | 22.2 | 119.2 | 111.2 | 119.2 | 116.2 |
| 3 | 123.8 | 27.8 | 124.8 | 116.8 | 124.8 | 121.8 |
| 4 | 126.2 | 30.2 | 127.2 | 119.2 | 127.2 | 124.2 |
| 5 | 128.2 | 32.2 | 129.2 | 121.2 | 129.2 | 126.2 |

| Wick ID | Bottom of Coarse Gravel Outside Permanent Casing | Bottom of 0.33" Thick Steel Plates | Top of Access Hatch | Invert of Force Main Access to Vault (max. elev) | Invert of Force Main Inside Vault | Invert of Force Main Discharge |
|---|---|---|---|---|---|---|
| 1 | 116.0 | 118.0 | 124.2 | 119.5 | 122.0 | 121.5 |
| 2 | 114.2 | 116.2 | 122.4 | 117.7 | 120.2 | 119.7 |
| 3 | 119.8 | 121.8 | 128.0 | 123.3 | 125.8 | 125.3 |
| 4 | 122.2 | 124.2 | 130.4 | 125.7 | 128.2 | 127.7 |
| 5 | 124.2 | 126.2 | 132.4 | 127.7 | 130.2 | 129.7 |

11. DRAWING 99 C-506, DETAILS VI

    A. Delete the detail “Typical Outside Drop Manhole Connection” in its entity.

    B. Delete the detail “Typical Precast Concrete Manhole with Hood (Catch Basin)” in its entity.

    C. Typical Precast Concrete Drain Manhole

        1. Delete the words “26” Heavy Duty Frame & Cover, C.I. Lebaron LK 110 or Approved Equal. (Cover to be Stamped Drain)” and replace with the words “Orleans Standard Drain Manhole Cover. See Drawing 99 C-507

        2. Delete the words “6” Min 3/4” Crushed Stone” and replace with words “6” Min 3/4” Crushed Stone or Processed Glass Aggregate”.

    D. Typical Precast Concrete Sewer Manhole

        1. Delete the words “Use Orleans Standard Manhole Frame & Cover. Min. Wt. 475 lb. (Cover to be stamped Sewer). Lebaron LK 110 or Approved Equal. Locking Frame and Cover to be Set 6” Above Finished Grade (Off Road Locations). Cover to be Stamped Sewer) Lebaron LCB268-1 or Approved Equal. Min Weight = 475 lbs.” and replace with the words “Orleans Standard Sewer Manhole Cover. See Drawing 99 C-507”.

        2. Delete the words “3/4” Crushed Stone” and replace with words “3/4” Crushed Stone or Processed Glass Aggregate”.

12. DRAWING 99 C-508, DETAILS VIII

    A. Bit. Conc. Pavement Section, delete the words “10” Compacted Gravel Sub-Base on Compacted Subgrade” with the words “12” Compacted Gravel Sub-Base (Mass Highway Spec. M2.01.7) on Compacted Subgrade.

    B. Delete the detail “Gravel Road Section – Effluent Disposal Access Drive” in its entity.

13. DRAWING 10 A-601, ROOM FINISH SCHEDULE

    A. Add the following new note:

        Note: TBD (To Be Determined) in the Room Finish Schedule indicates that the selection of colors will be determined during the Shop Drawing review process.

14. DRAWING 10 A-602, DOOR SCHEDULE AND LEGEND

    B. Door Schedule, revised the following Door Types

        1. Door 108A – Type F

        2. Door 109B – Type F

        3. Door V-1B – Type P

15. DRAWING 99 P-502, DETAILS II
    A. Gasoline/Oil/Sand Separator
        1. Delete the words “3’-6” Min.” and replace with the words “5-foot Diameter”.
        2. In Note 6, delete the words “…through the roof.” and replace with the words “…through the chimney.”
        3. Delete the Construction Material Paragraph in its entirety and replace with “Precast Concrete Manhole (H-20 Loading)”.
    B. Duplex Sump Pump Piping Detail
        1. Add the following new note:
            2. Similar Piping for Simplex Sump Pump.
        2. Delete the words “Check Valve (TYP.)” and replace with the words “Double Check Valve (TYP.)”.
16. DRAWING 10 E-002, WWTF – ELECTRICAL SITE PLAN - SYSTEMS
    A. Revise CCTV 10-002 from Pole Mounted to Building Mounted at Column Line A and Colum Line 1.
    B. Revise CCTV 10-003 from Pole Mounted to Building Mounted at Column Line A and Colum Line 4.
    C. Delete CCTV 10-004 and all of its associated components.
    D. Delete CCTV 10-006 and all of its associated components.
    E. Delete CCTV 15-001 and all of its associated components.
    F. Delete CCTV 15-002 and all of its associated components.
    G. Revise CCTV 15-003 from Pole Mounted to SBR N0. 2 Wall Mounted.
    H. Delete CCTV 20-001 and all of its associated components.
17. DRAWING 10 E-302, WWTF - GRADE LEVEL - SECURITY PLAN I
    A. Delete CCTV 10-101 and all of its associated components.
    B. Delete CCTV 10-120A and all of its associated components.
    C. Delete CCTV 10-120B and all of its associated components.
    D. Add CCTV 10-101 and all of its associated components in Truck Bay located at Column Line A and Colum Line 4.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 1**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of | | | |
| | $ - | per c.y. | 200 | $ - |
| 2G. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| 2H. | For Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | **$ -** |

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |

Company's Name

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 3G | Section 09300, Tile Work | | | $ - |
| 3H | Section 09900, Painting | | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | | **$ -** |

**PART IV - ALTERNATIVES**

| | | |
|---|---|---|
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | $ - |

**BASIS OF AWARD** - The OWNER's present funding constraint limits award of this contract to $22,350,000. The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraint will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding the total of $22,350,000. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additonal Funding may be obtained at the Annual Town Meeting proposed to be held in May 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$ -**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive** | | | $ - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive** | | | $ - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive** | | | $ - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | $ - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | $ - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A1. | For Addition of the Equipment Storage Facility, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-1** | **$ -** |

Company's Name

Date

Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

Company's Name

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Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

Date

Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

Company's Name

Company's Address

Date:

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

**Base Bid**

The work of the Subbidder for all Work of the Project, excluding the Work contained within each Alternative, the Contract sum of:

$ - l.s.

**Alternatives**

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

$ - l.s.

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

$ - l.s.

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

$ - l.s.

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

$ - l.s.

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

$ - l.s.

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

$ - l.s.

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

___ may be used by any General Bidder except:

___ may only be used by the following General Bidders:

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

Class of Work:

Bid Price:
$ -

2 Name:

Class of Work:

Bid Price:
$ -

3. Name:

Class of Work:

Bid Price:
$ -

4. Name:

Class of Work:

Bid Price:
$ -

5. Name:

| |
|---|
| |
| Class of Work: |
| |
| Bid Price: |
| $ - |

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name

2. Ever failed to complete any work awarded?

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project

| |
|---|
| |
| Engineer or Architect |
| |
| General Contractor |
| |
| Amount of Contract |
| $ - |

b) Project

Engineer or Architect

General Contractor

Amount of Contract
$ -

c) Project

Engineer or Architect

General Contractor

Amount of Contract
$ -

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

**SECTION 01025**

**MEASUREMENT AND PAYMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The purpose of this section is to define the basis of measurement and payment for each of the unit price or lump sum items listed in DOCUMENT 00410, FORM OF GENERAL BID. If no quantity or bid item appears in DOCUMENT 00410, FORM OF GENERAL BID for any of the following described items, no Work of that description is anticipated on the project.

B. The Contractor shall become acquainted with all Work associated with each Payment Item and shall have no claim for additional compensation due to unfamiliarity with the Work required to complete each Item in accordance with the Contract Documents.

C. No payment will be made for any item of Work until all documentation required by the Contract Documents has been reviewed and approved by the Engineer. No payment will be made for additional materials that are not installed on the Project. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.

**1.02 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.03 - PAYMENT ITEMS**

| Item | Description |
|---|---|
| PART I - MOBILIZATION / DEMOBILIZATION | |
| 1 | Mobilization/Demobilization |
| PART II – WWTF RELATED WORK | |
| 2A | Wastewater Treatment Facility |
| 2B | Effluent Disposal |
| 2C | Rock and/or Boulder Excavation |
| 2D | Replacement of Unsuitable Material Below Trench Grade |
| 2E | Replacement of Unsuitable Material Above Trench Grade |
| 2F | Experimental Excavation |
| 2G | Sheeting and/or Shoring Ordered Left in Place |
| 2H | Existing Perimeter Fence Repairs |
| 2I | Perimeter Fence and Gates |

| Item | Description |
|---|---|
| PART III – FILED SUBBIDS | |
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories |
| 3B | Section 05500, Miscellaneous Metal Work |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows |
| 3F | Section 08810, Glass and Glazing |
| 3G | Section 09300, Tile Work |
| 3H | Section 09900, Painting |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation |
| 3L | Division 16 – Electrical (All Sections) |
| PART IV - ALTERNATIVES | |
| A-1 | Addition of the Equipment Storage Facility |
| A-2 | Addition of Fiber Optic Conduits and Handholes |
| A-3 | Addition of Tracer Wire |
| A-4 | Addition of SBR Transfer Pump No. 4 |
| A-5 | Addition of SBR Blower No. 4 |
| A-6 | Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank) |

**1.04 - BASIS OF MEASUREMENT AND PAYMENT**

**PART I – MOBILIZATION / DEMOBILIZATION**

**ITEM 1 - MOBILIZATION/DEMOBILIZATION**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include transporting, mobilization, demobilization, utility connection fees, permits, licenses, bonds, insurance and all other incidental Work relative thereto.

B. Measurement. Measurement for mobilization/demobilization shall be made based on the lump sum amount bid as approved by the Engineer.

C. Payment. Payment for mobilization/demobilization listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the lump sum price bid under this Bid Item. The amount of this lump sum shall not exceed five (5) percent of the Contract amount, excluding Item 1, and no payment shall be made in excess of this amount. An amount of seventy-five (75) percent of the amount bid under Item 1 (exclusive of normal Contract retainage) will be made when the Contractor has mobilized to the Project site(s) and is ready to start construction. The remaining twenty-five (25) percent (exclusive of normal Contract retainage) will be made following demobilization from the Project site(s) following final completion and acceptance of the work by the Owner.

**PART II – WWTF RELATED WORK**

**ITEM 2A - WASTEWATER TREATMENT FACILITY**

A. General. The lump sum price bid for construction of the Wastewater Treatment Facility shall include all Work described in these Specifications, notices, Division 0 through Division 16 inclusive, and Contract Drawings, except for those items priced separately (Part I, Part II and Part III). All Allowances specified in SECTION 01020, ALLOWANCES shall be included under this Bid Item.

B. Measurement. The methods of measurement shall be based on the completed installation of the Wastewater Treatment Facility, as specified, based on the schedule of values approved by the Owner.

C. Payment.

1. Payment for Wastewater Treatment Facility listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under Item 2A based on a schedule of values approved by the Owner.

2. All Allowances specified in SECTION 01020, ALLOWANCES shall be included under this Bid Item. Payment for the allowances under Item 2A which are listed in SECTION 01020, ALLOWANCES shall be based upon the actual time and materials or Lump Sum as approved by the OWNER. If the actual costs exceed the allowance, the difference will be paid by the Owner. Should the actual cost be less than the allowance, the Owner will retain the difference. Refer to SECTION 01020, ALLOWANCES.

**ITEM 2B – EFFLUENT DISPOSAL**

A. General. The lump sum price bid for construction of the Effluent Disposal shall include all Work described in these Specifications, notices, Division 0 through Division 16 inclusive, and Contract Drawings, except for those items priced separately (Part I, Part II and Part III).

B. Measurement. The methods of measurement shall be based on the completed installation of the Effluent Disposal, as specified, based on the schedule of values approved by the Owner. The Contractor shall include the cost for 20-vertical feet of permanent steel casing in each Wick.

C. Payment.

1. Payment for Effluent Disposal listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under Item 2B based on a schedule of values approved by the Owner.

2. Payment for permanent steel casing in each Wick shall be based on the actual number of vertical feet provided.

**ITEM 2C - ROCK AND/OR BOULDER EXCAVATION**

A. General. The price bid under Item 2C shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include excavation, drilling and blasting, furnishing and placing replacement material, removal and legal disposal of rock, backfilling and compaction, monitoring blasts, and any other incidental Work relative thereto.

B. Measurement. Measurement of rock and/or boulder excavation shall be made based on the volume removed and replaced as approved by the Engineer computed, as follows:

1. Only boulders greater than one (1) cubic yard in volume, defined by the Engineer as removable only by blasting, shall be measured and paid for under this Bid Item. Measurement shall be based on the length, width and depth of boulders excavated within the trench limits.

2. Rock in pipe trenches shall be measured from its surface to a point six (6) inches below the invert of the pipe and, as follows:

a. For pipe twenty-four (24) inches or less in diameter a width of five (5) feet for depths twelve (12) feet or less and a width of seven (7) feet for depths greater than twelve (12) feet.

b. For pipe greater than twenty-four (24) inches in diameter a width of three (3) feet plus the inside diameter of the pipe for depths of twelve (12) feet or less and a width of five (5) feet plus the inside diameter of the pipe for depths greater than twelve (12) feet.

3. Rock or boulders encountered in other excavations, which are to be paid for separately, shall be measured from its surface to a point one (1) foot below the base of structure and to a width of one (1) foot outside the face of the structure.

4. Where more than one (1) pipe is installed in the same trench, payment shall be made on the basis of a common trench with the maximum trench width of seven (7) feet.

C. Payment. Payment for rock and/or boulder excavation listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under Item 2C.

1. No additional payment will be made for frost removal or for any other materials encountered in the excavations, no matter how stiff or compact of consistency, even if blasting is required for removal. Soft or disintegrated rock that can be removed without the use of explosives shall not be paid for under this Bid Item.

2. No additional payment will be made for rock and/or boulder excavation where existing utilities are removed and relaid to facilitate the Work within the trench limits defined hereinbefore.

3. Masonry or concrete structures encountered during the course of constructing the Work, which require blasting for removal, shall be paid for subject to the limits and conditions described herein.

4. No payment will be made for excavation of rock and/or boulders beyond the specified limits.

**ITEM 2D and ITEM 2E - REPLACEMENT OF UNSUITABLE MATERIAL**

A. General. The prices bid under Item 2D and Item 2E shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include excavation, sheeting or shoring not ordered left in place, dewatering, removal and legal disposal of unsuitable materials, filter cloth, furnishing and placing replacement materials, transportation, backfilling, compaction and any other incidental Work relative thereto.

B. Measurement. Measurement for replacement of unsuitable material above and below trench grade and/or subgrade shall be made based on the volume removed and replaced as approved by the Engineer and, as follows:

1. Unsuitable material below trench grade shall be measured from a point six (6) inches below the invert of pipe to the bottom of the excavation and a total width of three (3) feet plus the inside diameter of pipe for pipe twenty four (24) inches or less in diameter (minimum four (4) feet) for trench depths twelve (12) feet or less and five (5) feet plus the inside diameter of the pipe for trench depths greater than twelve (12) feet.

2. Unsuitable material above trench grade shall be measured from a point one (1) foot plus the thickness of permanent pavement thickness below the existing pavement surface or from a point six (6) inches below the existing unpaved surface to a point one (1) foot above the pipe and a total width of three (3) feet plus the inside diameter of pipe for pipe twenty four (24) inches or less in diameter (minimum four (4) feet) for trench depths twelve (12) feet or less and five (5) feet plus the inside diameter of the pipe for trench depths greater than twelve (12) feet.

3. Unsuitable material below precast concrete manholes shall be measured from a point six (6) inches below the base of the manhole to the bottom of the excavation and to a width of two (2) feet plus the outside diameter of the manhole.

4. Unsuitable material below foundations for structures shall be measured from the bottom of foundation varying in width on a forty-five (45) degree angle down and out two (2) feet from the bottom edges of foundation to a depth approved by the Engineer.

C. Payment. Payment for replacement of unsuitable material above and below trench grade and/or subgrade listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under the applicable division of Item 2D and Item 2E.

1. No payment will be made for replacement of suitable material above trench grade when suitable excess excavated material is available from other excavations made under this Project.

2. Bedding material placed from a point six (6) inches below the invert of pipe, to a point one (1) foot above the top of the pipe shall be included for payment under the applicable pipe laying Bid Item.

3. When more than one (1) pipe is installed in the same trench, payment will be based on a common trench with a minimum width of seven (7) feet.

4. No payment will be made for unsuitable material replaced beyond the limits approved by the Engineer.

**ITEM 2F - EXPERIMENTAL EXCAVATION**

A. General. The price bid under Item 2F shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include notification of utility owners, machine and/or hand excavation to locate utilities, backfill, compaction, maintaining utility marking locations, repair to utilities damaged while performing experimental excavations, temporary bituminous concrete patch, furnishing assistance to the Engineer and all other incidental Work relative thereto.

B. Measurement. Measurement of experimental excavation shall be made based on the volume excavated and backfilled as approved by the Engineer.

C. Payment. Payment for experimental excavation listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under Item 2F. No payment will be made for any cost associated with damages caused to existing utilities made during the performance of experimental excavation operations.

**ITEM 2G - SHEETING AND/OR SHORING ORDERED LEFT IN PLACE**

A. General. The price bid under Item 2G shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for complete and permanent earth support system(s), located at locations approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement of sheeting and/or shoring ordered left in place shall be made based on the square feet of sheeting and/or shoring left in place as approved by the Engineer, computed as follows.

1. Measurement of the length of sheeting and/or shoring left in place shall be the actual measured horizontal length of sheeting and/or shoring installed.

2. Measurement of the depth of sheeting and/or shoring left in place shall be made vertically from one (1) foot below the bottom of the structure slab to five (5) feet below finish grade.

C. Payment. Payment for sheeting and/or shoring ordered left in place listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per square foot under Item 2G.

1. No payment will be made for sheeting and/or shoring left in place outside of the measurement for payment limits specified.

**ITEM 2H - EXISTING PERIMETER FENCE REPAIRS**

A. General. The price bid under Item 2H shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for Existing Perimeter Fence Repairs, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on a percentage complete, as approved by the Engineer.

C. Payment. Payment for Existing Perimeter Fence Repairs listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under Item 2H.

**ITEM 2I - PERIMETER FENCE AND GATES**

A. General. The price bid under Item 2I shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified for the new Perimeter Fence and Gates and removal and legal disposal of the existing wood stockade fence as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on a percentage complete, as approved by the Engineer.

C. Payment. Payment for Perimeter Fence and Gates listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under Item 2I.

**PART III – FILED SUBBIDS**

A. General. The lump sum price bid for subbids for all work described in the Contract Documents.

B. Measurement. Measurement shall be based on the work required in the following sections of the Specifications:

| Item | Description |
|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories |
| 3B | Section 05500, Miscellaneous Metal Work |
| 3C | Section 07160, Bituminous Dampproofing, Section 07840, Firestopping, and Section 07900, Joint Sealants |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows |
| 3F | Section 08810, Glass and Glazing |
| 3G | Section 09300, Tile Work |
| 3H | Section 09900, Painting |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation |
| 3L | Division 16 – Electrical (All Sections) |

C. Payment. Payment for subbids shall be at the lump sum price bid for all work described in the Contract Documents.

**PART IV – ALTERNATIVES**

**ITEM A-1 – EQUIPMENT STORAGE FACILITY**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for Equipment Storage Facility, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing the Equipment Storage Facility, as approved by the Engineer.

C. Payment. Payment for Equipment Storage Facility listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-2 - FIBER OPTIC CONDUITS AND HANDHOLES**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include placement of conduits, handholes and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing the Fiber Optic Conduits and Handholes, as approved by the Engineer.

C. Payment. Payment for Fiber Optic Conduits and Handholes listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-3 – TRACER WIRE**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include placement of tracer wire, connectors, termination points, grounding, testing and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing the Tracer Wire, as approved by the Engineer.

C. Payment. Payment for Tracer Wire listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under this Bid Item.

**ITEM A-4 – SBR TRANSFER PUMP NO. 4**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for SBR Transfer Pump No. 4, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing SBR Transfer Pump No. 4, as approved by the Engineer.

C. Payment. Payment for SBR Transfer Pump No. 4listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under this Bid Item.

**ITEM A-5 – SBR BLOWER NO. 4**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for SBR Blower No. 4, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing SBR Blower No. 4, as approved by the Engineer.

C. Payment. Payment for SBR Blower No. 4listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-6 – SBR AERATION DIFFUSER GRIDS**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for two SBR Aeration Diffuser Grids (1 per SBR Tank), as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing two SBR Aeration Diffuser Grids (1 per SBR Tank), as approved by the Engineer.

C. Payment. Payment for two SBR Aeration Diffuser Grids (1 per SBR Tank) listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**PART 2 - PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF SECTION**

**SECTION 04120**

**STONE VENEER**

**(Filed Sub-Bid Required)**

PART 1 - GENERAL ..... 1
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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 4, MASONRY shall include the complete Work specified in all of the following Sections:

1. SECTION 04120, STONE VENEER
2. SECTION 04200, UNIT MASONRY AND ACCESSORIES

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 04120, STONE VENEER for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-101 | 10 A-102 | 10 A-103 | 10 A-201 | 10 A-202 | 10 A-301 |
| 10 A-302 | 10 A-303 | 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 |
| 10 A-404 | 10 A-406 | 10 A-407 | 10 A-408 | 10 A-501 | 10 A-503 | 10 A-504 |
| 10 A-505 | 10 A-604 | 10 A-605 | 10 A- 606 | 10 A-607 | 99 A-607 | 00 S-001 |
| 00 S-001 | 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 S-303 |
| 99 S-501 | 99 S-502 | 99 S-502 | 99 S-504 | 99 S-505 | 99 S-506 | 00 D-001 |
| 00 D-002 | 10 D-100 | 10 D-104 | 10 D-105 | 10 D-301 | 10 D-302 | 10 D-303 |
| 10 D-304 | 10 D-305 | 10 D-306 | 10 D-307 | 10 D-308 | | |

2. The Work of SECTION 04120, STONE VENEER for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-102 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 |
| 20 A-401 | 20 A-501 | 20 A-601 | 20 A-602 | 20 A-603 | 99 A-607 | 00 S-001 |
| 00 S-002 | 20 S-101 | 20 S-102 | 99 S-501 | 99 S-502 | 99 S-505 | 99 S-506 |
| 00 D-001 | 00 D-002 | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 04120, STONE VENEER and
SECTION 04200, UNIT MASONRY AND ACCESSORIES

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Stone Veneer as specified herein and/or as shown on the Contract Drawings.

1. Stone cladding, siding and veneer of exterior walls as indicated.

2. Thin stone veneer on thin set.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data:

a. Preparation instructions and recommendations.

b. Storage and handling requirements and recommendations.

c. Installation methods.

2. Selection Samples: Submit mortar color samples.

3. Verification Samples: Submit 2 manufacturer’s full-size samples of natural veneer stone for each pattern specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Store stone on pallets or wooden crates. Pallet shall be shrink-wrapped.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Stone Producer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

C. Stone Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.

D. Mock-Up: Provide a mock-up for evaluation of stone, mortar color and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until Architect approves workmanship, color, and sheen.
3. Refinish mock-up area as required to produce acceptable work.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. ASTM C91: Standard Specification for Masonry Cement.
2. ASTM C144: Standard Specification for Aggregate Masonry Mortar.
3. ASTM C150: Standard Specification for Portland Cement.
4. ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes.
5. ASTM C270: 08a Standard Specification for Mortar for Unit Masonry.
6. ANSI A118.4: Latex Portland Cement Mortar

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PROJECT CONDITIONS**

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install natural stone veneer under environmental conditions outside manufacturer's limits.

B. Hot and Cold Weather Requirements: ACI 530.1/ASCE 6/TMS 602.

C. Air Temperature: 40 degrees F or above during installation.

D. Mortar Mixing Water: Heat mortar mixing water when air temperature falls below 50 degrees F.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Acceptable Manufacturers for stone veneer:

1. STONEYARD® - 265 Foster Street; Littleton, MA 01460; Tel: 978-742-9800; Fax: 978-742-9898; Email: sales@stoneyard.com. Web: www.stoneyard.com
2. Quality Stone Veneer - 50 Howe Ave, Millbury, MA 01527; Tel: 508-581-4115; Fax: 508-762-1504. Web: www.qualitystoneveneer.com
3. Fieldstone Veneer - 49-1/2 Summer St. Milford, MA 01757; Tel: 844-983-6337. Web: www.fieldstoneveneer.com

**2.02 - NATURAL VENEER STONE**

A. Physical Characteristics:

1. Fieldstone: Collected stone from farms and fields in Massachusetts, Connecticut, Rhode Island, New Hampshire, Vermont, and Maine.
2. Color and Veining Range: Earth tones of brown, tan, gray, buff, pink, yellow, white, and black.
3. Density: 153.0 pcf.
4. Bulk Specific Gravity: 2.46.
5. Water Absorption: 0.54 percent.
6. Modulus of Rupture Perpendicular: 1,854 psi.
7. Modulus of Rupture Parallel: 2,692 psi.
8. Compressive Strength Perpendicular: 19,958 psi.
9. Compressive Strength Parallel: 17,307 psi.

B. Sizes and Shapes:

1. Natural Stone Veneer. Broad range of colors including brown, tan, gray, buff, pink, yellow, white and black.
2. Natural aged and split faces. Commonly used as an architectural stone siding for interior and exterior veneer applications.
3. Adhered Thin Veneer - 1.0-inch thick (plus or minus 0.25-inches). Lightweight (less than 14 lbs per square foot), natural stone, does not require a supporting masonry shelf. Used for exterior applications:
   a. Flats.
   b. Pre-Cut Corners for the appearance of full depth stone
   c. Mosaic Thin Veneer: style Boston Blend Ashlar from Stoneyard or equal.
      (1) Primarily natural weathered faces with some split faces
      Thickness: 1.0 inch (plus or minus 0.25 inch)
      (2) Facing area: 0.25 to 1.25 sf
      (3) Pre-cut corners present full size stone shape in a thin veneer

**2.03 - ACCESSORIES**

A. Building Paper: ASTM D226, No. 30 asphalt saturated felt.

B. House Wrap: Air/vapor barrier polymeric membrane as specified in SECTION 07270, AIR/VAPOR BARRIER MEMBRANE.

C. Concrete Bonding Agent: Water-based polyvinyl acetate type or concrete adhesive emulsion formulated for use as an admixture.

D. Joint Sealants and Joint Fillers: As specified in SECTION 07900, JOINT SEALANTS.

**2.04 - ADHERED MASONRY VENEER INSTALLATION MATERIALS AND ACCESSORIES**

A. Air and Water Barrier Membrane: Air & Water Barrier to be thin, cold applied, single component liquid and load bearing. Waterproofing Membrane to be non-toxic, non-flammable, and non-hazardous during storage, mixing, application and when cured:

1. Air Barrier Test (AC 212): Pass
2. Air Permeance (ASTM E2178): Pass
3. Elongation @ break (ASTM D751): 20-30 percent
4. 7 day Tensile Strength (ANSI A118.10): >265 psi (1.8 MPa)
5. 7 day Shear Bond Strength (ANSI A118.10): >200 psi (1.4 MPa)
6. 28 Day Shear Bond Strength (ANSI A118.4): >214 psi (1.48 – 2.4 MPa)
7. Service Rating (TCA/ASTM C627): Extra Heavy
8. Total VOC Content: < 0.05 mg/m3

B. Epoxy Waterproofing Flashing Mortar: Waterproof Flashing Mortar to be 3 component epoxy, trowel applied specifically designed for use under adhered masonry veneer:

1. Breaking Strength (ANSI A118.10): 450-530 psi (3.1-3.6 MPa)
2. Waterproofness (ANSI A118.10): No Water penetration
3. 7 day Shear Bond Strength (ANSI A118.10): 110-150 psi (0.8-1 MPa)
4. 28 Day Shear Bond Strength (ANSI A118.10): 90-120 psi (0.6–0.83 MPa)
5. 12 Week Shear Bond Strength (ANSI A118.10): 110-130 psi (0.8-0.9 MPa)
6. Total VOC Content: <3.4 g/L

C. Cementitious backer board units: size, thickness and installation as specified by cement backer board manufacturer, complying with ANSI A118.9.

D. Latex-Portland Cement Mortar for leveling beds and scratch/plaster coats: Mortar Bed to meet the following physical requirements:

1. Compressive Strength (ANSI A118.4 Modified): >4,000 psi (27.6 MPa)
2. Water Absorption (ANSI A118.6): ≤ 5 percent
3. Service Rating (TCA/ASTM C627): Extra Heavy
4. Smoke & Flame Contribution (ASTM E84 Modified): 0
5. Total VOC Content: < 0.05 mg/m3

E. Latex Portland Cement Mortar: Bond Veneer Mortar to be weather, frost, shock resistant, non-flammable and meet the following physical requirements:

1. Compressive strength (ANSI A118.4): >2,500 psi (17.2 MPa)
2. Bond strength (ANSI A118.4): >450 psi (3.1 MPa)
3. Smoke & Flame Contribution (ASTM E84 Modified): 0
4. Total VOC Content: < 0.05 mg/m3

F. Latex Portland Cement Pointing Mortar / Grout: Pointing Mortar to be weather, frost and shock resistant, as well as meet the following physical requirements:

1. Compressive Strength (ASTM C91): 3,500 psi (24.1 MPa)
2. Smoke & Flame Contribution (ASTM E84 Modified): 0
3. Total VOC Content: < 0.00 mg/m3

G. Expansion and Control Joint Sealant: Silicone Sealant to be a one component, neutral cure, exterior grade silicone sealant and meet the following requirements:

1. Tensile Strength (ASTM C794): 280 psi (1.9 MPa)
2. Hardness (ASTM D751; Shore A): 25 (colored sealant) /15 (clear sealant)
3. Weather Resistance (QUV Weather-ometer): 10,000 hours (no change)

H. Spot Bonding Epoxy Adhesive: Stone Adhesive (Standard Grade) for installing adhered masonry veneer, brick and stone over vertical and overhead surfaces shall be high strength, high temperature resistant, non-sag and shall meet the following physical requirements:

1. Thermal Shock Resistance (ANSI A118.3): >1,000 psi (6.9 MPa)
2. Water Absorption (ANSI A118.3): 0.1 percent
3. Compressive Strength (ANSI A118.3): >8,300 psi (57.2 MPa)
4. Shear Bond Strength (ANSI A118.3 Modified): >730 psi (5 MPa)

## PART 3 - EXECUTION

### 3.01 - EXAMINATION

A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 - PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 - INSTALLATION OF ADHERED MASONRY THIN VENEER – MORTARED OR DRY STACK JOINTS

A. General: Install in accordance with current versions of American National Standards Institute, Inc. (ANSI) “A108 American National Standard Specifications for Installation of Ceramic Tile” and TCNA “Handbook for Ceramic Tile Installation.” Cut and fit adhered masonry veneer neatly around corners, fittings, and obstructions. Perimeter pieces to be minimum half unit of stone. Maintain masonry courses to uniform dimensions. Form vertical and horizontal joints of uniform thickness. Install divider strips at junction of flooring and dissimilar materials.

B. Direct Adhere Method to Install Masonry Veneer: Install latex Portland cement mortar in compliance with current revisions of ANSI A108.02 (3.11), A108.1B and ANSI A108.5. Use the appropriate trowel notch size to ensure proper bedding of the adhered masonry veneer, selected so that 100 percent coverage of the back surface of the Thin Adhered Veneer is achieved. Work the latex Portland cement mortar into good contact with the substrate and comb with notched side of trowel. Spread only as much latex Portland cement mortar as can be covered while the mortar surface is still wet and tacky. When installing large format (>8-inch x 8-inch (200 mm x 200 mm) units, spread latex Portland cement mortar onto the back of (i.e. 'back-butter') each piece/unit in addition to troweling latex Portland cement mortar over the substrate. Beat each piece/unit into the latex Portland cement mortar with a beating block or rubber mallet to insure 100 percent full bedding and flatness. Allow installation to set until firm. Clean excess latex Portland cement mortar from adhered masonry veneer face and joints between pieces.

1. Pattern Bond:

   a. Layout work in advance and distribute color range of stone uniformly over total work area.

   b. Lay stone with face exposed.

   c. Take care to avoid concentration of any one color to any one wall surface.

   d. Maintain uniform joints, as stone allows.

   e. Do not use stacked vertical joints.

C. Pointing/Grouting Joints (NOTE: Stacked Stone Installations to omit pointing of mortar joints)

D. Polymer Fortified Pointing Mortar - for joint widths ≥1/16-inch (1.5 mm) and ≤1-inch (25mm]). Allow Thin Adhered veneer to cure a minimum of 24 hours at 70° F (21°C). Verify joints are free of dirt, debris, wedges or spacers. Sponge or wipe dust/dirt off veneer face and remove any water standing in joints. Surface temperature must be between 40-90° F (4-32°C). Pour approximately 4 quarts (3.8 L) of clean, potable water into a clean mixing container. Add a 50 lb. (22.7 kg) bag of LATICRETE Pointing Mortar to the container while mixing. Mix by hand or with a slow speed mixer to a smooth, stiff consistency. Install latex fortified cement grout/pointing mortar in compliance with current revisions of ANSI A108.1A (7.0), ANSI A108.02 (4.5) and ANSI A108.10. Dampen dry surfaces with clean water.

E. Place Pointing Mortar into a high-quality masonry mortar pointing bag. Carefully bag the pointing mortar into the joints. Once the mortar has become stiff in the joint, ("thumb-print dry") typically 15 to 20 minutes after pointing at 70° F (21°C), using a striking or joint tool, strike the mortar joints to the desired finish/contour. Remove excess mortar using a masonry brush or sponge. Do not over wash the mortar joint.

F. Higher temperatures may require faster time to initial cleaning; wider joints or lower temperatures may require a longer time to initial cleaning. Allow joints to become firm. Inspect joint for pinholes/voids and repair them with freshly mixed grout/pointing mortar. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film. Do not use acid cleaners on latex Portland cement grout/pointing mortar less than 10 days old.

G. Expansion and Control Joints: Provide control or expansion joints as located in contract drawings and in full conformity, especially in width and depth, with architectural details.

1. Substrate joints must carry through, full width, to surface of adhered masonry veneer.

2. Install expansion joints in adhered masonry veneer work over construction/cold joints or control joints in substrates.

3. Install expansion joints where adhered masonry veneer abut restraining surfaces (such as perimeter walls, curbs, columns), changes in plane and corners.

4. Joint width and spacing depends on application and should be determined by the project design team.

5. Joint width: ≥ ⅛-inch (3mm) and ≤ 1-inch (25mm).

6. Joint width: depth ~2:1 but joint depth must be ≥ ⅛-inch (3mm) and ≤ ½-inch (12mm).

7. Layout (field defined by joints): 1:1 length: width is optimum but must be ≤ 2:1. Remove all contaminants and foreign material from joint spaces/surfaces, such as dirt, dust, oil, water, frost, setting/pointing materials, sealers and old sealant/backer. Use Primer for underwater and permanent wet area applications, or for porous stone (e.g. limestone, sandstone etc.) installations. Install appropriate backing material (e.g. closed cell backer rod) based on expansion joint design and as specified in SECTION 07900, JOINT SEALANTS. Apply masking tape to face of adhered masonry veneer, brick or stone veneer. Use caulking gun, or other applicator, to completely fill joints with sealant. Within 5 to 10 minutes of filling joint, 'tool' sealant surface to a smooth finish. Remove masking tape immediately after tooling joint. Wipe smears or excess sealant off the face of adhered masonry veneer or other absorptive surfaces immediately.

H. Adjusting: Correction of defective work for a period of two (2) years following substantial completion, return to job and correct all defective work. Defective work includes, without limitation, adhered masonry veneer units stones broken in normal abuse due to deficiencies in setting bed, loose grout/pointing mortar, and all other defects which may develop as a result of poor workmanship.

1. Control and Expansion Joints:

   a. Keep joints open and free of debris.

   b. Coordinate control joints as specified in SECTION 07900, JOINT SEALANTS for sealant performance.

2. Sealant Recesses:

   a. Provide open joints 3/4-inch deep and 1/4-inch wide, where masonry meets doors, windows, and other exterior openings.

   b. Coordinate sealant joints as specified in SECTION 07900, JOINT SEALANTS for sealant performance.

3. Cutting and Fitting:

   a. Cut and fit thin veneer stone for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials.

   b. Coordinate with other work to provide correct size, shape, and location.

4. During progress of the work, cover top of unfinished stone masonry work for protection from weather.

**3.04 - INSTALLATION BUILDING VENEER**

A. Install building veneer stone and mortar in accordance with manufacturer's instructions and ACI 530.1/ASCE 6/TMS 602.

B. Maintain masonry courses to uniform dimensions. Form vertical and horizontal joints of uniform thickness.

**3.05 - CLEANING**

A. Keep face of stone free of mortar as work progresses.

B. If residual mortar is on face of stone, allow to dry partially and brush mortar off surface and sponge off residue.

C. When work is completed and mortar has set for 2 to 3 days, clean surface from top to bottom using mild masonry detergent acceptable to natural stone manufacturer.

D. Do not use harsh cleaning materials or methods that could damage stone.

E. Do not use metal brushes or acids for cleaning.

**3.06 - PROTECTION**

A. Protect installed natural stone veneer to ensure that, except for normal weathering, stone will be without damage or deterioration at time of Substantial Completion.

B. Touch-up, repair, or replace damaged stone before Substantial Completion.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700 – CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 04200**

**UNIT MASONRY AND ACCESSORIES**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 04200, UNIT MASONRY AND ACCESSORIES is a part of DIVISION 04, MASONRY which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 04120, STONE VENEER.

B. The Work of SECTION 04200, UNIT MASONRY AND ACCESSORIES, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Unit Masonry and Accessories as specified herein and/or as shown on the Contract Drawings.

B. The work under this Section includes the following:

1. Concrete masonry units (CMU), solid and hollow core units.
2. Fire-rated concrete masonry units.
3. Reinforced concrete masonry lintels.
4. CMU bond beams.
5. Cavity wall insulation.
6. Grouting as indicated and as specified herein.
7. Installing miscellaneous metal items built into masonry.
8. Premolded masonry joint fillers.
9. Installation of loose steel lintels, steel plates, and masonry anchors.
10. Door and window frames built into masonry are furnished by the Contractor in Division 8 and installed under the work of this Section.

11. Masonry joint reinforcing, ties, anchors, miscellaneous reinforcing provided and installed under the work of this Section.
12. Deformed steel bars for wall reinforcing and CMU lintel reinforcing are furnished by the Contractor under Division 3, installed under the work of this Section.
13. Sample wall.
14. Installation of beams, sills and structural items to be embedded in masonry.
15. Installation of anchors, for precast concrete, to be embedded in masonry.
16. Membrane flashing (thru-wall), termination bar and sealant.
17. Installation of anchor bolts embedded in masonry.
18. Installation of metal flashing is included in this section and furnished in SECTION 07531, EPDM SINGLE-PLY MEMBRANE ROOFING.
19. Air/Vapor Barrier Membrane.
20. Mortar Net.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's product data for:

a. Concrete masonry units of all types

b. Mortar and grout

c. Joint reinforcement

d. Anchors and ties

e. Membrane flashing, termination bar and sealant

f. Control joint key

g. Weephole inserts

h. Cavity wall insulation

i. Air/vapor barrier membrane and accessories.

2. Testing:

a. Provide efflorescence test results on actual masonry and mortar to be supplied for this project, including test results of potable water for mortar conforming to the specified requirements.

b. Provide from testing laboratory, the chemical analysis of water-soluble alkali content (%) of cement for mortar.

3. Samples for Approval:

4. Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections, control, expansion joints and wall openings.

5. Submit information and requirements for addressing special inspection required by SECTION 01065, STRUCTRURAL TESTS AND INSPECTIONS including all anticipated dates and time that will allow special inspection to be accomplished.

a. Engineer must be notified by Masonry Subcontractor within thirty (30) days of proposed inspection periods.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver masonry units in an air-dry condition.

E. Store masonry units above ground on level platforms that will permit circulation of air and prevent moisture absorption.

F. Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C90, when delivered to job site.

G. Handle masonry units, either individually or in groups, to keep units whole. Handle masonry units in a manner to maintain sharp edges and undamaged faces with minimum protection as follows:

| • Type of Unit | • Minimum Protection |
|---|---|
| • Concrete masonry units | • Handling |

H. Do not stack masonry units more than two (2) pallets high when stacking on frozen ground. Store masonry units on wooden planks.

I. Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

J. Cementitious and other package material shall be delivered in unopened containers, plainly marked and labeled with manufacturer's names and brands. Cementitious material shall be stored in dry, weather tight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Sample Masonry Panel(s):

1. Panels shall be L-shaped or otherwise configured to represent all the wall elements. Construct sample masonry panel(s) for concrete masonry exposed in finished work. Build panel(s) 4 ft. long x 2 ft. long x 6 ft. high by the required thickness as indicated on the drawings, with facing stone veneer on one side, and concrete masonry units on other side and incorporating joint reinforcement, vertical control joint, specialty shapes, insulation, air vapor/barrier membrane, accessories, weepholes and flashings, face units and backup units as indicated.

2. Construct sample panel(s) at project site location designated by the Engineer to allow acceptance by the Engineer prior to start of masonry work. Sample panel(s) shall not be built in, or as part of the structure, but shall be located where directed.

3. Construct sample panel(s) using specified materials and methods of construction, conforming to indicated shape, surface finish, color and texture range, mortar color, bond pattern, and joint finish.

4. Upon acceptance by the Engineer, sample panel(s) shall become the standard of workmanship and acceptance for represented masonry work. Do not start masonry work for which sample panel(s) are required until sample panel(s) have been accepted.

5. Protect and maintain sample panel(s) in original location and in original condition until the masonry work has been completed and approved.

6. After completion of the work, the sample panel(s), including all foundation concrete shall become the property of the Contractor and shall be removed from job site upon acceptance of represented masonry work, or when permitted by the Engineer.

C. Visual Appearance:

1. Provide stone veneer and concrete masonry units conforming to ASTM tolerances for visual appearance at time of delivery and maintain original appearance to conform to tolerances immediately prior to construction.

D. Remove masonry work damaged as a result of failure to comply with specifications, in the opinion of the Engineer, and reconstruct as directed by the Engineer at no additional cost to the Owner.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. A82: Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
2. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. C33: Standard Specification for Concrete Aggregates.
4. C55: Standard Specification for Concrete Brick.
5. C90: Standard Specification for Loadbearing Concrete Masonry Units.
6. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] cube specimens.)
7. C140: Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
8. C144: Standard Specification for Aggregate for Masonry Mortar.
9. C150: Standard Specification for Portland Cement.
10. C207: Standard Specification for Hydrated Lime for Masonry Purposes.
11. C270: Standard Specification for Mortar for Unit Masonry.
12. C331: Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
13. C404: Standard Specification for Aggregates for Masonry Grout.
14. C476: Standard Specification for Grout for Masonry.
15. C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
16. C979: Standard Specification for Pigments for Integrally Colored Concrete.
17. C1019: Standard Method of Sampling and Testing Grout.
18. D1056: Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
19. D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
20. D2000: Standard Classification System for Rubber Products in Automotive Applications.
21. D2240: Test Method for Rubber Property - Durometer Hardness.

B. American Concrete Institute ACI:

1. ACI 530/ASCE 5/TMS 402: Building Code Requirements for Masonry Structures & Commentary.
2. ACI 530.1/ASCE 6/ TMS 602: Specification for Masonry Structures & Commentary.

C. International Masonry Industry All Weather Council:

1. IMIAWC: Recommended Practices and Guide Specifications for Cold Weather Masonry.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SITE CONDITIONS**

A. Protection of Masonry:

1. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

2. Extend cover a minimum of 24-in. down both sides and hold cover securely in place.

3. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24-in. down face next to unconstructed wythe and hold in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention:

1. Prevent grout, mortar, and soil from staining the face of masonry and precast concrete to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

a. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.

b. Protect sills, ledges, and projections from mortar droppings.

c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

d. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements:

1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

a. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperatures is 40 deg. F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements:

1. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

a. When ambient temperature exceeds 100 deg. F, or 90 deg. F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

F. Prevent damage due to wind and wind-blown particles.

**1.10 - SPECIAL INSPECTION**

A. Provide in accordance with SECTION 01065, STRUCTURAL TESTS AND INSPECTIONS.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Provide masonry units with dimensions listed in ANSI A62.3 except where otherwise specified or indicated. Provide additional masonry units to complete masonry work as indicated.

B. For exposed alteration and restoration work, provide masonry units of same type, grade, size, and appearance as existing masonry work.

C. Furnish special coves, corners, bullnoses, and other special shapes as indicated.

D. Provide open cell neoprene or expanded polyethylene filler for top of nonload bearing masonry unit walls.

E. Obtain masonry units from one manufacturer.

F. Furnish stock and special shapes as shown in Facing Tile Institute Handbook to complete work as indicated.

**2.02 - MORTAR AND GROUT**

A. General:

1. Provide mortar conforming to ASTM C270, Type S, composed of portland cement, hydrated lime, and sand.
2. The damp, loose volume of sand is not to exceed three times the sum of the volumes of cement and lime.
3. Proportion of lime to portland cement, by volume: 1/4 to 1/2.
4. Portland cement: ASTM C150, Type I or Type II.
5. Lime: ASTM C207, Type S
6. Sand for Mortar: ASTM C144, from single acceptable source.
7. Sand for Grout: ASTM C404.
8. Water: Clean potable from single source and free from acids, alkalies, organic material, minerals and salts.
9. Do not use accelerators or other admixtures in mortar or grout without written approval of Engineer.
10. Retemper mortar only to replace water lost through evaporation and use mortar within 2 hours after mixing.

B. Colored Mortar:

1. Manufacturers:
   a. Glen-Gery Color Mortar Blend.
   b. Riverton Corp.
   c. Colorbond, Centurion R.D.
   d. Or acceptable equivalent product.
2. Provide colored mortar composed of factory mixed colored pigments, Type S, Portland cement and three parts, by volume, well-graded sand.
3. Pigments shall meet the requirements of ASTM C979. Do not use carbon black.
4. Color of mortar shall be selected by Architect.

C. Grout Mix: ASTM C476, 2,500 psi minimum compressive strength. Do not use air entraining admixtures. Provide fine or coarse grout to suit work being grouted.

**2.03 - CONCRETE MASONRY UNITS**

A. Unit Designations:

1. Hollow load-bearing units: ASTM C90
2. Solid load-bearing units: ASTM C90
3. Concrete building brick: ASTM C55

B. General:

1. Damaged units not permitted.
2. Provide concrete masonry unit Type I, moisture-controlled units.
3. Provide units free from iron and other substances that will stain plaster, paint, corrode metal or cause popouts. Aggregates not to contain more than 1.5 mg. of ferric oxide per 200 grams when tested in accordance with ASTM C331.
4. Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work indicated.

C. Hollow Load Bearing Units:

1. ASTM C90 light weight, Grade N, Type I.
2. Sand and aggregates: ASTM C33.
3. Moisture content when laid not to exceed 35 percent of total adsorption.
4. Wet-steam cured for a minimum of 12 hours followed by covered yard storage for not less than four weeks.
5. Nominal size: 8-in. by 16 in. by heights and bed thicknesses indicated or permitted.
6. Texture: Smooth for application of paint.
7. Provide external corner units: bullnosed.
8. Prism Strength: The average strength of 3 constructed masonry prisms shall be a minimum of 1,900 psi with no individual prism less than 1,700 psi when tested in accordance with ASTM E447.

D. Solid Concrete Masonry Units:

1. Provide solid concrete masonry units conforming to fire-rated wall requirements of Hollow Load Bearing Units.
    a. Net cross-sectional area of unit in every plane parallel to bearing surface at least 75 percent of gross cross-section area measured in sample plane.
2. Fire Rated Concrete Masonry Units: Provide concrete masonry units in fire rated assemblies and partitions which are listed by UL for the application indicated and provide construction which matches UL tested fire rated assemblies.
    a. Prism Strength: The average strength of 3 constructed masonry prisms shall be a minimum of 1,900 psi with no individual prism less than 1,700 psi when tested in accordance with ASTM E447.

**2.04 - LINTELS**

A. General:

1. Provide lintels to extend at least eight inches beyond each jamb of the masonry opening.
2. Provide lintels with all surfaces free of cracks, chips, and broken edges.
3. Provide lintels sized for wall thickness and masonry opening and with 3/8-in. allowance in height, width, and length for mortar joints.

B. Block Lintels:

1. Provide block lintels fabricated from standard lintel-type concrete masonry units of same material and texture as units in adjoining work, reinforced as indicated, and filled with grout having a minimum 28 day compressive strength of 2,500 psi as specified.

C. Steel Lintels:

1. Install galvanized steel lintels as specified under SECTION 05500, MISCELLANEOUS METAL.

**2.05 - JOINT REINFORCEMENT**

A. Manufacturers:

1. Reinforcing Corporation of America.
2. Dur-O-Wal, Inc.
3. Hohmann & Barnard, Inc.
4. Or acceptable equivalent product.

B. General:

1. Prefabricated, formed of ASTM A82 cold-drawn steel.
2. Hot-dip galvanized, ASTM A153, Class B-2.
3. Provide ladder type reinforcement with smooth cross wires flush welded together on 16-in. centers.
4. Provide prefabricated special pieces for corners and intersections of walls and partitions.
5. Provide joint reinforcing width according to width and type of wall indicated on drawings.

C. Exterior Cavity Walls:

1. Provide 3/16-in. side rods and 9-gage cross rods reinforcement.
2. Adjustable (two-piece) type with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties shall have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties shall extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties shall have hooks or clips to engage a continuous horizontal wire in the facing wythe.

**2.06 - VERTICAL REINFORCEMENT**

A. Contractor shall furnish vertical reinforcement and dowels as specified under SECTION 03200, CONCRETE REINFORCEMENT.

**2.07 - CAVITY WALL INSULATION**

A. Extruded, closed cell, polystyrene.

B. ASTM C578, Type IV. Factory Mutual approved for a Class I, fire rating.

C. R-Value: 5.0 deg. $F/ft^2/h/Btu$ per inch min. at 75 deg. Mean temperature in accordance with ASTM C518.

D. Compressive Strength: 25 $lb./in.^2$ minimum in accordance with ASTM D1621.

E. Provide in thickness as indicated.

**2.08 - MEMBRANE FLASHING AND TERMINATION BARS**

A. Provide 40 mil thick thru-wall flashing consisting of a 36 mil self-adhering rubberized asphalt membrane laminated to a 4 mil high density polyethylene film with silicone treated release sheet.

B. Products:

1. CCW-705-TWF Thru-Wall Flashing by Carlisle Coatings & Waterproofing Inc.
2. Perm-A-Barrier Wall Flashing by Grace Construction Products.
3. Blueskin SA Air/Vapor Barrier Membrane by Monsey Bakor.
4. Or acceptable equivalent product.

C. Termination Bar and Sealant:

1. Material: Type 304 stainless steel 26 gauge.
2. Size: 1/8-in. x 1-in. x 8 ft. long with ¼-in. holes spaced 6-in. o.c. Provide stainless steel screws suitable for masonry installation.
3. Type: Single-winged style to accept sealant.
4. Sealant shall be as recommended by membrane flashing manufacturer.

**2.09 - METAL DRIP EDGES**

A. Fabricate metal drip edges from 0.0156-in. thick stainless steel.

B. Extend drip edge at least 3-in. into wall and ½-in. out from wall, with a hemmed outer edge bend down 30 degrees.

**2.10 - CONTROL JOINT GASKETS**

A. Control joint gaskets shall be factory fabricated solid section of extruded rubber material conforming to ASTM D-2000 with a durometer hardness of 80 (+ or -5) when tested in conformance with ASTM D-2240.

B. The control joint gasket shall be provided with a solid shear section not less than 5/8-in. thick and 3/8-in. thick flanges.

**2.11 - COMPRESSIBLE JOINT FILLER**

A. Closed cell neoprene conforming to ASTM D1056, Class RE41.

B. Manufacturers:

1. D/A 2010 Rapid Soft Joint by Duro-O-Wal, Inc.
2. #NS-Closed Cell Neoprene Sponge by Hohmann & Barnard, Inc.
3. 3330 Horizontal Expansion Joint by Masonry Reinforcing Corp. of America.
4. 030 Soft Joint by National Wire Products Industries.
5. Or acceptable equivalent product.

**2.12 - VERTICAL EXPANSION JOINTS**

A. Provide 60 mil EPDM bellows with integral punched holes in 4-in. wide x .018-in. thick stainless-steel flanges.

**2.13 - SHOP TESTING**

A. Do not deliver, accept or install masonry units and mortar until the actual production run of masonry units has been tested and passes with "no effloresecence" results as specified.

B. Provide commercial testing laboratory approved by the Engineer to perform efflorescence testing.

1. Provide testing laboratory with a record of at least five (5) years of efflorescence testing.

C. Provide sample masonry units and mortar mix to testing laboratory.

D. Provide efflorescence testing of brick units by testing laboratory in accordance with ASTM C67.

1. Acceptable Test Result: ASTM C67 rating of "No Efflorescence."

E. Provide chemical analysis of water-soluble alkali content (%) of cement for mortar and adjust content in accordance with the recommendations of the Brick Institute of America to avoid efflorescence in the cured mortar joints.

**2.14 - MASONRY CLEANING AGENTS**

A. As recommended by masonry manufacturer. Muriatic acid not allowed.

## PART 3 - EXECUTION

### 3.01 - PREPARATION

A. Clean laitance, dust, dirt, debris, oil, grease, and other foreign substances which would affect bond of mortar, from surfaces to receive mortar.

B. Lay out walls to establish accurate spacing of bond pattern, for uniform joint widths, and to locate openings, movement-type joints, returns and offsets. Arrange units in manner which will result in less than two units being cut between each joint or wall opening.

C. Wet masonry having absorption rates in excess of 0.025 ounces per square inch per minute, when tested in accordance with ASTM C67, so that rate of absorption does not exceed that rate when masonry in installed.

### 3.02 - PROTECTION OF WORK

A. Protect the walls, including window sills, with non-staining waterproof coverings when work not in process.

B. Provide minimum 24-in. overhang of protective covering on each side of wall and anchor securely.

C. Protect facing materials from staining.

### 3.03 - INSTALLATION

A. Provide temporary bracing of all walls until walls have been completely erected.

B. Lay masonry plumb and square, true to dimensions, and with full, tightly bonded joints.

C. Horizontal joints of cavity and composite walls, which are to contain wall ties and joint reinforcement shall be level with each other.

D. Install products, indicated to be built into wall, as masonry work progresses. Fill spaces around built-in products with mortar, rake mortar joint, and allow space for sealant.

E. Fill backs of pressed-metal door frames solid with mortar.

F. Make joint width equal to difference between actual and nominal dimensions of unit being installed.

G. Tool exterior joints concave with hard glassy surface free from drying cracks. Tool interior joints flush in similar manner.

H. Provide level and solid mortar bearing in masonry walls directly under precast concrete slabs, beams, and sills, and under structural steel beams to sizes and thickness indicated.

I. Provide 1/2 in. minimum clearance between top of nonload bearing masonry walls and bottom of overhead construction.

J. Lay masonry units in a running bond with vertical joints breaking not less than 4 in. over units in course below, or in vertical stack bond as indicated.

K. Lay soldier course brick bond where indicated, three vertical bricks to one horizontal.

L. Lay vertical cored units with full beds on shells only. Fully butter vertical edges.

M. Cut masonry units with either dry or wet masonry saws.

N. Keep chases, wall cavities, air spaces, expansion joints and spaces to be grouted free from debris and mortar.

O. Lay concrete masonry and structural facing tile units dry.

P. Lay masonry units in full mortar bed.

Q. When resuming masonry work, clean exposed surface of set or partially set masonry and remove loose mortar prior to laying fresh masonry.

R. Install continuous wall reinforcement in accordance with manufacturer's printed installation instructions, and place in alternate horizontal masonry joints. Lap reinforcement not less than six inches and, at corners and intersections, connect to prefabricated reinforcement. Make splices in manner, and at those points, which will not reduce structural strength of wall. Make welded and mechanical connections to develop strength of reinforcement.

S. Install vertical reinforcement where indicated and in poured grout studs formed by vertically aligned cells of unit masonry. Secure reinforcement at top and bottom, and at intervals not more than 192 diameters of reinforcement. Use two-cell masonry units for vertical reinforcement.

T. Install control joint gaskets in concrete masonry unit walls where indicated and in accordance with manufacturer's printed installation instructions.

U. Set metalwork into masonry and build around metalwork. Metalwork furnished in accordance with requirements specified in the section herein.

V. Follow recommended practices and guide specifications for cold weather masonry work as set forth in IMIAWC-75.

W. Using a bristle brush, brush loose mortar from the faces of the walls whenever the scaffolding is moved or raised and at the end of each shift.

X. Install mortar net at the bottom of each air space. Mortar net thickness to match depth of air space.

Y. Construct faces of walls, and inside and outside corners, plumb, and courses level, within following tolerances:

1. Variation from plumb of lines and surfaces of columns, walls, and arises: 1/4 inch in 10 feet; 3/8 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

2. Variation from plumb of external corners, expansion joints, and other conspicuous vertical lines: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

3. Variation from level of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous horizontal lines: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

4. Variation of linear building lines from established position in plan and related portion of columns, walls, and partitions: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 2 inch total.

5. Variations of cross sectional dimensions of columns and in the thicknesses of walls: Minus 1/4 inch, plus 1/2 inch.

6. Variations from plumb in masonry control joints: 0-in.

**3.04 - MORTAR**

A. General:

1. Machine mix mortar, except small batches by hand mixing, mixed for at least five minutes after materials are in mixer. Where hand mixing is permitted, mix mortar in tight mortar box until required plasticity is obtained. Mix mortar with maximum amount of water.

2. Use mortar within 2 hours after mixing.

B. Beds:

1. Place full mortar beds on masonry unit bearing surfaces bonded to bearing surface of unit below, and to surface of previously installed unit in same course as unit being installed; furrowing of mortar not permitted. Pack mortar under and around joint reinforcement before masonry unit is installed.

2. Make mortar bed of such thickness that cured mortar joint is equal to difference between actual and nominal dimensions of unit being installed.

3. Do not allow mortar fins to protrude into cores for masonry units which are to be vertically reinforced.

C. Colored: Proportion for each batch and mix in drum-type mechanical mixer shall be mixed between 3 and 5 minutes after materials have been deposited in mixer.

D. Provide cured mortar joints free from efflorescence.

**3.05 - GROUTING**

A. Provide clean out units in bottom course at every dowel where height of grout placement exceeds four feet. Remove overhanging mortar, mortar droppings, and obstructions from grout spaces. Seal clean out holes only after masonry work, reinforcement, and final cleaning of grout spaces have been approved by Resident Engineer, and before grouting. Sealing to match surrounding masonry.

B. Place grout within two hours after mixing.

C. For vertically reinforced concrete unit masonry, place grout in all cells containing reinforcement, and in lifts of not more than four feet. Consolidate grout at time of placing by either puddling or vibrating; reconsolidate grout by puddling before plasticity is lost. When grouting is stopped for one hour and longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost grouted unit. Use coarse grout in grout spaces which are four inches and larger in all horizontal directions; place fine grout in grout spaces which are smaller than four inches in any horizontal direction.

D. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, shall be filled solid with grout. For purposes other than vertically reinforced concrete unit masonry, place grout where indicated, and only after mortar joints and other Cementitious materials have cured. Place coarse grout in grout spaces which are two inches and larger in all horizontal directions; place fine grout in grout spaces which are smaller than two inches in any horizontal direction. Place grout at rate which allows consolidation of successive layers while preceding layer is plastic. Placement height not to exceed four feet. Consolidate grout and puddle when grouting stopped for two hours and longer; form horizontal construction joints by stopping grout placement 1/2 course height below top of uppermost grouted unit. Grouting accomplished from back-up face of masonry units.

E. Prevent grout from coming into contact with finish surfaces which are exposed to view, and with those surfaces which are to receive other finishes.

F. Place grout where indicated at all stair connection locations as indicated on drawings.

**3.06 - LAYING CONCRETE MASONRY UNITS**

A. Lay approved units with moisture absorption ratio of less than 35 percent.

B. Lay units in running bond with vertical joints breaking not less than 4 in. over units in next course below or as indicated. Lay units, cored vertically, with full beds on shells only. Vertical edges fully buttered.

C. Do not wet units before laying except in hot weather. Lightly moisten contact surfaces with water using soft brush just prior to laying units.

D. Install reinforced concrete masonry unit lintels in concrete masonry unit walls and partitions as indicated. Extend lintels at least 8 in. beyond each jamb of masonry opening. Install only completely cured lintels.

E. Jamb units shall be of the shape and sizes to conform with wall units.

**3.07 - BONDING AND JOINT REINFORCEMENT**

A. Bond concrete masonry unit against concrete walls with corrugated dovetail anchors placed in dovetail slots. Place anchors 16-in. on centers. Contractor shall furnish and install dovetail slots as specified under SECTION 03300, CAST-IN-PLACE CONCRETE.

B. Place joint reinforcement, for interior concrete masonry unit walls and partitions, continuously in horizontal joint on 16-in. centers. Interrupt at control joints. Place special pieces, for reinforcing corners, around columns and intersections, in every joint where reinforcement occurs.

C. Bond intersecting masonry walls and partitions with box wall ties spaced vertically at 16-in. on centers.

**3.08 - VERTICAL REINFORCEMENT**

A. Place steel reinforcement bars vertically in all masonry walls as indicated.

B. Locate vertical reinforcement and dowels in first cells of CMU at jambs of all masonry openings and then space horizontally as indicated.

C. Embed dowels 1-ft.-6-in. into reinforced concrete at top and bottom of CMU walls and partitions. Overlap reinforcing 2-ft.-0-in. using 6-ft.-0-in. maximum length bars.

D. Grout cells as specified.

**3.09 - CUTTING AND JOBBING**

A. Leave slots and opening for inserts, wires, conduits, and similar items of construction, open or cut.

B. Provide recesses or openings at junction boxes, or other locations as indicated.

C. Provide openings in exterior walls and interior partitions at duct, conduit, exhaust and other wall penetrations. Bridge above openings using concrete masonry units. Reinforced masonry lintels shall be provided at openings greater than 1-ft.-4-in. Install membrane wall flashing at exterior wall openings.

D. Masonry units to be dried to 35 percent moisture content from prior cutting or grinding before installation of mechanical and electrical services.

**3.10 - PARTITIONS**

A. Partitions shall be continuous from floor to underside of floor or roof deck as indicated. Openings in fire walls around joists or other structural members shall be filled in accordance with SECTION 07840, FIRESTOPPING. An isolation joint shall be placed in the intersection between partitions and structural members. Continuous sealants shall be provided at all isolation joints as specified in SECTION 07900, JOINT SEALANTS.

**3.12 - BOND BEAMS**

A. Bond beams shall be filled with grout and reinforced as indicated.

**3.13 - CONTROL JOINTS**

A. Control joints keys shall be provided as indicated and shall be constructed by using special control joint units and in accordance with the drawings. The vertical mortar joint at control joint locations shall be continuous. The control joint key shall be interrupted in courses containing continuous bond beam steel. Provide backer rod and sealant at all exterior control joints as specified in SECTION 07900, JOINT SEALANTS.

**3.14 - COMPRESSIBLE JOINT FILLERS**

A. Compressible joint fillers shall be provided as indicated and where directed by the Engineer.

**3.15 - SHELF ANGLES**

A. Shelf angles shall be adjusted as required to keep masonry level and at the proper elevation. Shelf angles shall be galvanized steel and provided in sections not longer than 10 feet and installed with a 1/4-in. gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4-ft., unless limited by building configuration.

**3.16 - CAVITY WALL INSULATION**

A. Install insulation to cavity wall air/vapor barrier membrane with mastic as recommended by the manufacturer of the insulation at 1 ft. both horizontally and vertically on the inside face. Mastic to be compatible with air/vapor barrier membrane. Fit the courses of insulation between wall ties or horizontal joint reinforcement and other confining obstructions in the cavity. Tightly butt edges of insulation in both directions. Press insulation units firmly into place against the inside wythe of masonry or against other construction including structural members to form a continuous thermal barrier.

B. Seal joints between insulation units by applying adhesive, mastic or sealant, recommended by the insulation manufacturer, to edges of each unit to form a tight seal as units are shoved into place. Fill the voids in the completed installation with adhesive, mastic or sealant recommended by the insulation manufacturer.

C. Complete installation and concealment of insulation to avoid prolonged exposure of insulation to direct sunlight by covering exposed insulation.

**3.17 - MEMBRANE FLASHING INSTALLATION AND COORDINATION**

A. Self-Adhered, Composite Flexible Membrane Flashing: Prepare masonry surfaces to receive flashings smooth and free of projections. Install flashing to dry surfaces at air and surface temperatures of 25 deg. F. and above in accordance with manufacturer's recommendations at locations indicated.

1. Precut pieces of flashing to easily handled lengths for each location.
2. Remove release paper and position flashing carefully before placing it against the surface.
3. When properly positioned, place against surface by pressing firmly into place by hand roller or a blunt object. Fully adhere flashing to substrate to prevent water from migrating under flashing.
4. Overlap adjacent pieces 2 inches and roll all reams with a steel hand roller or a blunt object.
5. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing ½-in. back from outside face of wall and adhere flashing to top of metal drip edge.
6. At heads, sills and all flashing terminations, turn up ends a minimum of 2 inches and make careful folds to form an end dam, with the seams sealed.
7. Do not allow the rubberized asphalt surface of the flashing membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
8. Do not expose flashing membrane to sunlight for more than thirty days prior to enclosure.
9. Install termination bar fastened at 6-in. o.c. along top edge of all flashings. Apply bead of sealant along top edge of termination bar and flashing.

B. Accessories:

1. Apply surface conditioner at rate recommended by the manufacturer, prior to flashing installation. Allow surface conditioner to dry completely before flashing application.
2. Apply a bead or trowel coat of mastic along flashing top edge, seams, cuts and penetrations.

**3.18 - VERTICAL EXPANSION JOINTS**

A. Set stainless steel flanges in continuous bed of sealant. Sealant to be compatible with air/vapor barrier.

B. Attach expansion joints per manufacturers recommendations.

**3.19 - FIELD QUALITY CONTROL**

A. Repair joints that are unsound, not full of mortar, or which have hairline cracks due to shrinkage or poor adhesion, as follows:

1. Cut or rake affected mortar to a depth of 3/4 in.
2. Brush out debris.
3. Thoroughly moisten remaining mortar and adjoining masonry and paint with neat cement.
4. Point joint full of mortar.
5. Tool joint to a hard, glassy surface.
6. After first day, wet down walls having repaired joints, at least five times daily, for a minimum of three days.

B. Remove and reconstruct work injured by climatic conditions, or because of insufficient protection as directed by the Engineer and at no additional cost to the Owner.

C. Pointing consists of raking out defective joints, and stack bond pattern joints; repairing defective joints; and working joint after mortar has initially set.

1. Joints except control joints, joints in stack bond pattern and joints to be sealed: Tool concave in a manner which will compact and press the mortar against the units. Strike flush joints covered with plaster, drywall, or waterproofing membrane.

2. Control joints, expansion joints and joints to be sealed shall not contain mortar.

3. Defective joints: Rake out the full depth of the joint, patch with mortar, and tool to match adjacent joints.

D. Apply cleaning agent to sample wall area of 20 sq. ft. in location acceptable to Engineer if cleaning by water does not produce satisfactory results to the Engineer.

1. Do not proceed with cleaning until sample area is acceptable to Engineer.

2. Follow manufacturer's printed instructions.

3. Scrub with approved cleaning agent.

4. Immediately rinse with clear water.

5. Work small sections at a time.

6. Work from top to bottom.

7. Protect sash, metal lintels, and other materials which may corrode when masonry is cleaned with acid solution.

8. Protect precast architectural concrete from masonry mortar stain and overflow.

E. When left overnight, cover tops of wythes of masonry walls with a by waterproof membrane extending at least 24 inches down both sides. Protect masonry left for greater length of time in accordance with requirements specified in SECTION 01500, TEMPORARY FACILITIES. When work is resumed, clean all top surfaces of loose mortar. Wet units thoroughly, except concrete masonry units when required as specified.

**3.20 - FIELD TESTING**

A. Provide in accordance with SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING and as specified.

B. Test concrete masonry units in accordance with ASTM C140.

C. A minimum of two specimens of mortar from separate batches shall be taken each day. A layer of mortar 1/2 to 5/8 in. thick shall be spread on the masonry units and allowed to stand one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 109.

D. Test grout compressive strength in accordance with ASTM C1019. A minimum of two specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2,500 psi at 28 days.

E. Efflorescence Test: Masonry which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of “effloresced” will be subjected to rejection.

**3.21 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 05500**

**MISCELLANEOUS METAL**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 5, METALWORK shall include the complete Work specified in all of the following Sections:

1. SECTION 05500, MISCELLANEOUS METAL

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 05500, MISCELLANEOUS METALS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 C-001 | 00 C-104 | 99 C-503 | 99 C-504 | 00 A-001 | 10 A-101 | 10 A-102 |
| 10 A-103 | 10 A-104 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-406 | 10 A-407 | 10 A-501 | 10 A-502 | 10 A-503 |
| 10 A-504 | 10 A-603 | 10 A-604 | 10 A-605 | 10 A-607 | 00 S-001 | 00 S-002 |
| 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 S-106 | 10 S-107 |
| 10 S-301 | 10 S-302 | 10 S-303 | 15 S-101 | 30 S-101 | 99 S-501 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | | | |

2. The Work of SECTION 05500, MISCELLANEOUS METALS for Alternative A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 C-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-501 |
| 20 A-603 | 20 A-607 | 00 S-001 | 00 S-002 | 20 S-101 | 20 S-102 | 99 S-501 |
| 99 S-502 | 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 05500, MISCELLANEOUS METAL

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide metal fabrications not specifically included in other Sections and required for completion of work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of all miscellaneous metals work. Show anchorage and accessory items. Include details of all connections between all materials.

2. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered metal component will be installed.

3. Manufacturer's literature describing standard items.

4. Shop drawings showing materials, sizes, finishes, locations, attached hardware and fittings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, miter connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.

5. Setting diagrams, erection plans, templates and directions for installation of backing plates, anchors, and other similar items.

6. Manufacturer’s specifications, load tables, anchor details, installation details for grating.

7. Material, product data and specifications with standards designated.

8. One sample of finished railing proposed for use. Submit with shop drawing submittal.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Identify and match-mark, materials, items and fabrications, for installation and field assembly.

E. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

F. Carefully handle and store materials, protected from weather, rusting and other damage.

G. Store structural shapes, pipes, tubes and sheets off the ground on suitable supports, with webs of flanged shapes vertical.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Railings and Guardrails:

a. Railings and guardrails shall be designed for a live load of 100 plf vertical plus 50 plf horizontal applied concurrently or a concentrated load of 200 pounds applied in any direction at any point along the rail, whichever produces the most extreme condition.

b. Intermediate rails, balusters and panels or fillers shall be designed for a uniform load of 25 psf over the gross area of the guard of which they are a part. This loading need not be added to the loading of the main members prescribed above.

c. Handrails shall be designed for a live load of 50 plf applied in any direction or a concentrated load of 200 pounds applied in any direction at any point along the handrail, whichever produces the most extreme condition.

D. Aluminum grating and aluminum plate covers design shall be based upon the following criteria:

a. Design Live Loads:

i. Uniform Live Load: 300 psf

ii. Concentrated @ Center Span: 500 plf

b. Maximum bending stress = 12,000 psi

c. Maximum shear stress = 8,000 psi

d. Modulus of Elasticity = 10,000 ksi

e. Maximum deflection under 100 psf uniform live load = Span / 300

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Obtain field measurements prior to preparation of shop drawings and fabrication.

C. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Each welder, tacker and welding operator shall be certified by test within the past six months to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted and witnessed by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

**1.08 - REFERENCES**

A. Aluminum Association (AA):

1. AA M12C22A41.

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

c. A41: Clear Anodic Coating, Class I.

2. AAM12C22A42:

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

c. A42: Dark Bronze Anodic Coating, Class 1.

B. American Institute of Steel Construction (AISC):

1. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Steel.

D. Aluminum Association Standard Anodic Finish (AASAF).

E. American Society for Testing and Materials (ASTM) Publications:

1. A36: Specification for Structural Steel.
2. A53: Specification for Pipe, Steel Black and Hot-dipped, Zinc-Coated Welded and Seamless.
3. A123: Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
4. A153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. A167: Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. A269: Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
7. A276: Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
8. A312: Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
9. A325: Specification for High Strength bolts for Structural Steel Joints.
10. A366: Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
11. A569: Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
12. A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
13. B26: Specification for Aluminum-Alloy Sand Castings.
14. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. B211: Specification for Aluminum-Alloy Bars, Rods, and Wire.
16. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
17. B241: Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
18. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
19. B249: Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes.
20. B308: Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
21. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. Steel:

1. Conform to latest issue for the following:
   a. Steel Shapes and Plates: ASTM A36
   b. Steel Pipe: ASTM A53.
   c. Nuts, Bolts, Rivets, Washers, and Anchorage Devices: ASTM A325 and AISC Specification.
   d. Steel Sheets: Cold-rolled or hot-rolled carbon steel, ASTM A366, or ASTM A569.

B. Stainless Steel

1. Type 316 unless otherwise indicated or specified.
2. General: Type (or Grade) 304L for welding, otherwise Type (or Grade) 304.
3. Shapes and Bars: ASTM A276
4. Plate, Sheet, and Strip: ASTM A167
5. Tubing: ASTM A269
6. Pipe: ASTM A312, Schedule 40S

C. Aluminum:

1. Plates, rolled or extruded shapes, sheets or castings conforming (unless otherwise permitted or indicated) to the following Aluminum Association alloy and temper designations:
   a. Rolled structural sheets and plates: ASTM B209-6061-T6
   b. Rolled Structural Shapes: ASTM B308-6061
   c. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6
   d. Extruded structural tube or pipe: ASTM B429 Alloy 6061 T-6
   e. Gratings (bearing bars): ASTM B211-6061-T6
      (crimp bars): ASTM B211-6061-T5
   f. Castings: ASTM B26-214
   g. Sheets: ASTM B209-Alclad 3003-H14 and 3003
   h. Bolts and nuts: Type 316 stainless steel
   i. Pipe railings: ASTM B241-6061-T6
   j. Handrail posts: ASTM B241-6061-T6
   k. Die and hand forgings: ASTM B247 Alloy 6061-T6
   l. Welding filter rods: ASTM B241-6061-T6

D. Bolts, washers and nuts: Type 316 stainless steel

E. Welding:

1. Provide filler materials appropriate and compatible for the alloys and tempers in accordance with the AWS Structural Welding Code.
2. Provide Class 5356 electrodes.

**2.02 - FABRICATION**

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified with straight lines, square corners or smooth bends; free from twists, kinks, warps, dents, and other imperfections. Straighten work bent by shearing or punching.
2. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.
3. Provide sufficient quantity and size of anchors for the proper fastening of work.
4. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.
5. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.

6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

8. Welding:

   a. Grind exposed edges of welds to a 1/8-inch minimum radius. Grind burrs, jagged edges and surface defects smooth.

   b. Prepare welds and adjacent areas such that there is (1) no undercutting or reverse ridges on weld bead, (2) no weld spatter on or adjacent to weld or any other area to be painted, and (3) no sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

9. Bolting:

   a. Provide Type 316 stainless steel stud bolts and nuts with heavy aluminum washer for fastening of aluminum material.

   b. Draw up bolts or nuts tight, and deform threads where possible. Use bolts of lengths required so that bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

   c. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting equipment to supports to a tolerance of + 1/16-inch of exact dimensions indicated.

   d. Provide plastic protection caps.

B. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

C. Fabricated Products:

1. Pipe Sleeves in Concrete Construction: Weld standard weight, black steel pipe, with anchors to exterior to accommodate passage of conduits, pipes ducts and similar items.

**2.03 - ALUMINUM PLATE COVERS AND FRAMES**

A. Provide aluminum tread plate covers of type, size indicated and as specified.

1. Provide with nonskid surface, reinforced with aluminum bars and angles welded to underside of cover. Fit covers neatly and accurately in frames.

2. Maximum size of plate covers shall not exceed 3 feet square unless otherwise indicated.

3. Frames:

   a. Provide aluminum angle frames with leveling bars.

   b. Provide mitered corners and welded joints. Grind smooth where exposed.

   c. Provide welded strap anchors at 24-inch maximum [610 mm] spacing, minimum two per side, for securing in concrete floor or 1/2-inch [13 mm] diameter, Type 316 stainless steel expansion bolts for securing to concrete, as applicable.

4. Provide aluminum cover plates and frames with a natural mill finish.

B. Removable Type Plate Covers:

1. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

C. Hinged Type Plate Covers:

1. Covers hinged to frame with Type 316 stainless steel, heavy duty plain bearing hinges and stainless steel pins.

2. Attach hinges to covers and frames with Type 316 stainless steel machine screws.

3. Provide covers with slam lock and spoon handle and fixed wrench type handle, or as indicated.

4. Provide a minimum of two airtight plate cover lift handles for each plate cover section.

D. Gasketed and Bolted Type Covers:

1. Provide plate covers with continuous, compressible neoprene seals between cover and frame at perimeter.

2. Provide covers secured to frames with countersunk, flathead, Type 316 stainless steel machine screws spaced 6-inches [150 mm] on centers.

3. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

E. Bolted Type Covers:

1. Provide covers secured to frames with countersunk, flathead, Type 316 stainless steel machine screws spaced 6-inches [150 mm] on centers.

2. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

**2.04 - LOOSE LINTELS AND CMU PARTITION SUPPORTS**

A. Furnish loose lintels and CMU partition supports as indicated on drawings. Fabricate from structural steel shapes and plates. Hot-dip galvanize after fabrication.

**2.05 - ENGINE EXHAUST SLEEVE**

A. Fabricated of aluminum pipe or tubing with a minimum wall thickness of 1/8-inch. Inside diameter of sleeve 2 inches greater than outside diameter of exhaust pipe. Provide aluminum wall cover plate, aluminum plate with slip joint, and retaining ring. Weld plate to sleeve to form cover plate. Cut outer end to 45 degree.

**2.06 - GRAB BARS**

A. Provide grab bars at floor hatch openings adjacent to walls. Fabricated of 3/4-inch diameter solid aluminum rods and bent to shape indicated, with ends to be embedded in wall and bent downward for anchorage. Bars 2-feet wide with projected distance of 7 inches from wall to center of the bars.

**2.07 - ALUMINUM PIPE RAILS**

A. Provisions: All-welded assembly fabricated from 1-1/2-in. IPS, schedule 80 aluminum pipe, alloy 6061-T6 for posts, top rails and intermediate rails. Provide mitered connections at the intersections of posts and railings. Provide radius connections as indicated. Alloy of welding filler rods shall be compatible with alloy of posts and railings. Grind exposed welds smooth. Reinforce pipe rail posts with 14-inch long solid aluminum rod inserts at bottom of stanchions.

1. Complete railing, including anchorage and framing, and post spacing at a maximum of 4 feet on centers to withstand specified loading. Provide 1/4-inch thick aluminum kick plates as indicated.

2. Provide cast aluminum brackets for wall-mounted handrails.

3. Weld posts, to be mounted on top of stair stringers, to aluminum angle brackets. Fasten brackets to stringers with 1/2-inch diameter stainless steel bolts.

4. Side mount guard rail posts, to concrete. Weld to extruded aluminum brackets. Secure brackets to concrete with four 1/2-inch diameter stainless steel expansion bolts.

5. Set posts into concrete curbs, and into preformed holes. Secure in place with nonshrinking non-metallic grout. Provide holes at least 1 inch greater in diameter than outside diameter of posts and minimum of 6 inches deep.

6. Fabricate removable pipe railings in same manner as fixed railings.

7. Provide panels as large as practicable with joints between panels made neat and inconspicuous with exposed welds ground smooth.

**2.08 - ALUMINUM LADDERS**

A. Fabricate from 1-1/2-inch IPS, Schedule 80 aluminum pipe side rails and 1-inch solid round aluminum rod rungs, mortised and welded to uprights. Ladders for roof access, provide with uprights flared at top and turned back to form guard rails.

1. Provide rungs knurled or dimpled to minimize slipping.

B. Provide aluminum safety cages around ladders where the vertical distance between floors or landings is 20 feet or more. Fabricate cages from structural aluminum components as detailed.

C. Conform to OSHA Regulation 1910.27 for safety cages.

D. Ladder safety post extensions shall be provided on all fixed ladders 20 feet or less in height located below hatches and roof scuttles and as indicated. The aluminum telescoping tubular safety post extension shall lock in its vertical position and extend a minimum of 36 inches above the opening and shall be secured to the ladder rungs with stainless steel fasteners and brackets. The ladder post extension shall be Ladder UP Safety Post, Model LU-4 by Bilco Co.; Series L1E Safety Extension by Halliday Products; Pull-up Bar by Access Manufacturing or equal.

**2.09 - ALUMINUM FINISHES**

A. After fabrication, provide interior and exterior aluminum pipe railing assemblies, kick plates, posts, and ladders with Aluminum Association Standard clear anodized finish, Designation C22A41.

**2.10 - ALUMINUM PROTECTION**

A. Protect aluminum against electrolysis from all sources as specified in SECTION 01063, MISCELLANEOUS REQUIREMENTS. Under no circumstances shall aluminum contact a dissimilar metal.

1. Members Encased in Concrete: Zinc chromate primer.

2. Members in Contact with Concrete Masonry or Mortar: Coal tar epoxy.

B. Manufacturers:

1. 46H-413 Hi-Build Tnemec Tar by Tnemec Co., Inc.

2. Bitumastic 300M by Carboline Co.

3. Targuard by Sherwin Williams.

4. Or acceptable equivalent product.

**2.11 - RUNGS AND GRAB BARS**

A. Fabricate rungs from 1-inch diameter, Type 316 stainless steel rod and shaped to meet the requirements of OSHA 1910.27, Fig. D-1. Provide a clear width of 16 inches, drop front design approximately 3 inches deep and turned upward at least 2 inches at the embedded ends, and embed to a depth of 6 inches into the wall. Space rungs a maximum 12 inches apart vertically, and projecting 7 inches from face of wall to centerline of rungs. Provide stainless steel grab bars built into wall above the hinged floor plate covers.

1. Provide rung knurled or dimpled to minimize slipping.

**2.12 - FALL PREVENTION SYSTEM FOR LADDERS**

A. Provide ladders with a rigid, fall prevention system complete, of Type 316 stainless steel construction. Provide Saf-T-Climb system manufactured by Siebe Norton, Inc., Cerritos, CA, or an acceptable equivalent product.

1. System Components: Rigid notched carrier rail (1-5/16-inch stainless steel tubing) with guide channel, alignment guide and connecting strap; saf-t-lok sleeve and safety locking mechanism; mounting brackets; safety belt with two side "D" rings for attaching, body strap (nylon w/elk leather wrap), and buckle of stainless steel.

B. Conform to OSHA Regulation 1910.27 for fall prevention system.

**2.13 - STEEL BOLLARDS**

A. Pipe for the bollards shall be 6-inch O.D. in all locations standard strength galvanized steel conforming to ASTM A120 or A53, except for bollards located around electrical transformers which shall be 4 inch O.D.s standard strength galvanized steel conforming to ASTM A120 or A53. Lengths shall be such as to allow bollards to extend 4-feet above and below grade.

B. Concrete for bollard encasement and for filling the inside of the pipe shall conform to DIVISION 3, CONCRETE.

C. Bollards shall be covered with a dome top low-density polyethylene thermoplastic tube having ultra-violet resistance and anti-static properties with a nominal thickness of 0.250 inches. Color shall be OSHA yellow and surface of sleeve shall be smooth with round top. No ribbed or multiple piece systems accepted.

**2.14 - HATCHES**

A. Hatches shall be of the styles, types and sizes shown on the Contract Drawings. All hatches shall be of the same manufacturer. Manufacturer shall guarantee proper operation and against defects in material or workmanship for a period of five (5) years. All hatches shall be of aluminum as manufactured by the Bilco Company, Halliday Products Inc., or Babcock Davis.

B. Type J and JD hatches shall be single leaf and double leaf, respectively, watertight, self-draining type. Door leaf shall be of 1/4-inch thick aluminum diamond pattern plates reinforced with aluminum stiffeners as required and capable of withstanding a live load of 300 pounds per square foot. Channel frame shall be 1/4-inch thick aluminum with anchor flange around the perimeter. Each door leaf shall be equipped with a minimum of two (2) hinges, with stainless steel pins, compression spring operators enclosed in telescopic tubes to afford easy operation, and an automatic hold-open arm with release handle. Snap locks with removable handle and safety chains shall be provided. A 1-1/2-inch drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be stainless steel with factory mill finish and bituminous coating applied to exterior of frame.

C. Type K and KD hatches shall be single leaf and double leaf, respectively. Door leaf shall be 1/4-inch thick aluminum diamond pattern plate reinforced with aluminum stiffeners as required and capable of withstanding a live load of 150 pounds per square foot. Channel frame shall be of 1/4-inch thick extruded aluminum with built-in neoprene cushion and with strap anchors bolted on the exterior. Door leaf shall be equipped with a minimum of two (2) hinges bolted to underside and pivoted on torsion bars that counterbalance the door for easy operation. The door shall open 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. Doors shall be equipped with a snap lock and removable handle. Hardware shall be stainless steel with factory mill finish and bituminous coating applied to exterior of frame.

D. Type J and JD hatches that are not shown connected to a drainage system shall be provided with extensions to the drainage coupling to allow drainage to the area below.

E. Hatches shall be installed in accordance with the recommendations of the manufacturer and as approved by the Engineer.

F. Hatches shall be provided with integral protective safety grating panels which operate independently from the hatch cover. Panel shall be constructed with aluminum “I” bar construction, all T-316 stainless steel hardware, tamper proof stainless steel hinge bolts, lockable with owner-supplied padlock, hinged with positive latch to maintain upright position, load rated consistent with access cover, view area for observation and limited maintenance, safety orange powder-coated finish, nut rail and stainless steel spring nuts with 300 psf loaded doors.

**2.15 - MISCELLANEOUS ITEMS**

A. Provide items of miscellaneous metalwork not particularly specified, of the shape, size, material and detail indicated and suitable for the purpose intended.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Accurately set and properly secure in place as indicated and specified. Where bolted connections are used, draw closely together and draw nuts tightly. Use bolts of lengths so that they do not project more than 1/4-inch [6 mm] beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

B. Locate anchors and anchor bolts and build into connecting work. Insert expansion bolts into drilled holes.

C. After erection, clean aluminum with mild soap and water, followed by clear water rinse, after erection.

D. Miscellaneous metal items specified shall be installed as indicated, specified and in accordance with accepted shop drawings.

**3.02 - ALUMINUM PROTECTIVE COATING**

A. Protect aluminum from contact with dissimilar metals, concrete, masonry, motar or grout.

B. Coat surfaces of aluminum with heavy coat of bitumastic paint.

C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot wate and dry thoroughly.

**3.03 - ALUMINUM PIPE RAILINGS**

A. Set posts plumb and align railings horizontal or parallel to rake of stairs to within 1/4 inch in 10 feet [6 mm in 3 meters] unless otherwise indicated.

B. Side mount posts to concrete with aluminum brackets as indicated.

C. Set top mounted posts in concrete curbs into preformed holes.

1. Provide holes at least 1 inch greater in diameter than outside diameter of posts and a minimum of 6 inches [150 mm] deep.
2. Moisten interior of holes and surrounding surfaces.
3. Set railing in position and brace until grout sets.
4. Secure in place with non-metallic, non-shrink grout. Provide 1/8-inch [3 mm] build up of grout around base of posts, sloped away from posts.

D. Provide butt splice joints with internal sleeves bonded with adhesive.

E. Provide expansion joints at intervals of not more than 32 feet [10 meters].

1. Locate joints within 6 inches [150 mm] of posts.
2. Provide slip joint with internal sleeve extending 2 inches [50 mm] beyond joint on each side.
3. Fasten internal sleeve securely to one side only.
4. Provide gap of 0.002 inch per foot per degree Fahrenheit [.10 mm per meter per degree Celsius].

**3.04 - ALUMINUM HANDRAILS**

A. Install aluminum handrail brackets spaced at a maximum of 4 feet [1.2 meters] on center.

**3.05 - LADDERS**

A. Anchor uprights to wall with angles or bent plates, weld to uprights and bolt expansion to wall. Ground smooth all welds.

B. Secure interior ladders to floor slabs with floor flanges.

C. Install safety cages or fall prevention system as indicated and in accordance with accepted shop drawings.

**3.06 - ALUMINUM GRATINGS AND FRAMES**

A. Accurately set and properly secure frames and gratings in place. Where bolted connections are used, draw closely together and draw nuts tightly.

B. Provide standard panel widths.

C. Perform cutting and fitting as required for installation.

D. Place grating panels such that cross bars align.

E. Cutouts for pipes or circular obstructions shall be 2-inch [50 mm] larger in diameter than the diameter of the obstruction.

F. Provide saddle clips, z-clips or other approved fasteners to secure grating at every 4-square feet. Provide a minimum of four fasteners per grating section.

G. Attachments shall permit removal of the grating panels.

**3.07 - ALUMINUM PLATE COVERS**

A. Accurately set and properly secure frames and covers in place. Where bolted connections are used, draw closely together and raw nuts tightly.

B. Set frames with welded anchors in forms prior to concrete placement.

C. Provide standard panel widths.

D. Perform cutting and fitting as required for installation.

E. Cutouts for pipes or circular obstructions shall be 2 inches [50 mm] larger in diameter than the diameter of the obstruction.

**3.08 - LIFTING HOOKS**

A. Fasten lifting hook to 1/2-inch by 4-inch by 11-inch steel anchor plate and assembly placed in formwork before concrete is placed.

B. Place lifting hooks in punched holes in bottom flange of steel beams and secure in place by nuts.

**3.09 - ENGINE EXHAUST SLEEVE**

A. Secure sleeve to masonry wall with two anchor lugs welded to sleeve. Fasten aluminum plate with slip joint around sleeve to masonry on inside. Fit retaining ring between sleeve and engine exhaust pipe to retain insulated packing.

**3.10 - GRAB BARS**

A. Space grab bars at 12-in. on center or as indicted. Apply protective coat of bituminous material to embedded parts of bars.

**3.11 - STRUCTURAL DOOR FRAMES**

A. Provide structural steel angles, plates and strap anchors as indicated.

**3.12 - ANGLE PROTECTION**

A. Provide structural steel angles and strap anchors as indicated and specified.

**3.13 - FALL PREVENTION SYSTEM**

A. Install in accordance with manufacturer's printed instructions and as specified.

**3.14 - ALUMINUM PLANK**

A. Acurately set and properly secure frames and planks in place. Where bolted connections are used. Draw closely together and draw nuts tightly.

B. Provide standard panel widths.

C. Perform cutting and fitting as required for installation.

D. Cutouts for pipes or circular obstructions shall be 2 inch larger in diameter than the diameter of obstruction.

E. Attachments shall permit removal of plank.

**3.15 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07160**

**BITUMINOUS DAMPPROOFING**

**(Filed Sub-Bid Required)**

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**PART 1 - GENERAL**

**1.00 - SUBBID REQUIREMENTS**

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

1. SECTION 07610, BITUMINOUS DAMPPROOFING
2. SECTION 07840, FIRESTOPPING
3. SECTION JOINT SEALANTS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-101 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 |
| 10 A-303 | 10 A-304 | 10 A-305 | 10 A-406 | 10 A-407 | 10 A-505 | 10 A-602 |
| 10 A-603 | 10 A-604 | 10 A-605 | 10 A-606 | 10 A-607 | 00 S-001 | 00 S-002 |
| 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 A- 106 | 10 A-107 |
| 10 S-301 | 10 S-302 | 10 S-303 | 15 S-102 | 15 S-301 | 30 S-101 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | 00 P-001 | 10 P-101 | 10 P-102 |
| 10 P-103 | 10 P-104 | 10 P-`05 | 10 P-106 | 10 P-107 | 10 P-108 | 10 P-109 |
| 99 P-501 | 00 F-001 | 10 F-101 | 10 F-102 | 99 F-501 | 99 F-502 | 00 E-001 |
| 00 E-601 | 10 E-001 | 10 E-002 | 10 E-101 | 10 E-102 | 10 E-103 | 10 E-104 |
| 10 E-201 | 10 E-202 | 10 E-203 | 10 E-204 | 10 E-205 | 10 E-301 | 10 E-302 |
| 30 E-001 | 30 E-101 | 99 E-501 | 00 FA-001 | 10 FA-101 | 10 FA-102 | 10 FA-201 |
| 10 FA-202 | | | | | | |

2. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for Alternative A-1 for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-501 |
| 20 A-601 | 20 A-602 | 20 A-603 | 00 S-001 | 00 S-002 | 20 S-101 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | 20 P-101 | 99 P-501 | 00 E-001 |
| 00 E-601 | 20 E-101 | 20 E-102 | 99 E-501 | 00 FA-001 | 20 FA-101 | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 07610, BITUMINOUS DAMPPROOFING,
SECTION 07840, FIRESTOPPING and SECTION07900, JOINT SEALANTS

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. Provide and apply materials for below grade dampproofing as indicated and specified.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course. Product data from dampproofing manufacturer stating the specified VOC content and compliance.

2. Recycled Content Submittal

a. For products having recycled content, documentation indicating specified percentages by weight of postconsumer and pre-consumer recycled content.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with Section 01400 and as specified herein.

B. Installer Qualifications: Engage an experienced Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. D 1227: Specification for Emulsified Asphalt used as a Protective Coating for Roofing.

2. D 1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

**1.10 - PROJECT CONDITIONS**

A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

**1.11 - SEQUENCING AND SCHEDULING**

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Hydrocide 700B Semi-mastic by ChemRex, Inc.; Sonneborn Building Products Div.

B. Liquid Asphalt 472 Emulsion by Koppers Industries, Inc.

C. 220AF Fibered Dampproofing by Karnak Chemical Corporation.

D. Or acceptable equivalent product

**2.02 - BITUMINOUS DAMPPROOFING**

A. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's printed instructions.

1. Semi-mastic Grade: Emulsified asphalt semi-mastic, prepared with mineral-colloid emulsifying agents and containing fibers other than asbestos, complying with ASTM D 1227, Type II, Class I.

2. VOC Content: 0.25 lb/gal. (30 g/L) or less

**2.03 – PROTECTION COURSE**

A. Protection Course: Unfaced, fan-folded, extruded-polystyrene board insulation, nominal thickness ¼ inch with compressive strength of not less than 8 psi per ASTM D1621.

1. Recycled Content: Provide extruded polystyrene board insulation with recycled content so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than thirty (30) percent

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of manufacturer.

B. Install cant strips and similar accessories as shown and as recommended by manufacturer.

C. Fill voids, seal joints, and apply bond breakers as recommended by manufacturer.

D. Install separate flashings and corner protection stripping, as recommended by manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations.

E. Prime substrate as recommended by manufacturer.

F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

**3.03 – INSTALLATION, GENERAL**

A. Comply with manufacturer's printed instructions except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.

B. Application: Apply dampproofing to the following surfaces.

1. Exterior, below-grade surfaces of exterior concrete walls in contact with earth or other backfill.

2. Back side of concrete or masonry retaining walls and stone facing to prevent percolating of water through the wall or facing.

3. Where indicated on the Drawings.

C. Apply vertical dampproofing down walls from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

D. Semimastic Grade: Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 5 gal./100 sq. ft., to produce a uniform, dry-film thickness of not less than 30 mils.

**3.04 – PROTECTION AND CLEANING**

A. General: Where indicated, install protection course of type indicated over completed and cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

**3.05 - INSTALLATION OF PROTECTION COURSE**

A. General: Where indicated, install protection course of type indicated over completed and cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07610**

**METAL ROOFING**

**(Filed Sub-bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

1. SECTION 07610, METAL ROOFING
2. SECTION 07710, ROOF SPECIALTIES

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

E. Reference Drawings

1. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-103 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 |
| 10 A-303 | 10 A-305 | 10 A-505 | 10 A-603 | 00 S-001 | 00 S-002 | 10 S-105 |
| 10 S-303 | 99 S-505 | 99 S-506 | | | | |

2. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-102 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 |
| 20 A-501 | 00 S-001 | 00 S-002 | 20 S-102 | 99 S-505 | 99 S-506 | |

F. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 07610, METAL ROOFING and
SECTION 07710, ROOF SPECIALTIES

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

G. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SUMMARY**

A. Scope of Work: Contract Drawings indicate extent and general configuration of roof. Provide materials for and install complete roof system including, but not limited to:

1. Metal Roof.
2. Underlayment Board.
3. Exterior Sheathing.
4. Fasteners and attachment devices.
5. Flashings and other accessories.
6. Attic ventilation accessories.

B. Material Included But Not Installed Under This Section:

1. Extra Stock: Matching sheet metal for fabrication and installation under Section. Furnish extra stock in timely sequence.

**1.02 - REFERENCES**

A. Aluminum Association: “Publication 35: Specifications for aluminum sheet metal work in building construction.”

B. American Society for Testing and Materials, current edition to apply:

C. B209 – Aluminum and Aluminum-Alloy Sheet and Plate.

D. Underwriters Laboratory: Building Materials Directory.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.03 – PERFORMANCE REQUIREMENTS**

A. Structural Design: Comply with design criteria.

B. Watertightness: No uncontrolled water leakage shall occur through roof system.

C. Wind Uplift: Shall be installed to meet applicable building codes.

D. Fire Safety: Shall be installed to meet applicable building codes.

E. Material Compatibility: Prevent contact between dissimilar metals and between metals and potentially corrosive or staining substances.

F. Special Environmental Conditions: Roof shall be compatible with following environmental conditions when applicable:

1. Marine environment.

2. High industrial pollution levels.

G. Expansion and Contraction: Shall be installed to accommodate thermal expansion and contraction.

**1.04 - SUBMITTALS**

A. Product Data: Submit manufacturer's specifications, standard detail drawings and installation instructions.

B. Shop Drawings:

1. Submit shop drawings indicating thickness and dimensions of parts, fastenings and anchoring methods.

2. Indicate roof terminations, clearly showing flashings and change of direction.

3. Clearly indicate locations of field-applied sealant.

4. Show locations of nailing clips and fasteners.

5. Provide a plan showing layout of entire roof.

C. Samples:

1. Submit two sample panels showing metal thickness, profile and required finish.

2. Submit standard color samples on metal for Architect's selection.

D. Applicators: Submit list of completed Projects and name of Architects.

**1.05 – QUALITY ASSURANCE**

A. Manufacturer's Qualifications:

1. Twenty years minimum experience in factory fabrication of metal roofing systems.

2. Products listed in this specification section are as manufactured by Classic Products, Inc.

3. No other bidder will be accepted without prior written approval of architect based upon other manufacturer's products meeting all specified requirements.

4. Substitution requests must be submitted at least ten working days prior to bid date and approved substitutions will be set forth in an addendum.

5. No substitutions will be permitted after bid date.

6. No fax requests will be accepted.

B. Installer's Qualifications: Installer shall provide necessary manpower and equipment to assure progress of work in accordance with Project schedule. Installer shall employ a foreman on Project site who shall have a minimum of five years experience installing similar products on comparable projects.

C. Regulatory Requirements: Comply with requirements of applicable building codes and other agencies having jurisdiction for wind uplift ratings.

D. Pre-Installation Conference:

1. Conduct meeting.

2. Convene and conduct pre-installation conference. Notify others whose work requires coordination with roof installation.

3. Review and coordinate scheduling, sequencing of trades that influence roof installation, tool and utility requirements, and other Project requirements.

**1.06 – DELIVERY, STORAGE AND HANDLING**

A. Comply with manufacturer's delivery, storage and handling instructions.

B. Schedule deliveries to assure continuous progress of work.

C. Protect products against damage.

D. Store under waterproof covering, with proper ventilation to prevent condensation.

E. Inspect materials upon arrival at site and note damaged materials. Do not install damaged materials.

F. Verify access limitations to site and roof. Verify that materials proposed to be stored or staged on roof do not exceed structural limitations of building.

**1.07 – SEQUENCE AND SCHEDULING**

A. Schedule work of this Section to avoid impeding work of other sections.

**1.08 – WARRANTY**

A. Furnish manufacturer's standard limited transferable warranty stating architectural fluorocarbon finish will be:

1. Free of fading or color change in excess of 5 NBS units as measured per ASTM D2244 for a period of 20 years.

2. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D659 for a period of 20 years.

3. Will not peel, crack or delaminate for a period of 50 years.

B. Furnish written warranty signed by applicator for five-year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.

## PART 2 - PRODUCTS

### 2.01 - MANUFACTURER

A. Acceptable Manufacturers

1. Classic Metal Roof Systems
2. Modern, Standing Seam Metal Roofing
3. East Coast Metal Roofing, Inc.

B. Basis of Design Product: Oxford Shingle aluminum roofing panels as manufactured by Classic Metal Roof Systems, Inc., Piqua, OH, Tel. 1-800-543-8938.

C. Substitutions

1. Substitutions must fully comply with specified requirements.
2. Refer to Quality Assurance Section 1.05 for substitution request procedures.

### 2.02 - MATERIALS

A. Panels

1. Metal roofing shall be roll formed tension-leveled panels. Panel material shall be with a minimum thickness of 0.032, 3105-H14 aluminum with a smooth texture and coated with a two coat Kynar 500 or Hylar 5000 finish applied over a polyester prime coat.
2. Provide factory-formed interlocking panels with a 12-inch x 60-inch exposure.
3. Panels shall be warranted for 20 years against peeling, cracking, blistering, chipping, and rust-through. Color will be selected from the manufacturer's premium color range.

### 2.03 - ACCESSORIES

A. General: Accessories shall be as recommended by roof system manufacturer to meet performance criteria.

B. Base and counter flashings, copings, fascias, and trim shall be of the same material and thickness and have the same finish as the roof panels. All hold down clips and fasteners shall be concealed and made of galvanized steel or stainless steel. All components shall be manufactured by the roofing system manufacturer

C. Soffit panels shall be roll-formed with a minimum thickness of 0.032 aluminum and coated with a two coat Kynar 500 or Hylar 5000 finish as used for the roof panels. Matching "J" channel trim shall be provided. Panels shall be Full Vent PAC-750 soffit as manufactured by PAC-CLAD. Color to be selected from the manufacturer's standards

D. Gutters shall be 4-inch x 6-inch, 0.032 aluminum with concealed hangers. Color to match adjacent trim or siding color. Provide end caps, corners and all accessories.

H. Downspouts shall be 3-inch x 4-inch, 316 Stainless Steel with boots and concealed fasteners. Color to be stainless steel with brushed finish.

I. Snow Cleat System shall be Cleat System or equal approved for use with the metal shingle roof panels by the metal roof system manufacturer. Rail system shall be clamped to the metal shingles and held in place with set screws. Rails shall match roof panel color.

J. Roof jacks shall be made of EPDM rubber compound resistant to ozone and UV light. Life expectancy within a temperature range of -65 to 250 degrees F shall be 20 years.

E. Install eaves membrane around entire chimney(s) extending at least 6 inches (152mm) up the wall and 12 inches (305mm) on to the roof surface. Lap the membrane over the roof deck underlayment

F. Underlayment

1. Self-Adhered Underlayment installed on roof eaves, rakes, ridges, and valley of entire roof. See roof plans for exact locations and dimensions. Self-adhering waterproof membrane to be made of rubberized asphalt with a cross laminated polyethylene film or Polymer Modified Bituminous Sheet Materials used as Steep Roofing Underlayment with a minimum thickness of 60 mils as manufactured by W.R. Grace Construction Products, or equal

    a. Basis of Design: Grace Ultra – Roofing Underlayment.

2. One layer 30 lb. asphalt felt; ASTM D226; or one layer Roof Aqua Guard or other synthetic underlayment in field area of roof as shown on roof plan.

G. Exterior Sheathing Board: See spec SECTION 06200, CARPENTRY.

H. Flashing

1. Flashings shall provide for positive drainage, prevent ponding of water, and allow moisture to drain off roof without affecting underlying construction. Flashing to prevent capillary action.

2. Flashings utilizing pop rivets must be self-sealing or sealed with sealant and always be above line of water flow.

I. Penetration Seals

1. Round Penetrations: Flash with aluminum and neoprene pipe boots.

2. Rectangular Openings: Flash with flashings compatible with roof system.

J. Snow Retention Devices: If necessary, provide and install snow retention devices approved by roof manufacturer for use with roof system.

K. Fasteners

1. Panels shall be fastened to the deck with nail clips provided by the roof system manufacturer. Use 5 clips per panel and one fastener per clip.

2. Provide fasteners of sizes and types required by Project conditions to meet performance specifications and roof manufacturer's recommendations. Fasteners shall be corrosion resistant and compatible with roofing and other materials.

3. Pop Rivets: Provide non-corroding, not-staining type. They shall be sealed and located above flow of water. Rivets shall have a minimum shank diameter of 0.125 inches and shall be of sufficient length to form a proper head.

L. Sealants

1. Sealants shall be color-matched butyl rubber sealant provided by roof system manufacturer, non-corrosive and compatible to adjacent material.

2. Seal with cartridge-type sealant.

    a. Sealants shall remain fluid.

    b. Sealants shall adhere to panel surfaces. Clean panels that may be lightly coated with lubricants or airborne contaminants. Sealants must be compatible with contiguous materials.

    c. Sealants should be applied only to dry surfaces.

**2.04 - FINISHES**

A. Painted

1. Pretreatment: Metal shall undergo continuous cleaning, rinsing, and chemical conversion process immediately prior to painting.

2. Exterior Coat:

a. Primer coat shall be 0.2 mil minimum average thick, fully cured, and corrosion resistant and flexible base for topcoat.

b. Topcoat shall yield a 0.7 mil minimum average thick coating. Topcoat shall be fully cured and of consistent color throughout Project.

c. Adhesion:

(1) Bend Test: 1/8" mandrel, no tape pull-off per ASTM D522.

(2) Reverse Impact: 3 x metal thickness per ASTM D2794.

d. Corrosion Resistance:

(1) Salt Spray: 1000 hours per ASTM B117.

e. Accelerated Weathering: 2,000 hours per ASTM G23 or ASTM G26.

f. Weatherability: 5-year South Florida or equivalent exterior exposure:

(1) Color Retention: 5 AEE units maximum degradation per ASTM D2244.

(2) Chalk resistance: 8 minimum rating per ASTM D4214.

3. Gloss Retention: 75% minimum retention per ASTM D523.

4. Back Coat: Corrosion resistant primer plus wash coat, 0.7 mil minimum average total dry thickness.

B. Color: As selected by architect from manufacturer’s standard colors. (Custom colors available, consult manufacturer.)

**2.05 – FABRICATION TOLERANCES**

A. Panel Construction: Uniformly dimensioned. Fasteners and nailing clips shall be concealed.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrate to ensure it is solid and smooth.

B. Do not commence installation until field conditions have been verified.

C. Ensure cuttings from field fabrication are removed prior to installation.

**3.02 - PREPARATION**

A. Field measure prior to fabrication of custom fabricated items.

B. Lay out work to provide random appearance and to avoid short courses. Where field cutting is required, make cuts in a workmanlike manner.

C. Protection:

1. Adjacent surfaces: When possible, install flashings prior to siding and stucco installation.

2. Dissimilar metals: Isolate any dissimilar metals to prevent corrosion.

**3.03 - INSTALLATION**

A. General: Comply with approved shop drawings, manufacturer's installation instructions, and applicable construction and safety regulations.

B. Underlayment: Install underlayment according to procedures recommended by roof system manufacturer.

C. Panels shall be interlocked with each other and securely attached to the roof deck.

D. Flashings:

1. Follow approved details.
2. Flashings shall be lapped four inches and fastened 12 inches on center.
3. Lap valley minimum of six inches.
4. Allow for expansion and contraction of lineal accessories.

E. Protective Materials: Provide temporary protective materials if needed to protect previously installed roof surfaces.

F. Sealants:

1. Apply only to dry surfaces in accordance with sealant and roof manufacturer's instructions.
2. Apply only in bend thickness of minimum 3/8".
3. Apply in workmanlike manner.
4. Install sealants only when ambient temperature and conditions are in accordance with sealant manufacturer's recommendations.

G. Accessories: Securely install in accordance with manufacturer’s instructions.

**3.04 – ADJUSTING, CLEANING, AND PROTECTION**

A. Protect roof from damage by work of other sections on, above, or adjacent to roof.

B. Installed panels and accessories shall be secured before leaving roof area at end of day.

C. Keep installed roof clean and protected from damage.

D. Clean gutters of roof installation debris at completion.

E. Repair minor damage to finishes. Use matching coatings recommended by roof manufacturer. Remove and replace items which can not be satisfactorily repaired.

F. Protect roofing from metal filings or shavings. Metal filings or shavings shall be cleaned from panels or flashing surfaces by end of each day.

**3.05 - CONTRACT CLOSEOUT**

G. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07840**

**FIRESTOPPING**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 07840, FIRESTOPPING is a part of DIVISION 07 THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07160 – BITUMINOUS DAMPROOFING.

B. The Work of SECTION 07840, FIRESTOPPING, requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. Provide firestopping as indicated and specified including the following:

1. Penetrations through fire resistance rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire resistance rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire resistance rated construction, including gypsum drywall partitions, masonry walls and adjacent construction.

B. General Contractor shall be responsible for providing firestopping for the project.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Submit manufacturer's literature for each type of Firestop material to be installed. Indicate product characteristics, typical uses, performance and limitation criteria, and test data.

2. Shop Drawings: Show typical installation details for the methods of installation. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

a. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement derived from a similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgement shall follow the requirements set forth by the International Firestop Council.

3. Certificates: Submit certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.

4. Installation Instructions: Submit manufacturer's installation procedures for each type of product.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number and shelf life.

E. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the “System Performance Requirements” article:

1. Firestopping tests are performed by UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per ASTM E 814.

3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119.

C. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design, and extent to that indicated for Project and that has performed successfully.

D. Single Source Responsibility: Obtain through penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.

E. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

F. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through penetration firestop systems are installed per specified requirements.

G. Preinstallation Conference: Conduct conference at Project site.

H. Field Testing of firestop systems will be performed for each type of firestop systems.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. E84: Test Methods for Surface Burning Characteristics of Building Materials.

2. E119: Test Methods for Fire Tests of Building Construction and Materials.

3. E814: Test Method for Fire Tests of Through-Penetration Five Stops.

B. Underwriters Laboratories Inc.

1. UL Fire Resistance Directory.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

B. F-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire resistance rating of the constructions penetrated.

C. T-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-ratings shall be per code but not less than 1 hour. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature rise rating.
4. Where firestop systems protect penetrating items larger than a 4 inch diameter nominal pipe or 16 square inches in overall cross sectional area.

D. Fire Resistive Joint Sealants: Provide joint sealants with fire resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.

E. For Firestopping Exposed to View, Traffic, Moisture, and Physical Damage, Provide Products That Do Not Deteriorate When Exposed to These Conditions:

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetration with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F. For firestopping exposed to view, provide products with flame spread values of less than 25 and smoke developed values of less than 450, as determined per ASTM E 84.

**1.10 - PROJECT CONDITIONS**

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

**1.11 - SEQUENCING AND SCHEDULING**

A. Coordinate the work of this Section as required with the work of other trades.

B. Coordinate construction of openings and penetrating items to ensure that firestopping systems are installed according to specified requirements.

C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

D. Do not cover up those firestopping installations that will become concealed behind other construction until Owner’s inspection agency and authorities having jurisdiction, if required, have examined each installation.

1. Notify the Owner’s inspecting agency at least seven days in advance of through-penetration firestop system installations. Confirm dates and times on days preceding each series of installations.

## PART 2 - PRODUCTS

### 2.01 - GENERAL

A. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire-resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

1. Provide paintable firestop products at locations exposed to the public. Mechanical and electrical rooms are not considered public spaces.

2. Provide VOC compliant materials.

B. Compatibility: Provide through-penetrations firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including, but not limited to, the following:

a. Slag-/rock-wool-fiber insulation.

b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.

c. Fire-rated form board.

d. Fillers for sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

### 2.02 - MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Specified Technologies Inc. (STI), Somerville, NJ.

2. Hilti, Inc., Tulsa, OK.

3. 3M Fire Protection Products, St. Paul, MN.

4. Bio Fireshield, Carlisle, MA.

5. W.R Grace, Flamesafe.

6. Or acceptable equivalent product.

### 2.03 - MATERIALS

A. Firestop Mortar:

1. Specified Technologies Inc. SpecSeal Mortar.

2. Bio Fireshield Novasit K-10.

3. Hilti FS 635 Trowelable Firestop Compound.

B. Firestop Sealants and Caulks:

1. STI SpecSeal Sealant.
2. Dow Corning Firestop Sealant No. 2000.
3. 3M CP25WB + Caulk.
4. Bio Fireshield Biotherm and Biostop.
5. Hilti FS-ONE High Performance Intumesent Firestop Sealant.

C. Firestop Putty:

1. STI Spec-Seal Firestop Putty Bars and Pads.
2. 3M MPS-2 Moldable Putty Stix and Putty Pads.
3. Hilti CP 617 and CP 618 Putty Pads and Putty Sticks.

D. Firestop Collars:

1. STI SpecSeal Firestop Collars.
2. 3M PPD Collars.
3. B10 Fireshield Bio Firestop Sleeve.
4. Hilti CP 643 and CP 642 Firestop Collars.

E. Wrap Strips:

1. SpecSeal Wrap Strip.
2. 3M FS-195 Wrap Strip.
3. Hilti CP 645 Firestop Wrap Strips.

F. Cast-In-Place Firestop Device:

1. Hilti CP 680 Cast-In-Place Firestop Device.

G. Fire Safing Insulation:

1. Fibrex Insulations, Inc.
2. Owens Corning HT, Inc.
3. Thermafiber LLC.
4. Or approved equal.

H. Accessories: Forming/damming materials - mineral fiberboard or other type recommended by manufacturer.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

4. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

B. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

**3.03 - INSTALLING THROUGH PENETRATION FIRESTOPS**

A. General: Comply with the "System Performance Requirements" article in Part 1 and the through penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross sectional shapes and depths required to achieve fire ratings of designated through penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install Fill Materials for Through Penetration Firestop Systems by Proven Techniques to Produce the Following Results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Install fire safing insulation at all interior full-height fire rated walls at roof intersections.

**3.04 - FIELD QUALITY CONTROL**

A. Allow for 3 random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.

B. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

C. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

**3.05 - CLEANING**

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 07900**

**JOINT SEALANTS**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 07900, JOINT SEALANTS is a part of DIVISION 07, THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07160, BITUMINOUS DAMPPROOFING.

B. The work of SECTION 07900, JOINT SEALANTS, requires the subcontractor to perform all work specified under this section

### 1.01 - SCOPE

C. Provide joint sealants as indicated and specified including the following:

1. Exterior Joints in Vertical Surfaces and Non-traffic Horizontal Surfaces as Indicated Below:
    a. Joints between architectural precast concrete units.
    b. Control and expansion joints in unit masonry.
    c. Perimeter joints between materials listed above and frames of doors, louvers, and windows.
    d. Other joints as indicated.
    e. Joints at precast concrete coping.
2. Interior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces as Indicated Below:
    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Tile control and expansion joints.
    d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
    e. Perimeter joints between interior wall surfaces and frames of interior doors, louvers, and windows.
    f. Perimeter joints of toilet fixtures.
    g. Other joints as indicated.
3. Interior Joints in Horizontal Traffic Surfaces as Indicated Below:
    a. Joints as indicated.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: For each joint sealant product specified.
2. Samples: For selection purposes submit three (3) of manufacturer's standard color chart including bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in service performance.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM C 834: Standard Specification for Latex Sealing Compounds.
2. ASTM C 919: Standard Practice for Use of Sealants in Acoustical Applications.
3. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
4. ASTM C 1193: Standard Guide for Use of Joint Sealants.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

**1.10 - PROJECT CONDITIONS**

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees F (4.4 degrees C).
3. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

**1.11 - SEQUENCING AND SCHEDULING**

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

1. Provide paintable sealants at locations that are exposed to view.

**2.02 - MANUFACTURERS**

A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two components.

1. Sonolastic NP-2; Sonneborne
2. Dymeric; Tremco
3. Sikaflex-2c, NS; Sika
4. Dynatrol 2; Pecora
5. Vulkem 922; Vulkem
6. Chem-Calk 500; Bostik
7. Or acceptable equivalent product.

B. Type 2 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

1. Tremco Acrylic Latex; Tremco
2. AC-20; Pecora
3. Chem-Calk 600; Bostik
4. Or acceptable equivalent product.

C. Type 3 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.

1. Sanitary 1700; GE Silicones
2. 898 Silicone; Pecora
3. 786 MR Silicone; Dow Corning
4. Or acceptable equivalent product.

D. Type 4 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.

1. Tremco Acoustical Sealant; Tremco
2. AC-20 FTR Acoustical Sealant; Pecora Corp.
3. Sheetrock Acoustical Sealant; United States Gypsum Co.
4. Or acceptable equivalent product.

**2.03 - JOINT SEALANT BACKING**

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self adhesive tape where applicable.

**2.04 - MISCELLANEOUS MATERIALS**

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

**3.03 - INSTALLATION OF JOINT SEALANTS**

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

**3.04 - CLEANING**

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

**3.05 - PROTECTION**

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

**3.06 - SCHEDULE**

A. Exterior Joints for Which No Other Sealant Type is Indicated: Type 1; colors as selected.

B. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type 2.

C. Interior Joints for Which No Other Sealant is Indicated: Type 2; colors as selected.

D. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type 3.

E. Exposed and Concealed Joints where Acoustical Sealant is indicated and required: Type 4, colors as selected.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08500**

**FIXED WINDOWS**

**(Filed Sub-Bid Required)**

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**PART 1 – GENERAL**

**1.00 - SUBBID REQUIREMENTS**

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 8, WINDOWS AND DOORS shall include the complete Work specified in all of the following Sections:

1. SECTION 08500, FIXED WINDOWS

2. SECTION 08550, WINDOWS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 08500, FIXED WINDOWS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 | 10 A-404 | 10 A-405 |
| 10 A-406 | 10 A-407 | 10 A-602 | 10 A-603 | 10 A-604 | 10 A-607 | 00 S-001 |
| 00 S-002 | 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 99 S-505 | 99 S-506 |

2. The Work of SECTION 08500, FIXED WINDOWS for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-401 |
| 20 A-601 | 20 A-602 | 20 A-603 | 00 S-001 | 00 S-002 | 20 S-101 | 99 S-505 |
| 99 S-506 | | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 08500, FIXED WINDOWS

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide High-Performance, Thermal-Barrier, Custom Architectural Grade, Preglazed Aluminum Windows and Frames, and Auxiliary System Components as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer’s product data and specifications, including installation instructions.
2. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, masonry openings, operable units, and attachments to other work.
3. Submit details showing construction parts, metal thicknesses, installation and erection details, thermal-break and glazing details including connections, anchorage, fastening and sealing methods.
4. Submit sections of typical members, dimensioned elevations, frame sizes, type and spacing of anchors and fasteners, and details of accessories.
5. Submit three (3) color charts for aluminum finish.

6. Submit two samples each of sash corner, glass, finishes, hardware, anchorage and fastener. Engineer reserves the right to reject material finishes with objectionable variations from the established samples.

7. Submit certified test reports with results and written compliances conforming to the Design Requirements specified in this section.

8. Design calculations verifying compliance with performance criteria specified, acceptable to governing authorities having jurisdiction, prepared, signed and stamped with the seal of a registered professional engineer, as specified.

9. Certificates: Submit for approval the following:

   a. Proof of testing laboratory AAMA certification and copies of testing agencies background and experience in performing similar tests to those specified.

   b. Registered professional engineer who prepares signs and stamps its seal shall provide a written statement confirming responsibility for the design and attest that the work prepared meets the Specifications and the requirements of governing authorities having jurisdiction and conforms to the prevailing standards of practice for the type of work specified.

10. Test Reports: Submit for approval the following:

    a. Valid AAMA "Authorization for Product Certification" indicating that the aluminum windows and frames to be provided for this Project conform to AAMA/NWWDA 101 I.S.2.

11. Warranties: Submit for review copies of written warranties agreeing to replace aluminum window and frame system components that fail to perform as specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Delivery of Materials:

   a. Deliver aluminum window and frame system materials, components and accessories dry and undamaged, with manufacturer's protective wrapping intact.

   b. Deliver aluminum window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.

   c. Inspect aluminum window and frame system components upon delivery for damage. Remove and replace all damaged items at no additional cost.

E. Storage of Materials:

   a. Do not store aluminum window and frame system components in contact with concrete or other materials that might cause corrosion or staining.

   b. Store aluminum window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.

   c. Provide a ¼-inch space between aluminum window and frame system components in order to promote air circulation.

F. Handling of Materials:

a. Do not subject aluminum window and frame components to bending or stress.

b. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

c. Handle material using appropriate handwear and tools that do not damage finish of items to remain exposed.

**1.06 - DESIGN CRITERIA**

A. Standards:

1. Comply with applicable standards and recommendations by AA, AAMA, and ASCE, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.

2. Comply with AAMA/NWWDA 101/I.S.2 including “non-mandatory” Appendix B, C, and D except where more stringent Wind Velocity Maps are included in ASCE 7 or other governing authorities having jurisdiction.

B. Modifications: Aluminum window and frame requirements shown are intended to establish basic dimensions of units, modules, profiles, mullion depths, sight lines, support locations of members and the visual design intention. Within these limitations Contractor shall be responsible for the structural adequacy, weather resistance, thermal and condensation resistance, and the detailing and fabrication of all aluminum window and frame system, including anchorage, and to make whatever modifications of, and additions to, the details as may be required to fulfill the minimum performance requirements of AAMA Optional Performance Grade and the requirements of non-mandatory Appendixes specified, at no additional expense to the Owner. Maintain the visual design concept as shown, including member sizes, profiles, support locations and alignment of components.

C. Performance Criteria:

1. Loading Analysis Criteria:

a. Wind Loads: Provide structural analysis, calculations and details indicating compliance with the ASCE 7-93 and ASCE 7-88, based on project location, heights and wind speed of 115 miles per hour (MRI 100 years), Ground Roughness (Exposure) Category D; Importance Factor based on ASCE 7 - Category IV - Essential Facility, and corresponding formula coefficients, to determine velocity pressures.

b. Seismic Loads: Provide aluminum window and frame system, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of the ASCE 7, Section 9, whichever are more stringent.

c. Dead Loads: Provide aluminum window and frame system components that do not deflect an amount that will reduce glazing bite below 75 percent of required glazing bite dimension when carrying full dead load. Provide minimum of 1/8 inch clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum of 1/16 inch clearance between members and operable windows and doors.

d. Live Loads: Provide aluminum window and frame system, including anchorage that accommodates supporting structure’s deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

e. Deflection of Framing Members, ASTM E330: Maximum deflection of L/175 at center of single span when subjected to both positive and negative applicable design pressures, with no permanent deformation or damage of any main frame, sash, panel or sash member in excess of 0.2 percent of the span when the load is removed.

2. Water and Air Infiltration Tests: A 5 foot-0 inch by 3 foot-0 inch window shall comply with the following:

    a. Static Test Pressure Water Penetration Testing, ASTM E331 and AAMA 910: After the AAMA 910 life cycle test, no evidence of uncontrolled water penetration to the interior of the building through the aluminum windows and frames when subjected to a static air pressure difference of 12 pounds per square foot.

    b. Air Infiltration Testing, ASTM E283: After the AAMA 910 life cycle test, maximum air infiltration of 0.08 cubic feet per minute per square foot, when subjected to a static air pressure difference of 6.24 pounds per square foot.

3. Aluminum Window Classification (Grade): Based on AAMA/NWWDA 101/I.S.2, provide the following:

    a. Performance Class: In addition to General Requirements of Section 1, Gateway Performance Requirements established in Table 2.1, the Specific Performance Requirements of Section 2.2 and the Material and Component Requirements of Section 3, provide Optional Performance Class – Architectural AW, for all aluminum windows and frames.

    b. Performance Grade: As a minimum, provide Optional Performance Grade 65 aluminum windows and frames tested for structural test pressure of 1.5 times design pressure, unless structural calculations based on performance criteria specified identifies the need for more stringent optional performance grade for any area of the Project.

    c. Product Type: Provide AW - Fixed Window, as shown on the Drawings.

4. Provide design, detailing and fabrication based on the most stringent combination of standards, testing and engineering analysis specified.

5. Thermal Movements: Aluminum window and frame system, including anchorage, shall withstand thermal expansion and contraction movements of system and supporting elements resulting from not less than an ambient temperature change of 120 degrees F, which may cause a surface material temperature change of 180 degrees F. Limit the deflection as for wind pressure loading. Thermal movements shall not cause permanent deformation, cracking, opening of joints, undue stress on fasteners, or other effects detrimental to weathering performance.

6. The design of the aluminum window and frame system, including anchorage, as shown and specified is intended to prevent excessive condensation on the indoor faces of the work, with the heating and ventilating system in operation, and under the following conditions. Provide aluminum window and frame system design, detailing and fabrication in compliance with AAMA 1503.1 that achieves and maintains this design intention:

    a. Outdoor: Ambient temperature 0 degrees F; 15 mph wind.

    b. Indoor: Ambient temperature of 75 degrees F; relative humidity of 25 percent.

    c. Excessive condensation is defined as visible water.

    d. Condensation Resistance Factor: 58 minimum for frame.

7. Provide internal drainage to lead all infiltrated water to the exterior through weep slots.

8. Provide Fire-Rated glazing materials installed as borrowed lites in fire-rated frames and wall applications

9. Testing: Manufacturer's standard window units shall comply with the requirements and testing in accordance with the specified tests. Provide certification by the manufacturer of compliance with such tests; otherwise, perform the required tests through a AAMA accredited and recognized testing laboratory or agency and provide certified test results.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications:

1. Engage a single installer skilled, trained and with successful experience in the installation of aluminum window and frame systems and with specific skill and successful experience in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work.

C. Erection Tolerances:

1. Limit variations from plumb, level or dimensioned angle to the following:

a. 1/8-inch maximum deviation in 10 foot vertical or angular run and in 20 foot horizontal runs.

b. 1/4-inch maximum deviation in 40 foot runs, all directions.

2. Limit variations from theoretical member locations shown, based on established floor lines and column lines, including variations from plumb and level, to the following:

a. 3/8-inch total maximum deviation for members at all locations.

b. 1/8-inch maximum change in deviation for members for 10 foot runs, all directions.

3. Limit offsets in end-to-end and edge-to-edge alignments of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:

a. 1/16-inch maximum offset in flush alignment, including members which are to be 1/2-inch or less out-of-flush, and including members which are separated 2-inches or less by a reveal or protrusion in the plane of the aluminum windows and frames.

b. 1/8-inch maximum offset in alignments which are to be out-of-flush by more than 1/2-inch or separated by a reveal or protrusion of more than 2- inch width.

D. Source Quality Control:

1. Obtain all aluminum window and frame system components, operating hardware, custom panning, flashing and accessories from the same manufacturer.

2. Provide aluminum windows and frames labeled with AAMA Hallmark labels.

E. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer’s satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work in accordance with ASTM E329 and AAMA qualifications.

**1.08 - WARRANTY**

A. General Warranty: The special warrantees specified in this Article shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.

B. Special Warrantees: Provide the following:

1. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:

a. Coating shall not spall, check, craze, peel or otherwise lose adhesion for a period of ten years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet - 0 inches from the item.

b. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified standards the manufacturer shall, at its own expense, replace or field paint, at the discretion of the Owner, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.

c. The warranty shall not apply where any failure is caused by accidents, or any external conditions or forces beyond the control of the manufacturer.

2. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame system components including the failure of insulating glass. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weatherstripping, and other components of the system.

C. Warranty Period:

1. Windows: Three years from date of substantial completion.

2. Glazing: Five years from date of substantial completion.

3. Metal Finish: Fifteen years from date of substantial completion.

**1.09 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM B209: Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for

2. ASTM B221: Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Standard Specification for

3. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications

4. ASTM D395: Rubber Property-Compression Set, Standard Test Methods for

5. ASTM D573: Rubber - Deterioration in an Air Oven, Standard Test Method for

6. ASTM D2000: Rubber Products in Automotive Applications, Standard Classification System for

7. ASTM E283: Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Windows Under Specified Pressure Differences Across the Specimen, Standard Test Methods for

8. ASTM E329: Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction, Standard Specification for

9. ASTM E330: Structural Performance of Exterior Windows, Curtain Walls, and Windows by Uniform Static Pressure Difference, Standard Test Methods for

10. ASTM E331 - Water Penetration of Exterior Windows, Curtain Walls, and Windows by Uniform Static Air Pressure Difference, Standard Test Method for

11. National Fire Protection Association (NFPA):

a. NFPA 80: Fire Doors and Windows

B. Aluminum Association Standards (AA):

1. AA: The Aluminum Association Incorporated, American National Standard Alloy and Temper Designation Systems for Aluminum

2. AA: The Aluminum Association Incorporated, Designation System for Aluminum Finishes

C. American Architectural Manufacturers Association and the Window and Door Manufacturers Association, (AAMA/NWWDA):

1. 101/I.S.2 – Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

D. American Architectural Manufacturers Association (AAMA):

1. AAMA 611-98: Voluntary Guide Specification for Anodized Architectural Aluminum.

2. AAMA 800: Voluntary Specifications Test Methods for Sealants

3. AAMA 910: Voluntary 'Life Cycle'/Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors

4. AAMA 1503.1: Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections

5. AAMA 2605-02: Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

E. American Society of Civil Engineers (ASCE):

1. 7 - Minimum Design Loads for Buildings and Other Structures

F. Federal Specification (FS):

1. RR-W-365: Wire Fabric (Insect Screening)

G. National Association of Architectural Metal Manufacturers (NAAMM).

H. Society of Protective Coating (SSPC)

1. Paint 12 - Paint Specification No. 12: Cold-Applied Asphalt Mastic (Extra Thick Film)

I. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - PROJECT CONDITIONS**

A. Protection: Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

1. Do not install aluminum windows and frames until all work that could damage aluminum window and frame systems has been completed.

2. Provide temporary closures until construction sequencing allows installation of aluminum window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the work specified herein.

C. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Working Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

**1.11 - SYSTEM DESCRIPTION**

A. This Section describes exterior, high-performance, minimum 3-1/4-inch frame depth, factory-fabricated and factory-glazed, aluminum windows with integral structural polyurethane thermal-breaks and applied muntins complying with the requirements of AAMA/NWWDA 101/I.S. 2 - Architectural Performance Class and Section 4 - Optional Performance Grades, all with Architectural Class I anodized finish or with a complete selection of factory-applied, three coat, custom and premium exotic color, custom blended full strength polyvinylidene fluoride finishes and colors with extended life topcoat, as selected; all designed, detailed and fabricated as required to resist specified loadings, and resistance to air and water penetration specified and in accordance with the requirements of governing authorities having jurisdiction; associated high-performance operating hardware, auxiliary system items, accessories, fasteners and similar items for completely functioning systems.

B. Fire-rated, clear and wireless glazing and frame material for use in locations such as doors, sidelites, interior windows, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45 minutes to 2 hours with required hose stream test; for use in interior and exterior applications. Coordinate with spec section 08810 Glass and Glazing.

**PART 2 – PRODUCTS**

**2.01 - MANUFACTURERS**

A. EFCO Corporation.

B. Graham.

C. Kawneer.

D. Or acceptable equivalent product.

**2.02 - MATERIALS**

A. Extrusions:

1. Provide extruded, double tubular aluminum mullions, applied muntins, pressure plates, snap covers, two-piece snap trim, sills and glazing stops and trim, equal to ASTM B221, 6063-T5 alloy and temper as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.

    a. Minimum Thickness: 0.125-inches.

2. Provide extrusions within commercial tolerances, formed true to details shown and free of defects impairing strength, durability, color or finish.

B. Sheets:

1. Provide aluminum sheet closures, auxiliary components and accessories, equal to ASTM B209, 5005 alloy for exposed sheet and 3003 alloy for nonexposed sheet or as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.

    a. Provide thicknesses for Principal Formed Sheet Members: 0.125-inches minimum thickness.

2. Provide sheet free of defects impairing strength, durability, color or finish.

C. Fasteners: 300 Series non-magnetic stainless steel, guaranteed by the manufacturer to be non-corrosive and compatible with the aluminum window members, trim, hardware, anchors and other components of the window units.

1. Do not use exposed fasteners, except where unavoidable for the application of operating hardware. Match the finish of the metal surrounding fastener, unless otherwise specified.

2. Provide Philips flat-head machine screws for exposed fasteners, unless otherwise specified.

D. Thermal Separators: Integral, structural polyurethane.

E. Glass and Glazing:

1. Glass: 1-in. thick clear, insulating-glass units, with low-E coating pyrolytic on third surface for tinted windows.

a. Tint: Solar gray with visible light transmittance of 18%.

2. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

3. Factory-Glazed Fabrication: Glaze aluminum windows in the factory and comply with AAMA/WDMA 101/I.S.2/NAFS.

4. Glazing Stops: Provide snap-on glazing stops. Provide glazing stops to match sash and ventilator frames.

F. Wire Fabric Insect Screen and Frames: Provide insect screen and frames for each operable sash.

1. Provide 18 by 16 mesh of 0.009-inch diameter stainless steel wire, complying with FS RR-W-365, Type VI, mounted with polyvinylchloride splines into 5/16-inch by 1-1/2-inch by 0.050-inch extruded tubular aluminum frames with finish to match window in color and performance; corners mitered, gusset reinforced and crimped.

2. Provide insect screens that mount into exterior or interior extruded tracks using two stainless steel leaf springs.

3. Where windows swing outward, and insect screens are mounted on interior, provide sliding wickets framed as for fixed insect screens and trimmed for a tight fit and durability during operation.

G. Weatherstripping: Provide double rows of manufacturer's replaceable epdm stripping complying with ASTM D2000, secured in extruded aluminum ports at all vent perimeters.

H. Brackets, Gussets, Reinforcements and Splice Clips:

1. Provide aluminum brackets and reinforcements wherever possible. Where steel units are required for higher strength or other unavoidable necessity, hot-dip galvanize the pieces after fabrication, with 2.0 ounces zinc coating.

I. Auxiliary Components and Accessories:

1. Provide extruded aluminum, minimum 0.125-inch thick wall, with exposed surfaces finished to match aluminum windows and frames in color and performance; concealed fasteners; all weatherseals; designed for unrestricted expansion and contraction.

2. Provide complete selection of exterior wrap-around custom panning accessories; two-piece head and jamb receptors; sills and subsills with thermal-breaks, anchors and end dams; two-piece interior snap trim and clips; interior glazing adapters, expanders, receptors, stools and other trim necessary for a complete installation, as determined by Engineer.

3. Provide intermediate, thermally broken, expansion-type, vertical and horizontal integral mullions (stack; offset stack; and three-piece) and mullion covers in configurations and types as required for combinations of windows and sizes of window areas shown.

J. Bituminous Paint: Cold applied asphalt mastic complying with SSPC-Paint 12, compounded for 30-mil thickness per coat.

K. Expansion Anchor Devices: Where inserts have not been provided in supporting concrete structure, provide drilled-in expansion bolt anchors of either toothed-stainless steel or lead shield design.

**2.03 - WINDOW OPERATION**

A. General:

1. Projected Double Hung Windows: Swing-out as shown, side-hinged vent sash and fixed window combinations as shown, provide operable sash with two balance-support arms, pivots with friction shoes.

B. Operating Hardware:

1. Strike and Cam: White bronze, UNS C86200 cast white manganese bronze complying with ASTM B584.

2. Concealed Stainless Steel Hinges: Heavy-duty four-bar hinges with nonmagnetic stainless steel balance arms. Provide sliding pivots with nylon friction-adjustable shoe in a stainless steel track.

3. Limit Opening Device: Provide stainless steel adjustable hold-open limit arm with release key for all project-out operable windows.

4. Lock: Lift type throw. Cam-action lock with keeper, one per ventilator.

5. Provide on gear type rotary operator located on jamb at sill with standard crank handle. Provide on per window.

**2.04 - FABRICATION**

A. General: Provide specified manufacturer's standard fabrication and accessories, except to the extent more stringent requirements are specified. Include complete system for assembly of components and anchorage of window units.

B. Sizes and Profiles: The required sizes for window units and the profile requirements are shown on the Drawings. The details shown are based upon standard details by one manufacturer. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the size requirements, performance requirements and with minimum/maximum profile requirements shown and specified.

C. Frame and Vent: All members shall be minimum 0.125-in. thick, double tubular; corners mitered, double gusset reinforced, factory-sealed with sealant complying with AAMA 800 and crimped.

D. Water Control: Provide pressure equalization gasket on vent interior; vent and frame weeps, foam baffles, and exterior hoods to allow water to drain by gravity and resist wind-blown rain.

E. Provide field-mounted drip caps on vent exteriors above frame sill.

F. Operating Hardware:

1. Cut, reinforce, drill and tap frames and windows as required to receive operating hardware. Comply with manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

2. Design, detail and fabricate reinforcement for maximum heavy-duty use, consisted with required guarantee period and performance criteria specified.

G. Provide extruded aluminum applied muntins, and custom panning shapes as shown and specified.

H. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

I. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

**2.05 - FINISHES, GENERAL**

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.06 - ALUMINUM FINISHES**

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42 (Integrally colored or electrolytically deposited color coating 0.7 mils) complying with AAMA 611.

1. Color: Dark bronze

**PART 3 – EXECUTION**

**3.01 - INSPECTION**

A. Contractor shall examine the alignment of substrates and the sequence of work before erection of the custom aluminum window and frame systems work begins and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the custom aluminum window and frame systems work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Custom aluminum window and frame systems work shall not be installed when there is no assurance of adequate, long term protection by Contractor.

**3.02 - INSTALLATION**

A. All windows shall be installed by factory-trained erectors in strict accordance with installation data provided by approved shop drawing submittal, and the requirements of these Specifications.

B. Do not install component parts that are observed to be defective in any way, including warped, bowed, dented, abraded and broken members, and including damaged glass.

C. Do not cut, or trim, component parts during erection, in a manner that would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the custom aluminum window and frame systems. Return component parts which require alteration to the shop for refabrication, if possible, or for replacement with new parts.

D. Install component parts level, plumb, true to line and with uniform joints and reveals. Provide required support secured to structure with non-staining and noncorrosive shims, anchors, fasteners, spacers and fillers. Use erection equipment that will not mar or stain finished surfaces, and will not damage the component parts.

E. Apply a bituminous coating of approximately 30-mil dry film thickness, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.

F. Apply sealant in accordance with manufacturer’s written recommendations at joints, wipe off excess and leave exposed sealant surface clean and smooth.

G. Anchor components parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements which are intended or necessary.

**3.03 - PROTECTION**

A. Contractor shall provide protective treatment and other precautions required through the remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering at time of Final Acceptance.

B. Contractor shall advise Engineer, in writing, of protection and surveillance requirements that Contractor shall provide at no additional expense to the Owner, to ensure that aluminum windows and frame system will be without damage or deterioration at the time of Final Acceptance by the Owner.

C. Where protective coating has been supplied, remove coating completely immediately before installation and when construction activities no longer requires its retention.

**3.04 - ADJUSTMENT**

A. All windows shall be adjusted for smooth operation and weathertight closure providing a tight fit at contact points and at weatherstripping after installation is complete and readjusted when necessary prior to Substantial Completion.

B. At the completion of the work, restore adjacent work, marred by the work of this Section, to an undamaged and clean condition.

C. Adjacent work that has been physically damaged, or that does not respond adequately to cleaning, shall be replaced with new materials at no additional expense to the Owner.

**3.05 - CLEANING**

A. Clean aluminum surfaces immediately after installation, exercising care to avoid damage of finish. Lubricate hardware and other moving parts.

B. Maintain the aluminum window and frame systems and glazing in a clean condition throughout the construction period, so that they will be without any evidence of deterioration or damage, other than the effects of normal weathering, at the time of Final Acceptance.

C. Select methods of cleaning that will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08550**

**WINDOWS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 08550, WINDOWS is a part of DIVISION 08, OPENINGS: WINDOWS AND DOORS which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 08500 - FIXED WINDOWS.

B. The Work of SECTION 08550, WINDOWS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Aluminum Window Types (1) Double-Hung Window Units and (2) Non-operative (Fixed) Window Units as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: For each type of product. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

2. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

3. Samples: For each exposed product and for each color specified, 2-inches x 4 inches in size.

4. Samples for Initial Selection: For units with factory-applied color finishes. Include similar Samples of hardware and accessories involving color selection.

5. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below:

a. Exposed Finishes: 2-inches x 4 inches.

b. Exposed Hardware: Full-size units.

6. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

7. Qualification Data: For manufacturer and Installer.

8. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

9. Field quality-control reports.

10. Sample Warranties: For manufacturer's warranties.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE and HANDLING and as specified.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Delivery of Materials:

1. Deliver aluminum window and frame system materials, components and accessories dry and undamaged, with manufacturer’s protective wrapping intact.

2. Deliver aluminum window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.

3. Inspect aluminum window and frame system components upon delivery for damage. Remove and replace all damaged items at no additional cost.

D. Storage of Materials:

1. Do not store aluminum window and frame system components in contact with concrete or other materials that might cause corrosion or staining.

2. Store aluminum window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.

3. Provide a 1/4-inch space between aluminum window and frame system components in order to promote air circulation.

E. Handling of Materials:

1. Do not subject aluminum window and frame components to bending or stress.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

3. Handle material using appropriate handwear and tools that do not damage finish of items to remain exposed.

**1.06 – DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

**1.07 - QUALITY ASSURANCE**

C. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

D. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

E. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

F. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project. Engage a single installer skilled, trained and with successful experience in the installation of aluminum window and frame systems and with specific skill and successful experience in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work.

G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.

2. Acceptance of mockups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Engineer specifically accepts such deviations in writing.

**1.08 - WARRANTY**

A. General Warranty: The special warrantees specified in this Article shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.

B. Special Warrantees: Provide the following:

1. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:

a. Coating shall not spall, check, craze, peel or otherwise lose adhesion for a period of ten years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet - 0 inches from the item.

b. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified standards the manufacturer shall, at its own expense, replace or field paint, at the discretion of the Owner, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.

c. The warranty shall not apply where any failure is caused by accidents, or any external conditions or forces beyond the control of the manufacturer.

2. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame system components including the failure of insulating glass. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weather stripping, and other components of the system.

C. Warranty Period

1. Windows: Three years from date of substantial completion.

2. Glazing: Five years from date of substantial completion.

3. Metal Finish: Fifteen years from date of substantial completion.

4. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

(1) Failure to meet performance requirements.

(2) Structural failures including excessive deflection, water leakage, and air infiltration.

(3) Faulty operation of movable sash and hardware.

(4) Deterioration of materials and finishes beyond normal weathering.

(5) Failure of insulating glass.

b. Warranty Period:

(1) Window: 10 years from date of Substantial Completion.

(2) Glazing Units: Five years from date of Substantial Completion.

**1.09 - REFERENCES**

A. American Architectural Manufacturers Association (AAMA):

1. 502: Voluntary Specification for Field Testing of Newly Installed Fenestration Products

2. 901: Voluntary Specification for Rotary & Linear Operators in Window Applications

3. 902: Voluntary Specification for Sash Balances

4. 907: Voluntary Specification for Corrosion Resistant Coatings on Carbon Steel Components

5. 2605: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

B. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures - Includes Supplement No. 1

C. ASTM International (ASTM):

1. C1036: Standard Specification for Flat Glass

2. D3656: Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

3. E405: Standard Test Methods for Wear Testing Rotary Operators for Windows
4. E1886: Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
5. E1996: Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
6. E2112: Standard Practice for Installation of Exterior Windows, Doors and Skylights
7. E2190: Standard Specification for Insulating Glass Unit Performance and Evaluation

D. Forest Stewardship Council (FSC):

1. STD-01-001: FSC Principles and Criteria for Forest Stewardship
2. STD-40-004: FSC Standard for Chain of Custody Certification

E. National Wood Window and Door Association (NWWDA):

1. I.S. 2: Wood Window Units

F. Screen Manufacturer's Association (SMA):

1. 1201: Insect Screens For Windows, Sliding Doors, And Swinging Doors

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - PREINSTALLATION MEETINGS**

A. Preinstallation Conference: Conduct conference at Framingham, MA.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

**1.11 - PROJECT/SITE CONDITIONS**

A. Protection: Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

1. Do not install aluminum windows and frames until all work that could damage aluminum window and frame systems has been completed.
2. Provide temporary closures until construction sequencing allows installation of aluminum window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the work specified herein.

C. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Working Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

## PART 2 - PRODUCTS

### 2.01 - WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: LC.

2. Minimum Performance Grade: 25.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x degrees F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

F. Outside-Inside Transmission Class (OITC): Rated for not less than 30 OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.

G. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.

### 2.02 - MANUFACTURERS

**A.** Aluminum Double Hung Windows:

1. Crystal Window and Door Systems, Ltd.

2. Superior Window Company.

3. Wojan Windows.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

### 2.03 - ALUMINUM WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Double hung.

2. Fixed.

B. Frames and Sashes: Aluminum.

1. Exterior Finish: Aluminum.

a. Color: As selected by Engineer from manufacturer's full range.

2. Interior Finish: Manufacturer's standard colors/finishes.

a. Color: As selected by Engineer from manufacturer's full range.

C. Insulating-Glass Units: ASTM E2190, certified through IGCC as complying with requirements of IGCC.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.

b. Kind: Fully tempered.

2. Lites: Two.

3. Filling: Fill space between glass lites with argon.

4. Low-E Coating: Pyrolytic on second surface.

5. Integral Louver Blinds: Glass manufacturer's standard, horizontal louver blinds with aluminum slats and polyester fiber cords, located in space between glass lites, and operated by hardware located on inside face of sash

   a. Operation: Tilt, raising, and lowering.

   b. Color: As selected by Engineer from manufacturer's full range.

D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

1. Dual Glazing:

   a. Interior Lite: Glass.

   b. Exterior Lite: Insulating-glass unit.

E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907 or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Engineer from manufacturer's full range.

F. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.

2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

**2.04 - ACCESSORIES**

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: Two per sash, permanently located at exterior and interior lites

2. Material: Manufacturer's standard.

3. Pattern: As indicated on Drawings

4. Profile: As selected by Engineer from manufacturer's full range.

B. Color: As selected by Engineer from manufacturer's full range

C. Horizontal Louver Blinds: Provide manufacturer's standard, removable, horizontal louver blinds with aluminum slats and polyester fiber cords that are operated by hardware located on inside face of sash.

1. Operation: Tilt, raising, and lowering.

2. Color: As selected by Engineer from manufacturer's full range.

**2.05 - INSECT SCREENS**

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

2. Finish for Interior Screens: Baked-on organic coating in color selected by Engineer from manufacturer's full range.

3. Finish for Exterior Screens: Matching color and finish of cladding.

4. Mesh Color: Manufacturer's standard.

C. Aluminum Wire Fabric: 18- by 16-inches mesh of 0.011-inch- diameter, coated aluminum wire.

1. Wire-Fabric Finish: Charcoal gray.

**2.06 - FABRICATION**

A. Fabricate aluminum windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 - INSTALLATION**

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

**3.03 - FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.

2. Air-Infiltration Testing:

a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.

b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.

b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Engineer and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.

5. Test Reports: Prepared according to AAMA 502.

C. Remove and replace noncomplying windows and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

**3.04 - ADJUSTING, CLEANING, AND PROTECTION**

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

**SECTION 08810**

**GLASS AND GLAZING**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 8, DOORS AND WINDOWS shall include the complete Work specified in all of the following Sections:

1. SECTION 08810, GLASS AND GLAZING

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of DIVISION 8, DOORS AND WINDOWS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 | 10 A-404 | 10 A-405 |
| 10 A-406 | 10 A-407 | 10 A-602 | 10 A-603 | 10 A-604 | 10 A-607 | |

2. The Work of DIVISION 8, DOORS AND WINDOWS for Alternative A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-401 |
| 20 A-601 | 20 A-602 | 20 A-603 | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

2. Subbid for: SECTION 08810, GLASS AND GLAZING

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and set glass required to complete glazing at interior windows as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's specification for glass and glazing materials and working drawings showing methods of glazing installation.

2. Samples:

a. Glass samples not less than 6 in. square.

b. Three properly labeled samples of each type of glass and glazing material for review.

3. Manufacturer's certification that materials meet or exceed specifications requirements.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver each pane of glass affixed with manufacturer's labels; do not remove labels prior to installation, inspection or final acceptance.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Fire-rated, clear and wireless glazing material for use in locations such as doors, sidelites, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45 minutes to 2 hours with required hose stream test; for use in interior and exterior applications

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Requirements of Regulatory Agencies: Provide glass installation meeting requirements of applicable state and local codes.

C. Design Criteria:

1. Exterior Glass and Glazing:

a. Provide exterior glass and glazing capable of withstanding wind loads as specified.

b. Provide watertight glass and glazing systems.

D. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 degrees F (250 degrees C), and the fire-resistance rating in minutes

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. Z97.1: Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

B. American Society for Testing and Materials (ASTM) Publications:

1. C1036: Specification for Flat Glass.

2. C1048: Specification for Heat Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

3. C1172: Specification for Laminated Architectural Flat Glass.

4. E773/774: Specification for Sealed Insulating Glass Units.

C. ASTM E 119: Fire Tests of Building Construction and Material

D. National Fire Protection Association (NFPA)

1. NFPA 80: Fire Doors and Window

**1.09 - JOB CONDITIONS**

A. Apply glazing compounds on dry surfaces, at temperatures above 40 degrees F.

## PART 2 - PRODUCTS

### 2.01 - GLASS MATERIALS

A. General:

1. Safety glass conforming to ASTM C1048 and ANSI Z97.1.
2. Glass Thickness:
    a. Provide glass thicknesses as specified unless accepted glass manufacturer recommends greater thickness to meet windload requirements.
    b. Provide glass in adjacent windows or glazed panels of same thickness unless shown otherwise.

### 2.02 - GLASS TYPES

A. Exterior Insulating Glass Units:

1. 1/4-in. float glass.
2. Solar control low-e type.
3. 1-in. overall thickness of unit.
4. Low-e coating to be applied to the number two (2) surface for clear windows.
5. Winter night time u-value equal to or less than .29.
6. Clear class with visible light transmission of 69%.

B. Interior Glass Units:

1. Laminated Safety Glass:
    a. 1/4-in clear laminated glass conforming ASTM C1036 and C1172, Type 1 – Flat.
    b. Construction shall consist of two sheets of 1/8-in. thick, clear floatglass bonded to interlayer of polyvinyl butyral plastic sheeting.
    c. Glazing: Conform to glass manufacturer’s printed instructions with regard to sealant, setting blocks, glazing tapes and heel beads.
2. Fire-resistive glazing products.
    a. Products:
        (1) Basis of Design: Oldcastle Glass, Inc.; Pyroguard
        (2) Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated
    b. Fire-Protection-Rated Glazing: Glass Type: 90-minute fire-rated glazing; film-faced ceramic glazing or laminated ceramic glazing. Provide safety glazing labeling OH-90
    c. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

### 2.03 - GLAZING SYSTEM COMPONENTS FOR METAL WINDOWS

A. Provide glazing tape, heel bead sealant, removable snap-on metal glazing bead. Furnish components in color approximating window finish.

**2.04 - ELASTIC GLAZING COMPOUND**

A. Channel Glazing and Face Glazing Manufacturers:

1. 795 manufactured by Dow.
2. 895 manufactured by Pecora Corporation.
3. Spectrum 2c manufactured by Tremco Manufacturing Co.
4. Or acceptable equivalent product.

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Check openings and glazing channels scheduled to receive glass: Free of projections, burrs, irregularities, and debris and other defects that would affect glass or plastic and glazing materials.

B. Inspect glass for edge damage or face imperfections.

C. Correct defects before glazing.

**3.02 - PREPARATION**

A. Examine frames receiving glass or plastic sheet to ensure if clean and dry.

B. Verify sealants are compatible with glazing materials.

C. Remove oil and dust from glass and plastic materials by wiping clean immediately prior to installation.

D. Use solvents to remove protective coatings or film from aluminum surfaces, that neither etches nor mars surfaces.

**3.03 - GLAZING**

A. General:

1. Conform to Flat Glass Marketing Association's "Glazing Manual", manufacturer's recommendations and accepted working drawings.
2. Do not glaze when temperature is below 40 degrees F.
3. Glaze doors and operating windows in closed position.
4. Maintain edge clearance, in accordance with manufacturers recommendation, from perimeter of glass to inside of rabbet.
5. Maintain minimum 1/8-in. clearance between faces of glass and plastic and adjacent stop or bead.
6. If any glass dimension exceeds 50 inches, provide setting blocks at the sill and spacer shims on other edges.
7. Clean and dry glazing rabbets, glass edges, and applied stops before glazing.
8. Glaze windows neatly and evenly.
9. Do not extend glazing tapes and glazing compounds over edges of glazing stops.
10. Do not apply glazing tapes and glazing compounds more than 1/32 in. under edges of glazing stops.

B. Vision Panels:

1. Double glazed with applied glazing beads and elastic glazing compound.
2. Minimum edge clearance of glass: 1/4-in. all around.
3. Minimum face clearance of glass: 1/8-in. from sash rabbet, all around.

**3.04 - GLASS REPLACEMENT**

A. Replace broken, scratched or damaged glass due to faulty materials or installation with new glass, at no additional cost to the Owner.

**3.05 - PROTECTION**

A. Protect installed glass and plastic against breakage, damage from sandblasting, welding spatter or other sources.

**3.06 - CLEANING**

A. Clean glass and surrounding surfaces of spatter and blemishes resulting from glazing operations.

B. Prior to final acceptance clean and polish lights inside and outside.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09300**

**TILE WORK**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 9, FINISHES shall include the complete Work specified in all of the following Sections:

1. SECTION 09300, TILE WORK

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 09300, TILE WORK is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-104 | 10 A-301 | 10 A-408 | 10 A-409 | 10 A-601 |
| 10 A-602 | 10 A-605 | 10 A-606 | 99 A-607 | 00 M-001 | 10 M-104 | 10 M-107 |
| 99 M-501 | 99 M-502 | 00 P-001 | 00 P-002 | 10 P-103 | 10 P-104 | `10 P-105 |
| 10 P-106 | 10 P-107 | 10 P-108 | 10 P-109 | 99 P-501 | 99 P-502 | 00 E-001 |
| 10 E-202 | 10 E-205 | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 09300, TILE WORK

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified

**1.01 - SCOPE**

G. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Modular Tile as specified herein and/or as shown on the Contract Drawings.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS:

B. Product data for each item specified, including installation instructions.
Samples: Submit representative samples of tile specified or proposed for use to Engineer/Architect for review and tests before materials are purchased. Materials delivered shall conform to submitted samples, subject to normal variation for quality of product specified.

C. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

D. Submittals required under this section include, but are not limited to the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in tiles.

2. tile type, color, and dye lot.

3. Type of subfloor.

4. Type of installation.

5. Pattern of installation.

6. Pattern type, location, and direction.

7. Type, color, and location of insets and borders.

8. Type, color, and location of edge, transition, and other accessory strips.

9. Transition details to other flooring materials.

E. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Tile: Full-size Sample.

2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.

F. Product Schedule: For tile. Use same designations indicated on Drawings.

G. Certificate of Compliance:

1. Submit certified test reports that modular tile meets all the performance requirements stated in paragraph 1.5 Performance Requirements. Submit certified test reports from a NVLAP Certified Lab that tile meets all performance criteria.

H. Qualification Data: For Installer.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

J. Maintenance Data: For tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

2. Precautions for cleaning materials and methods that could be detrimental to tile.

K. Warranty: Special warranty specified in this Section.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with Section 01610 and as specified

B. Deliver materials in manufacturer's original sealed container bearing standard grade-seal in accordance with ANSI A137 and with seals unbroken.

C. Deliver dry-set mortar in sealed, moisture proof containers.

D. Handle tile in manner to prevent chipping and breakage.

E. Store materials away from moisture and under cover in manner to prevent damage or contamination.

F. Extra stock:

1. For replacement and maintenances purposes, furnish, and deliver to Owner's maintenance department, additional ceramic tile materials of each size, color, pattern and type from same runs as actually used on job and in quantities as follows.

2. Not less than 5 percent of total amount used.

G. Provide sufficient amount of mortar and grout materials for proper installation of extra stock

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

C. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648, Class 1, by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

D. Mockups: Before installing tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

E. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to review methods and procedures related to tile installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.

2. Review ambient conditions and ventilation procedures.

**1.08 - WARRANTY**

A. Special Warranty for Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, more than 10 percent loss of bind strength, dimensional stability, excess static discharge, and delamination.

3. Warranty Period: From date of Substantial Completion - Lifetime limited stain warranty, lifetime limited modular warranty, lifetime limited colorfastness to light warranty, lifetime static warranty, 10 year limited colorfastness to atmospheric contaminants, and 10 year stain warranty.

**1.09 - REFERENCES**

A. ANSI A108.1: Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed with Portland Cement Mortar.

B. ANSI A108.4: Installation of Ceramic Tile with Organic Adhesives or Water Cleanable.

C. ANSI A108.5: Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

D. ANSI A118.1: Dry-Set Portland Cement Mortar Standard.

E. ANSI A137.1: Specification for Ceramic Tile.

F. ASTM C144: Specification for Aggregate for Masonry Mortar.

G. ASTM C150: Specification for Portland Cement.

H. ASTM C206: Specification for Finishing Hydrated Lime.

I. ASTM C207: Specification for Hydrated Lime for Masonry Purposes.

J. TCA, Tile Council of America, Inc

**1.10 - PROJECT CONDITIONS**

K. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

L. Environmental Limitations: Do not install tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

M. Do not install tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by tile manufacturer.

N. Where demountable partitions or other items are indicated for installation on top of tiles, install tiles before installing these items.

**1.11 - EXTRA MATERIALS**

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile: Full-size units equal to 5 percent of amount installed for each type indicated.

**PART 2 - PRODUCTS**

**2.01 - TILE (CPT)**

A. Glazed Ceramic Wall Tiles: Standard-grade, cushion-edged, 4-1/4-in. square, 5/16-in. thick, nonvitreous body, glaze tiles. Tile shall exhibit no cracking or crazing when subjected to standard autoclave (accelerated steam) test. Colors will be selected by Engineer. Provide surface bullnoses and other special shapes for thin-setting bed installation to produce a complete, neatly finished installation, as indicated on drawings.

B. Ceramic Mosaic Floor Tile: Standard grade, dust-pressed, unglazed porcelain type, cushion edged, and paper back-mounted or paper face-mounted. Tiles shall be approximately ____ by ____ by 1/4-in. thick. Colors will be selected by Engineer. Tile shall show no staining when subjected to attack by N/10 acids, alkalies, or organic.

C. Quarry Tile: 6-in. by 6-in. by 1/2-in. thick standard grade tile made from shale by the extrusion process, free from warpage, cupping or other distortions. Color selected by Engineer. Score backs of tiles and grind tile to size after firing. Acceptable manufacturers: American Olean Tile Co.; Summitville Tiles, Inc.; or an acceptable equivalent.

D. Portland Cement (including white portland cement): Conform to requirements of ASTM C150.

E. Hydrated Lime: Conform to requirements of ASTM C206 or ASTM C207.

F. Sand for Mortar Setting Beds: Conform to requirement of ASTM C144.

G. Clevage membrane: 15-lb. roofing felt or 4 mil polyethylene film.

H. Reinforcing: 2-in. by 2-in. by 16/16 gage welded wire mesh.

I. Dry-Set Portland Cement Mortar (for setting ceramic floor tile): Bear hallmark of TCA, (Tile Council of America, Inc.) and conform to ANSI A118.1.

J. Organic Adhesive (for setting ceramic wall tile); Bear hallmark of TCA (Tile Council of America) and conform to ANSI A136.1.

K. Grout (for glazed ceramic wall tiles): Manufacturer's prepared white, dry-set portland cement grout containing additives to produce proper curing and develop satisfactory hardness and bond in joints between dry tile.

**2.02 - INSTALLATION ACCESSORIES:**

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed tile and is recommended by tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

C. Miscellaneous Materials: As recommended by manufacturer to complete installation.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting tile performance. Examine tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.

2. Subfloor finishes comply with requirements specified in DIVISION 3, CONCRETE, SECTION CAST-IN-PLACE CONCRETE for slabs receiving tile.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 – INSTALLATION OF GLAZED CERAMIC WALL TILES**

A. Install on concrete floor slabs using dry-set mortar method. Install tiles in strict accordance with ANSI A108.5. Apply in strict accordance with manufacturer's instructions.

B. Clean surface to receive tile of all dust, dirt, and other particles, and leave in suitable condition to receive ceramic floor tile. Tile setter: Inspect and approve subfloor before beginning installation.

C. (NTS: Use the following paragraph for tile floors over structural concrete subfloors subject to bending and deflection.)

D. Apply cleavage membrane and reinforced cement mortar setting bed over structural concrete subfloors, supporting reinforcing mesh so that it will be approximately in middle of bed.

E. Mortar Setting Bed: One part portland cement to six parts of damp sand by weight; it may not contain more than one-tenth of hydrated lime. Do not make mortar setting bed under 3/4-in. or over 1-1/4-in. thick. Firmly tamp and screed level, maintaining proper slope to drains.

F. Set ceramic floor tile and grout in a first-class manner by mechanics experienced in such work using materials recommended by manufacturer and in strict accordance with recommendations of TCA, (Tile Council of America, Inc). Set tiles with edges true and square and parallel to walls of room. Lay borders and defined lines before field or body of floor. Form all intersections and returns accurately and fit tiles closely and neatly at all plumbing fixtures, pipes, and fittings so that coverplates or escutcheons will overlap tiles properly. Secure all tiles firmly in place, and remove loose tiles, or tiles sounding hollow when rapped, and replace.

G. Firmly beat sheets of mounted tiles into mortar and bring surface to a true plane at proper elevations. Complete beating and leveling within one hour after placing of sheets. Within one hour after installation of sheets, if paper face-mounted, remove paper and glue by wetting without using excess water. At this time, adjust all tiles out of line.

H. Mix a neat cement paste of white portland cement with water to a creamy mixture, and brush into joints. Completely fill joints flush with surface of tiles. Clean off all excess grout with clean burlap bags or other cloths. Before grout sets, fill in all skips and gaps.

**3.03 INSTALLATION OF QUARRY TILE:**

A. Set quarry tile in a first class manner and in accordance with ANSI A108.1, using materials recommended by manufacturer. Press tiles firmly into position and properly beat in or vibrate to obtain proper contact on back. Grout quarry tile in same manner as ceramic floor tile.

**3.04 CLEANING AND CURING:**

A. Thoroughly sponge and wash all completed tile work, working diagonally across joints, and finally polish with clean dry cloths. Acid clean unglazed tiles only when necessary and not until 10 days after setting tiles. Wet tiles with clean water before cleaning with a 10 percent muriatic-acid solution. After acid cleaning, flush tiles thoroughly with clean water.

B. Cure floor tiles by keeping them damp at least three days, and during this time do not permit any traffic on tiles.

**3.05 PROTECTION:**

A. Cover finished tile floors with clean building paper before foot traffic is permitted on them. Place board walkways on floors that are to be used as passageways by workmen

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16998**

**FIELD INSPECTION AND ACCEPTANCE TESTS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Field Inspection and Acceptance Tests as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.

2. Submit data sheets for the insulation resistance testing of conductors and motors prior to performing operating testing. List all cables and motors to be tested.

3. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.

4. After completion of the testing, submit all test results with observed notes and recommendations.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated 1.08 - REFERENCES

B. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.

1. National Electrical Manufacturer’s Association – NEMA

2. American Society for Testing and Materials – ASTM

3. Institute of Electrical and Electronics Engineers – IEEE

4. InterNational Electrical Testing Association – NETA – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD).

5. American National Standards Institute – ANSI:
    a. ANSI C2: National Electrical Safety Code
    b. ANSI Z244-1: American National Standard for Personnel Protection
6. State and Local Codes and Ordinances
7. Insulated Cable Engineers Association – ICEA
8. Association of Edison Illuminating Companies – AEIC
9. Occupational Safety and Health Administration:
    a. OSHA Part 1910; Subpart S, 1910.308
    b. OSHA Part 1926; Subpart V, 1926.950 through 1926.960
10. National Fire Protection Association – NFPA:
    a. ANSI/NFPA 70B: Electrical Equipment Maintenance
    b. NFPA 70E: Electrical Safety Requirements for Employer Workplaces
    c. ANSI/NFPA 70: National Electrical Code
    d. ANSI/NFPA 780: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

C. All inspections and tests shall utilize the following references:
1. Project Design Specifications
2. Project Design Drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus

**1.09 - DESCRIPTION**

A. Provide field inspections and acceptance testing as specified herein.

B. After electrical installation is complete, (a) adjust and set all protective devices (in accordance) with results of electrical studies, (b) perform tests to demonstrate that the entire system is in working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Test shall be performed per InterNational Electrical Testing Association (NETA): Acceptance Testing Specification for Electrical Power Distribution System and Equipment (STD). Tests are in addition to, and not a substitution for, tests of individual items at the manufacturer's facilities. Perform insulation and ground resistance tests before operating tests. Determine proper rotation of motors before permanent connections are made.

C. Tests are also intended to accomplish the following:
1. Provide initial acceptance tests and recorded data.
2. Ensure a successful start-up with a minimum of last minute interruptions and problems.
3. Determine the suitability of the equipment and systems for energizing and placing into operating service.
4. Ensure that each system component is installed satisfactorily, will perform and will continue to reliably perform its function.

D. Provide all necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation.

E. Engage the services of a nationally recognized Independent Electrical Tester to perform the required field inspections, test, and adjustments specified. The Independent Electrical Tester shall meet the following qualifications:

1. The testing firm is not to be a subsidiary, division, or department of the Contractor performing the work of Division 16.
2. The testing firm is not to be subsidiary, division, or department of the manufacturer of the equipment, materials or systems being inspected or tested.
3. The testing firm shall perform all testing in accordance with International Electrical Testing Association, Inc. (NETA), standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by a Registered Professional Electrical Engineer. Test results shall indicate recommended action for sub-par test results. Results shall list recommended test values that should be obtained for a new installation.
4. Testing and checkout work shall be performed with personnel skilled and trained in the particular tests being conducted.
5. Evidence of the proposed testing firm's qualifications, accreditation, and experience shall be submitted for evaluation. Testing firm shall be member of NETAwith minimum of five years of testing industrial electrical systems to NETA requirements and procedures.

F. The Independent Electrical Testing Contractor shall provide supervision, labor, materials, tools, test instruments, or other equipment, and services, required to adjust, set, calibrate, and test operate the components of the various electrical systems and circuits throughout the installation, the construction package, and as specified herein.

G. Perform these tests after the electrical installation is complete. These tests shall demonstrate that the entire electrical system is in proper working order and in accordance with: applicable codes; and the supplier's instructions, drawings, and specifications.

H. Testing by the Independent Electrical Tester in no way changes the requirements to perform the specified tests, checkouts, and inspections required under the equipment specification sections.

I. The listings and descriptions of the tests, and checks described herein is not to be considered as complete and all inclusive.

J. Retests required by defects and failures of equipment to meet specifications shall be conducted at no additional cost.

1. Replace wiring and equipment found to be defective, or failing to meet specified requirements, at no additional cost.
2. Supply electric current necessary for tests.

K. Where specified in other Division 16 sections, perform work under the supervision of factory trained technicians, representing the equipment being tested or inspected.

**1.10 - SCHEDULING**

A. The Contractor is responsible for the preparation of proposed procedures, testing and inspection forms, and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work to be coordinated and to be compatible with the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and NETA approved check out forms for the review. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks.

B. Prior to check out and testing for start-up, verify that all equipment and wiring is permanently identified with nameplates and tags. Check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions. Make routine checks and tests as the job progresses to verify that all wiring and equipment are properly installed.

C. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act
2. Accident Prevention Manual for Industrial Operations, National Safety Council

3. Applicable state and local safety operating procedures
4. Owner's safety practices
5. National Fire Protection Association
6. American National Standards for Personnel Protection

D. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

E. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

F. Ensure that all testing and checkout work is conducted in a safe manner. Special safety precautions such as the following to be utilized where appropriate:

1. Locking and tagging procedures
2. Barricades
3. De-energization and/or isolation of equipment prior to testing
4. Review of procedures with site personnel
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

G. Report all inspections, tests, and calibration in writing on NETA approved report forms. The recorded data from shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall serve as the test and inspection checklist for inspection requirements. Submit all test and check out data in accordance with SECTION 01300, SUBMITTALS prior to adjustments, repairs, drying out, or similar work prior to final testing and acceptance. "As-found" and "as-left" test data to be recorded and reported in writing.

H. Sequence tests and checks such that the equipment can be energized immediately after the completion of the applicable tests.

**PART 2 - PRODUCTS**

**2.01 - TESTING EQUIPMENT**

A. Calibration:

1. All calibration and setting checks by the Independent Electrical Test shall be performed with the laboratory's calibrated test instruments. This test equipment to have calibrations traceable to the National Bureau of Standards. The Independent Electrical Tester dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. All testing instruments shall be checked to verify satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.
2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

**2.02 - TESTING**

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are ensure that systems are energized when required, loads applied, and other requirements are carried out on timely, coordinated basis.

2. Conduct tests in presence of the Owner's representative. Provide ten calendar days or more advance notification of when any test is to be performed.

3. Conduct testing such that warranties or guarantees are not voided. Coordinate all testing with manufacturer's factory trained technicians, where applicable. Where specified tests are not compatible with the manufacturer's recommendations, obtain the manufacturer's review prior to testing. Permit witnessing by the manufacturer's representative if so requested.

B. Preparation:

1. Make up no low voltage connections at service entrance, transformers, motors, switchboard and motor control centers, permanently until correct phase rotation of all equipment is determined. Install and insulate these connections temporarily, if necessary, while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

**PART 3 – EXECUTION**

**3.01 - INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS**

A. Independent Electrical Testing:

1. The Independent Electrical Tester shall perform all inspections and testing as specified herein.

B. List each circuit and measured resistance as test data.

C. Maintain records of all insulation resistance values. Identify conductor, or equipment, date that value was taken, and resistance value. Submit the information in neat tabular forms.

**3.02 - SPECIFIC TESTS AND INSPECTIONS**

A. General:

1. The following specific items or work shall be performed by the Independent Electrical Tester. The equipment and cable shall be de-energized and isolated as necessary to perform the tests.

2. Perform tests and inspections as specified throughout Division 16. Tests and inspections required by these sections are not necessarily repeated under this section.

3. Provide assistance as requested by the Independent Electrical Tester in performing its work.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Motors:

a. Visually inspect the motor for any physical damage.

b. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.

c. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

2. Grounding Systems:

   a. All main plant building loops and major equipment grounds to be tested to remote earth or directly referenced to an extremely low resistance (3 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds to be made to determine the adequacy and integrity of the grounding. All ground testing results to be properly recorded, witnessed, and submitted.

   b. Ground tests shall be performed in accordance with NETA using a J. G. Biddle Company low resistance, Null balance type, ground testing ohmmeter, and test lead resistance compensated for. The test instrument to be the type, which compensates for potential and current rod resistances.

   c. Test entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 3 Ohms.

3. Outdoor Pad Mounted Transformer:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

4. Low voltage Switchboard:

   a. At the time of equipment receipt, visually inspect the equipment for any damage or defects. Coordinate inspections with factory-trained technicians.

   b. Energize heaters for prolonged storage, if required.

   c. Perform complete inspections and electrical tests in accordance with SECTION 16366, LOW VOLTAGE SWITCHBOARDS and NETA.

5. Circuit Breakers – Low Voltage:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with NETA.

6. Motor Control Centers:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS and NETA.

7. Dry-Type Transformers:

   a. All 480 volt primary, air-cooled, transformers shall be given an insulation test, by means of a megger, after connections with the primary cables are complete. The supply cable shall be meggered with the primary winding and to the open air circuit breaker. Secondary leads may be meggered with the secondary windings to the open load breakers.

   b. Check continuity and correctness of connections of all windings and ratings.

   c. Perform inspection checks, and electrical tests in accordance with NETA.

8. 600 VAC Wire and Cable:

   a. Before energizing, the continuity and insulation resistance of all wiring shall be measured with a megger from each wire to all others and to ground.

   b. All cables and wires to be checked for proper identification numbering and/or color coding.

   c. Perform inspection checks and electrical tests in accordance with NETA.

9. Overhead Conduit Systems:

   a. The overhead conduit system to be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

      (1) Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).

      (2) Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.

      (3) Conduits are routed as far away from possible fire hazards and heat sources as practical.

      (4) Conduits are supported at the required intervals.

      (5) Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.

      (6) Number of bends in the conduit does not exceed NEC requirements without a pull box installed.

      (7) Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.

      (8) Conduits are terminated in threaded hubs or bushings to prevent damage to wire.

      (9) Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.

      (10) Pull fittings are of adequate size such that cable can be installed and replaced at a later date without bending the cable less than code or manufacturer's requirements.

      (11) Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.

      (12) Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.

      (13) Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

10. Panelboard electrical checks to be as included in the Wire and Cable section of this specification. Panelboards to be checked for proper circuit identification on the door schedule.

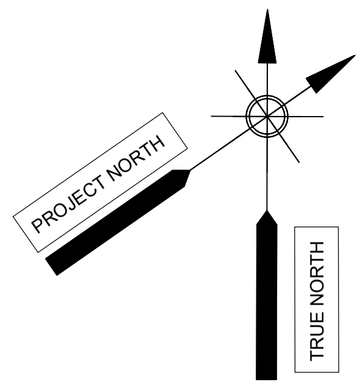
11. Sealing of Openings: Inspect the entire job to insure that all openings and holes provided or utilized are properly sealed as specified.

12. Where referenced NETA Standards indicate optional testing, perform these tests as described.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**



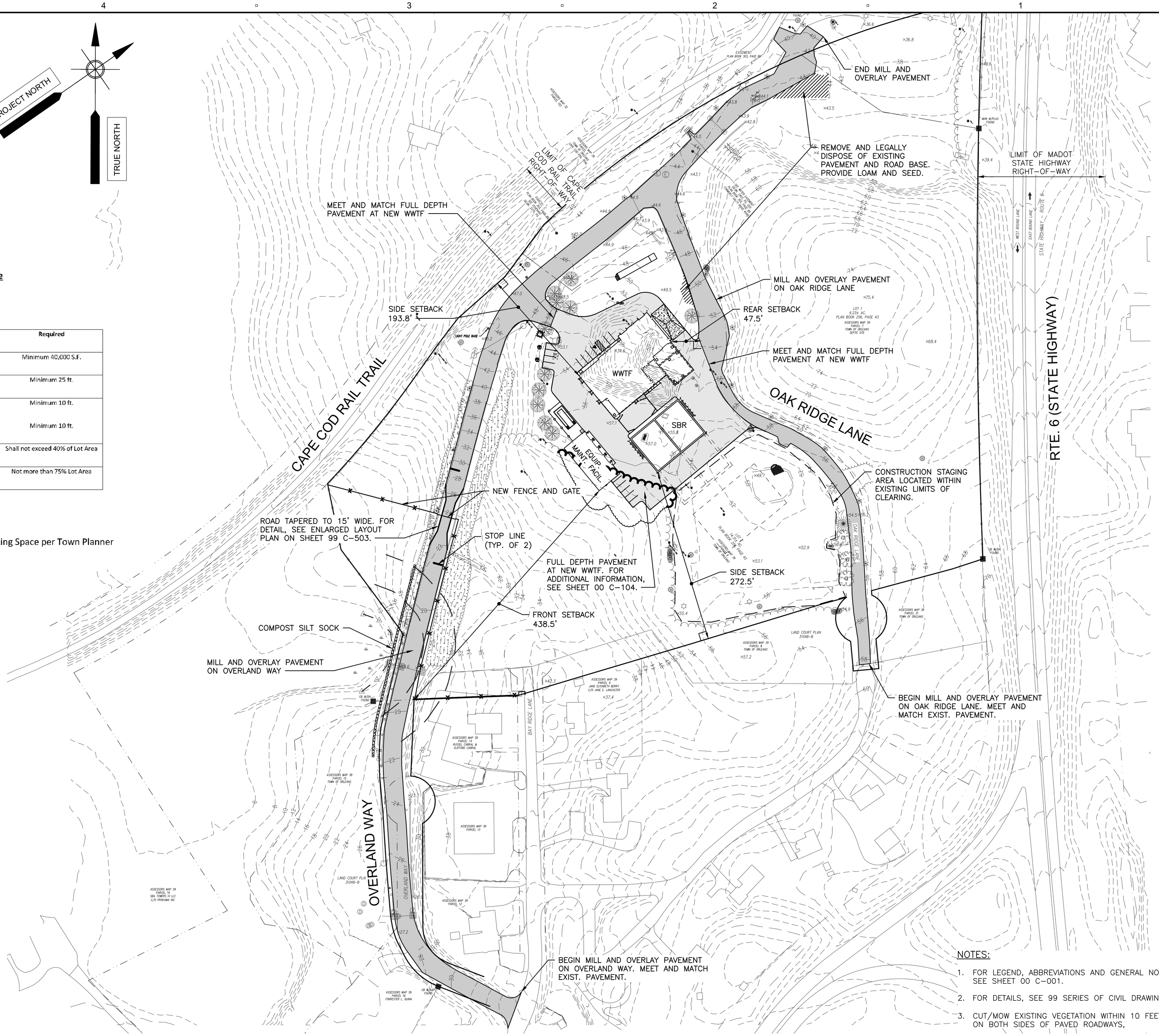

## Zoning Compliance Table

**Zoning District: GB**
**Use: Municipal**

| | Proposed | Required |
|---|---|---|
| **Lot Area (Upland)** | 158,919 S.F. | Minimum 40,000 S.F. |
| **Setback - Front Yard** | 438.5 ft. | Minimum 25 ft. |
| **Setback - Side Yard** | 193.8 ft. | Minimum 10 ft. |
| **Setback - Rear Yard** | 47.5 ft. | Minimum 10 ft. |
| **Floor Area Ratio** | 14,363 S.F./617,681 S.F. *100 = 2.3% | Shall not exceed 40% of Lot Area |
| **Impervious Surface** | 95,615 S.F./617,681 S.F. *100 = 15.5% | Not more than 75% Lot Area |

Parking Requirements:

Employees Maximum Shift: 6
15 Parking Spaces Provided Including One Van Accessible Parking Space per Town Planner Direction.




## PLAN

SCALE: 1"=80'

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE 99 SERIES OF CIVIL DRAWINGS.
3. CUT/MOW EXISTING VEGETATION WITHIN 10 FEET ON BOTH SIDES OF PAVED ROADWAYS,

1" = 80' — 0 — 80 — 160 — 240 — SCALE FEET

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
THOMAS E. PARECE
CIVIL
No. 34463
REGISTERED PROFESSIONAL ENGINEER

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| | | |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | T. LAFFER |
| Drawn By: | Z. BANKOVIC |
| Dept Check: | C. BENZIGER |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

CIVIL

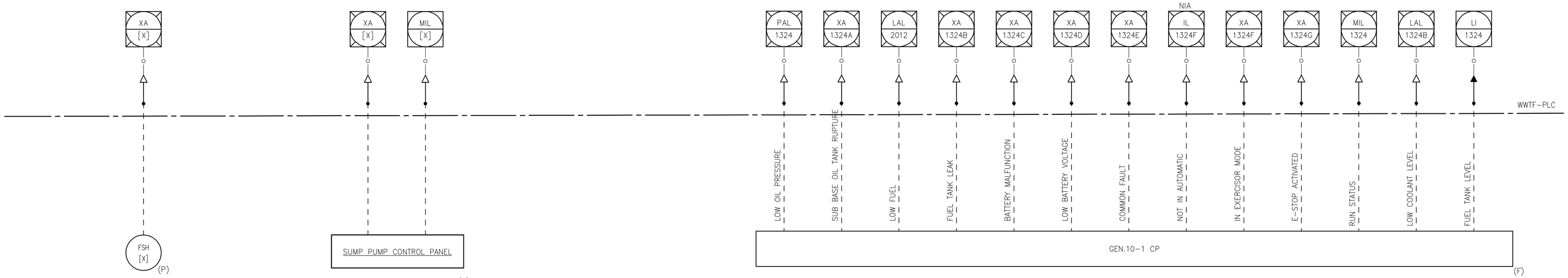
**SHEET TITLE**

**PAVEMENT PLAN AND ZONING COMPLIANCE**

**SHEET NUMBER**

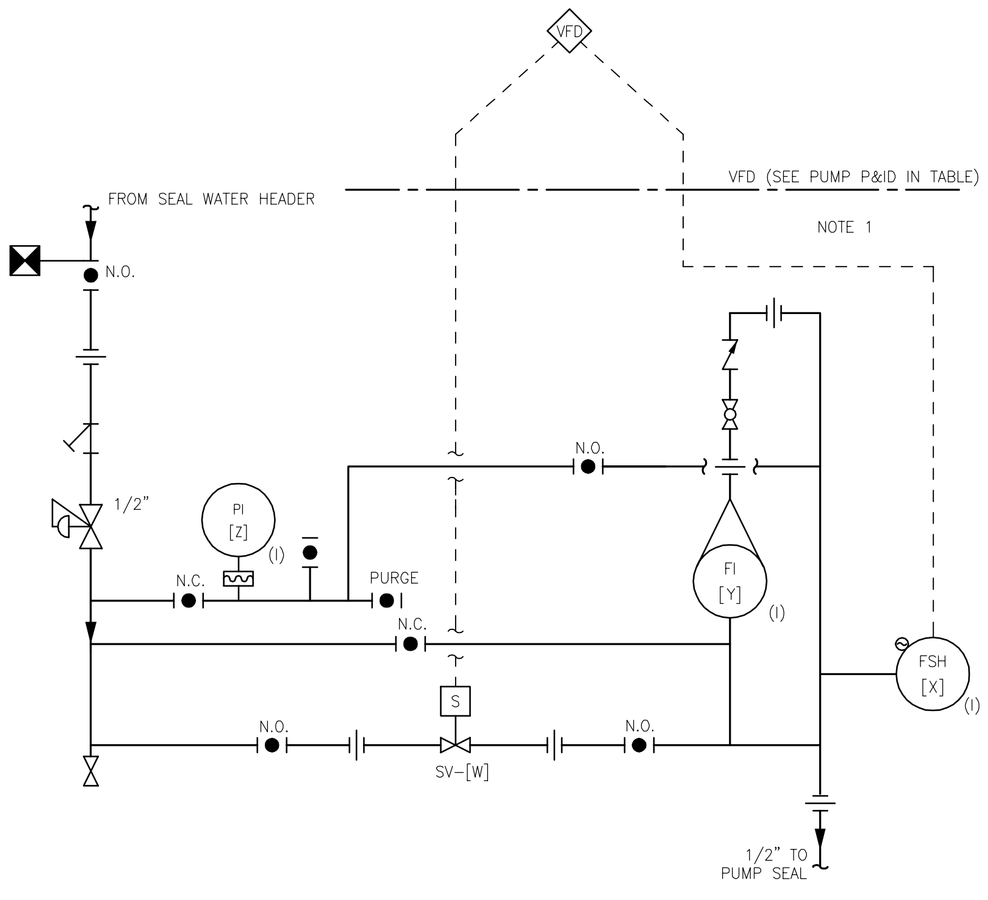
**00 C-108**

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\C00 C-108.DWG
LAST UPDATE: Tuesday, January 28, 2020 1:50:43 PM
PLOT DATE: Wednesday, February 12, 2020 6:39:23 AM




| TAG [X] | FIXTURE | LOCATION |
|---|---|---|
| FSH 1321A | EWS-1 | TRUCK BAY/SEPTAGE RECEIVING |
| FSH 1321B | EWS-2 | SODIUM HYPOCHLORITE/PACL ROOM |
| FSH 1321C | EWS-3 | LABORATORY |
| FSH 1321D | EWS-4 | POLYMER ROOM |
| FSH 1321E | EWS-5 | SODA ASH ROOM |
| FSH 1321F | EWS-6 | DISK FILTER ROOM |

| TAG | LOOP [X] | LOCATION |
|---|---|---|
| 10-SP-1/1A | 1322A | |
| 10-SP-2/2A | 1322B | |
| 10-SP-3 | 1322C | |




SEAL WATER PANEL

| TABLE OF SEAL WATER INSTRUMENTS | | | | | | |
|---|---|---|---|---|---|---|
| PUMP | SHEET | SOLENOID [W] | FLOW SWITCH [X] | ROTAMETER [Y] | PRESSURE GAUGE [Z] | LOCATION |
| SBR.TP-1 | 10 DI-603 | SV-1011 | FSH 1011 | FI 1011 | PI 1011C | MCC.10-1 |
| SBR.TP-2 | | SV-1012 | FSH 1012 | FI 1012 | PI 1012C | |
| SBR.TP-3 | | SV-1013 | FSH 1013 | FI 1013 | PI 1013C | |
| TSL.P-1 | 10 DI-615 | SV-1171 | FSH 1171 | FI 1171 | PI 1171C | |
| TSL.P-2 | | SV-1172 | FSH 1172 | FI 1172 | PI 1171C | |

| TABLE OF RESPONSIBILITY - ELECTRICAL, GENERAL, AND SYSTEM INTEGRATOR | | | | |
|---|---|---|---|---|
| | ELEMENT | GENERAL CONTRACTOR | SYSTEM INTEGRATOR | ELECTRICAL CONTRACTOR |
| 1 | FURNISH, TEST AND CALIBRATE INSTRUMENTS | | X | |
| 2 | INSTALL INSTRUMENTS | X | | |
| 3 | INSTALL FIELD LOCATED DEVICES ASSOCIATED WITH INSTRUMENTS INCLUDING TRANSMITTERS, INDICATORS, CONTROL PANELS, AND ANCIALLARY COMPONENTS THAT ARE NOT LOCATED WITHIN PROCESS PIPING AND TANKS. LOCATIONS SHALL BE AS INDICATED ON THE ELECTRICAL DRAWINGS. | X | | |
| 4 | FURNISH NETWORK EQUIPMENT, SCADA THIN CLIENT WORKSTATIONS/ENCLOSURES | | X | |
| 4 | FURNISH AND INSTALL INTERCONNECTING WIRE, CABLE, CONDUIT, AND CONNECTIONS FOR INSTRUMENTS | | | X |
| 5 | FURNISH AND INSTALL ETHERNET CABLES | | | X |
| 6 | FURNISH AND INSTALL FIBER OPTIC NETWORK CABLE | | X | |
| 7 | FURNISH AND INSTALL GAS MONITORING CONTROL PANELS, HORN STROBES AND ALARM DEVICES | | | X |
| 8 | FURNISH GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | X | | |
| 9 | INSTALL GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | | | X |

NOTES:

1. SEE 99 D-504 FOR ADDITIONAL SEAL WATER DETAILS.

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
SARAH PAPAZIAN
INSTRUMENTATION
No.52296
REGISTERED
PROFESSIONAL ENGINEER

Jan 24 2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| | | |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | S. PAPAZIAN |
| Drawn By: | S. PAPAZIAN |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

INSTRUMENTATION

**SHEET TITLE**

# MISC SIGNALS II AND TABLE OF RESPONSIBILITY

**SHEET NUMBER**

# 99 DI-602

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTP\SHEETS\DI\99 DI-602.DWG
LAST UPDATE: Monday, January 27, 2020 2:55:24 PM
PLOT DATE: Monday, January 27, 2020 2:59:59 PM

February 28, 2020

**ADDENDUM NO. 2**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 2 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 4 pages and 4 pages of attachments for a total of 8 pages.

**ATTACHMENTS**

1. SECTION 02445, VINYL FENCE

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. TABLE OF CONTENTS
   A. Page TOC-2, DIVISION 2 - EQUIPMENT, add “Section 02445, Vinyl Fence”.
   B. Page TOC-4, DIVISION 11 - EQUIPMENT, add “Section 11306, Prefabricated Low-Pressure Sewerage Pump Station”.
2. SECTION 00200, INSTRUCTIONS TO BIDDERS
   A. Page 00200-2, ARTICLE 1.01, RECEIPT AND OPENING OF BIDS, Paragraph B., delete the words “Any bid received from a bidder who did not attend the mandatory pre-bid conference will be returned to the applicant unopened. No exceptions will be made.” in its entirety.
   B. Page 00200-2, ARTICLE 1.01, RECEIPT AND OPENING OF BIDS, Paragraph F., delete the paragraph in its entirety and replace with the following new paragraph:
      F. A non-mandatory Pre-Bid Conference was held on February 20, 2020 at 9:00 am at the Town of Orleans, 19 School Road, Orleans, MA 02653. Refer to the attached Attendance List.

3. SECTION 00410, FORM OF GENERAL BID

   A. Page 00410-2, Paragraph 2, second sub-paragraph, delete the words "…the proposed work, attended the mandatory pre-bid conference, and…" and replaced with the words "…the proposed work and…".

4. SECTION 01500, TEMPORARY FACILITIES

   A. Page 00410-5, Article 3.09, Scaffolding, delete the article in its entirety and replace with the following new article:

      3.09 - SCAFFOLDING

      A. The Contractor shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of the work except for the work performed by the Filed Sub-Bid subcontractors.

      B. All Filed Sub-Bid subcontractors shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of their work.

      C. Neither the Engineer nor the Owner will act as an arbitrator on questions of whether the Contractor or any of his subcontractors shall furnish or remove scaffolding required for any portion of the work.

5. SECTION 02445, VINYL FENCE

   A. Add new SECTION 02445, VINYL FENCE as attached.

6. SECTION 02053, PAVING, CURBING, SIDEWALKS AND ROADWAYS

   A. Page 02053-4, Article 2.07, Paragraph A., delete the paragraph in its entirety and replace with the following new paragraph:

      A. Cement concrete for walks shall be of 5,000 psi compressive strength at 28 days and shall conform to Section M4.02.00 (air entrained) of the State Specifications.

7. SECTION 11308, RECESSED IMPELLER PUMPS AND APPURTENANCES

   A. Page 11308-12, Article 3.07, Paragraph B., delete subparagraph B.3 in its entirety.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. ADDENDUM No. 1

   A. Changes to the Contract Drawings, Item No. 5, delete the words "Add new DRAWING 99 DI-602 as attached." and replace with the words "Add new DRAWING 00 C-108 as attached."

2. DRAWING 00 G-002, INDEX OF DRAWINGS

   A. INSTRUMENTATION add "99 DI-602".

3. DRAWING 00 C-104, SITE LAYOUT PLAN - WWTF

   A. Delete the words "10' High White Vinyl Fence" in its entirety and replace with the words "10' High White Vinyl Fence. Fence shall have 5" x 5" (Heavy Wall) Posts, 3" x 3" Rails and 7/8" x 1-1/2" (Heavy Wall) Pickets."

4. DRAWING 00 D-003, PROCESS PIPING SCHEDULE

   A. Add the following new Pipe to the schedule:

| Legend | Service | System Design Conditions | | | |
|---|---|---|---|---|---|
| | | Temp. (Deg. F) | | Pressure (PSI) | |
| | | Oper. | Max. | Work. | Max |
| W1 | Municipal Water | 40 | 80 | 60 | 150 |

| Piping | | | | |
|---|---|---|---|---|
| Material | Diameter Range | Sch./Class | Lining/Coating | Joint Type |
| Ductile Iron | All | See Specs. | Cement | Flanges/Restrained Mechanical Joint |

| Insultation | | Valving | | |
|---|---|---|---|---|
| Type | Thickness (In.) | Block | Check | Throttling |
| --- | --- | Gate | --- | --- |

| Test Requirements | | | | Specs. Section Number | Remarks |
|---|---|---|---|---|---|
| Pressure (PSI) | Medium | Test Duration (Min.) | Leakage Allowance (See Notes) | | |
| 150 | Water | 60 | Zero | 02600 | --- |

5. DRAWING 10 DI-603, SLUDGE TRANSFER PUMPS P&ID

   A. Delete the words “Type III” and replace with the words “Type I”.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 2**

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**SECTION 02445**

**VINYL FENCE**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
1.07 - REFERENCES ..... 2
PART 2 - PRODUCTS ..... 3
2.01 - MATERIALS ..... 3
2.02 - COMPONENTS ..... 3
2.03 - GATES – Not Used ..... 3
PART 3 - EXECUTION ..... 4
3.01 - VERIFICATION OF CONDITIONS ..... 4
3.02 - INSTALLATION ..... 4
3.03 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary to furnish and install vinyl fence as specified herein and as shown on the drawings.

B. Attention is directed to the GENERAL INFORMATION and DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Materials brochures.
2. Fabric and post samples showing size, color, and finish.
3. Drawings showing height of fence, sizes and types of materials used for entire fencing system.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not to degrade quality, serviceability or appearance.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM):

1. D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
2. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
3. D638: Standard Test Method for Tensile Properties of Plastics.
4. D648: Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. General. Entire fence and gate system shall be white vinyl.

B. Materials of Construction

1. Cell classification as per ASTM D1784 - 14344B
2. Tensile Strength - 6,500 psi as per ASTM D638
3. Izod impact (ft. lbs/in notch) 23'C - 5.0 O'C - 2.0 - ASTM D256
4. Tensile modulus 425,000 psi as per ASTM D638
5. Deflection Temperature 67° C as per ASTM D648
6. Thermal expansion 3 x 10.5 in / in F

### 2.02 - COMPONENTS

| Component | Cross Section (inch) | Wall Thickness (inch) | Corner Radius (inch) |
|---|---|---|---|
| Posts | 4 x 4 | 0.140 | 11/32 |
| | 5 x 5 | 0.135 - Standard Wall | 3/8 |
| | 5 x 5 | 0.170 - Heavy Wall | 3/8 |
| Rails | 1 1/2 x 1 1/2 | 0.120 | 7/32 |
| | 1 3/4 x 3 1/2 | 0.100 | 13/32 |
| | 3 x 3 1/2 - 'T' Rail | 0.095 | 13/32 |
| | 2 x 6 - Hollow | 0.125 | 5/16 |
| | 1 1/2 x 5 1/2 - Ribbed | 0.090 | 11/32 |
| | 2 x 6 - Ribbed | 0.090 | 5/16 |
| | 3 x 3 | 0.110 | 5/16 |
| | 3 1/2 x 3 1/2 | 0.115 | 3/8 |
| Pickets | 7/8 x 1 1/2 | 0.060 | 3/16 |
| | 7/8 x 1 1/2 - Heavy Wall | 0.090 | 3/16 |
| | 7/8 x 3 | 0.060 | 3/16 |
| | 7/8 x 6 - Ribbed | 0.060 | 3/16 |
| | 7/8 x 7 - Tongue & Groove | 0.060 | 1/16 |
| | 1 1/2 x 1 1/2 | 0.060 | 7/32 |

### 2.03 - GATES – NOT USED

## PART 3 - EXECUTION

### 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

### 3.02 - INSTALLATION

A. Installation shall be made by skilled mechanics experienced in erection of this type of fence.

B. All posts shall be set in concrete foundations to a minimum depth of 48 inches. Diameter of the foundation shall be post O.D. plus 12-inches. The foundation shall be a 1-2-4 mixture of concrete and shall be 54 inches deep, minimum. All foundations shall extend approximately 1 inch above grade and shall slope away from the post to provide for proper drainage.

C. Line posts shall be spaced at a maximum of 10-foot intervals. Intermediate rails shall be used to brace end and gate posts to the adjacent line post, and corner posts to the 2 adjacent line posts. Changes in line of 30 degrees or more shall be considered corners.

D. All connections shall be in accordance with the manufacturer’s recommendations.

E. Any abraded areas of fence shall be replaced at no cost to the Owner.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

February 19, 2020

**ADDENDUM NO. 3**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 3 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 2 pages and 0 pages of attachments for a total of 2 pages.

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. ADDENDUM No. 2
   - A. Revise the Issue Date from “February 28, 2020” to “February 19, 2020”.
   - B. Changes to be Made to the Contract Specifications
     - a. Item 1., delete “EQUIPMENT” and replace with “SITE WORK” and delete “Sewerage” and replace with “Sewage”.
     - b. Item 2., delete Item 2.B. in its entirety.
     - c. Item 3., delete “Page 00410-2” and replace with “Page 00410-1”.
     - d. Item 4., delete “Page 00410-5” and replace with “Page 01500-5”.
     - e. Item 6., delete “SECTION 02053” and replace with “SECTION 02503” and delete “Page 02053-4” and replace with “Page 02503-4”.
   - C. Changes to be Made to the Contract Drawings
     - a. Item 5., delete “SLUDGE” and replace with “SBR”.

## CHANGES TO BE MADE TO THE CONTRACT DRAWINGS

None

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 3**

February 28, 2020

**ADDENDUM NO. 4**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 4 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 10 pages and 162 pages of attachments for a total of 172 pages.

**ATTACHMENTS**

1. Non-mandatory Pre-Bid Conference Attendance List and Presentation dated February 20, 2020
2. SECTION 00310, BID BOND
3. Orleans_MA-2019-01-Bid Form_Add_4-02-27-20
4. Orleans_MA-2019-01-SubBid Form_Add_4-02-27-20
5. SECTION 02725, MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES
6. SECTION 05120, STRUCTURAL STEEL
7. SECTION 06610, FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS
8. SECTION 13330, PROCESS INSTRUMENTS
9. SECTION 13330A, DATA SHEETS
10. SECTION 13331, CONTROL SYSTEM INTEGRATION
11. SECTION 13350, SCADA EQUIPMENT
12. SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES
13. Town of Orleans, MA, Downtown Area Collection System Layout, dated February 2020
14. Reference Drawings from Contract No. 2019-02, Downtown Area Collection System and Pumping Stations:

| | | | | |
|---|---|---|---|---|
| 00 DI-001 | 00 DI-601 | 01 DI-601 | 01 DI-602 | 02 DI-601 |
| 02 DI-602 | 03 DI-601 | 03 DI-602 (fka 03 DI-603) | 99 DI-601 | |

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. ADDENDUM NO. 2

   A. Changes to be Made to the Contract Specifications, delete Item 4. in its entirety and replace with the following new item:

      3.09 – SCAFFOLDING AND HOISTING

      A. The Contractor shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of the work except for the work performed by the Filed Sub-Bid subcontractors. The Contractor shall provide, set up and maintain in a safe condition all derricks and hoisting machinery, perform all hoisting operations in a safe method and remove all derricks and hoisting machinery as required for the execution of their work, except for the work performed by the Filed Sub-Bid subcontractors.

      B. All Filed Sub-Bid subcontractors shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of their work. All Filed Sub-Bid subcontractors shall provide, set up and maintain in a safe condition all derricks and hoisting machinery, perform all hoisting operations in a safe method and remove all derricks and hoisting machinery as required for the execution of their work.

      C. Neither the Engineer nor the Owner will act as an arbitrator on questions of whether the Contractor or any of his subcontractors shall furnish or remove scaffolding required for any portion of the work.

2. GENERAL

   A. Sub-Bid Opening - March 18, 2020 at 2:00 pm.

   B. General Bid Opening - March 25, 2020 at 2:00 pm.

   C. The Owner has pre-selected the manufacturers for the following equipment: (a) Septage Receiving Station; (b) Rotary Drum Thickeners; (c) Effluent Disk Filters; and (d) Sequencing Batch Reactors. All payment terms, performance guarantees, warranties and the like shall be in accordance with the following section: (a) SECTION 11333 - SEPTAGE RECEIVING STATION; (b) SECTION 11365 - ROTARY DRUM THICKENERS; (c) SECTION 11399 - EFFLUENT DISK FILTERS; and (d) SECTION 11600 - SEQUENCING BATCH REACTORS. In the event of a discrepancy between the Proposals and these sections, these sections shall govern.

3. TABLE OF CONTENTS

   A. Page TOC-2, DIVISION 0 – BIDDING AND CONTRACT REQUIREMENTS, add SECTION 00310, BID BOND, as attached.

   B. Page TOC-2, DIVISION 02 – SITE WORK, add SECTION 02065, TEMPORARY BY-PASS PIPING AND SERVICE CONNECTIONS, as attached

   C. Page TOC-4, DIVISION 08 – DOORS AND WINDOWS, add SECTION 08210, FLUSH WOOD DOORS, as attached.

4. SECTION 00100, ADVERTISEMENT FOR BIDS

   A. Page 00100-1, Paragraph 3., first subparagraph, delete the words "…until 10:00 a.m. prevailing time, on March 11, 2020 at which time and place…" and replace with the words "…until 2:00 p.m. prevailing time, on March 18, 2020 at which time and place…".

5. SECTION 00200, INSTRUCTIONS TO BIDDERS

   A. Page 00200-2, ARTICLE 1.01, RECEIPT AND OPENING OF BIDS, Paragraph F., delete the paragraph in its entirety and replace with the following new paragraph:

      "F. A non-mandatory Pre-Bid Conference was held on February 20, 2020 at 9:00 am at the Town of Orleans, 19 School Road, Orleans, MA 02653. Refer to the attached Attendance List and Presentation."

6. SECTION 00310, BID BOND

   A. Add new SECTION 00310, BID BOND as attached.

7. SECTION 00410, FORM OF GENERAL BID

   A. Page 00410-2, Paragraph 5., delete subparagraph D. in its entirety and replace with the following new subparagraph:

      D. Bidder shall print out in Landscape Format and submit the completed Microsoft Excel Proposal Form. In addition, Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

   B. Delete "Orleans_MA-2019-01-Bid Form_v2" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_4-02-28-20" in both hard copy and Microsoft Excel format.

8. DOCUMENT 00420, FORM OF SUBBID

   A. Delete "Orleans_MA-2019-01-SubBid Form_v2" in its entirety and replace with the attached new "Orleans_MA-2019-01-SubBid Form_Add_4-02-28-20" in both hard copy and Microsoft Excel format.

9. SECTION 00800, SUPPLEMENTARY CONDITIONS

   A. Page 00800-2, ARTICLE 5 - BONDS AND INSURANCE NOTICE TO CONTRACTOR, SC-5.04, add the following new paragraph:

      The General Contractor shall carry the coverage for Subcontractors by naming the Subcontractors, the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured at the limits specified herein. SECTION 05020A-3, INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS are separate from the Owners and Contractors Protective Liability and shall name the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured.

10. SECTION 00830, STATE STATUTES AND REGULATIONS COMMONWEALTH OF MASSACHUSETTS

    A. Page 00830-1, ARTICLE A. – Revisions to General Conditions, Paragraph A., add the following to the end of Subparagraph 4.:

       Town of Orleans building permit fees are waived.

11. SECTION 01020, ALLOWANCES

    A. Page 01020-2, ARTICLE 1.05 - ALLOWANCES FOR PRODUCTS, delete Paragraph C. in its entity and replace with the following new paragraph:

       C. The scheduled allowances are as follows:

**SCHEDULED ALLOWANCES**

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 1 | Electric Company Connection/Service Fee | $125,000 | 2.J. |
| 2 | Telephone Company Connection/Service Fee | $30,000 | 2.K. |
| 3 | Gas Company Connection/Service Fee | $30,000 | 2.L. |
| 4 | Planting Operations | $30,000 | 2.M. |
| 5 | Section 11333 - Septage Receiving Station | $400,000 | 2.N. |
| 6 | Section 11399 - Effluent Disk Filters | $450,000 | 2.O. |
| 7 | Section 11600 - Sequencing Batch Reactors | $550,000 | 2.P. |
| 8 | Section 11365 - Rotary Drum Thickeners | $225,000 | 2.Q.. |

Notes:

1. Item No. 1 - The allowance is for the cost by the Electric Company to provide all labor, materials, tools, and equipment required for providing electrical service to the WWTF and Effluent Disposal Site.

2. Item No. 2 – The allowance is for the cost by the Telephone Company to provide all labor, materials, tools, and equipment required for providing telephone service to the WWTF.
3. Item No. 3 - The allowance is for the cost by the Gas Company to provide all labor, materials, tools, and equipment required for providing gas service to the WWTF.
4. Item No. 4 - The allowance is for the cost of the Contractor to provide all labor, materials, tools, and equipment required to purchase and plant landscaping at the WWTF and/or Effluent Disposal Site.
5. Item No. 5 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Septage Receiving Station as specified in Section 11333, Septage Receiving Station and as included in the manufacturer's proposal.
6. Item No. 6 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Effluent Disk Filters as specified in Section 11399, Effluent Disk Filters and as included in the manufacturer's proposal.
7. Item No. 7 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Sequencing Batch Reactors as specified in Section 11600, Sequencing Batch Reactors and as included in the manufacturer's proposal.
8. Item No. 8 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Rotary Drum Thickeners as specified in Section 11365, Rotary Drum Thickeners and as included in the manufacturer's proposal.

12. SECTION 01030, SPECIAL REQUIREMENTS

    A. Page 01030-5, ARTICLE 1.11 - SCOPE OF WORK AND SEQUENCE OF CONSTRUCTION, Paragraph O., delete the words "No construction activity shall be allowed on the Project for two working days prior to the following dates:" in its entirety and replace with the words "No construction activity shall be allowed on the Project on the following dates, unless otherwise approved by the Owner:"

13. SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING

    A. Page 02210-2, ARTICLE 1.01 – SCOPE, add the following new Paragraph D.:

       D. Existing on-site materials may be used for backfilling non-structural excavations and constructing embankments and fills.

14. SECTION 02435, CRUSHED STONE

    A. Page 02435-2, ARTICLE 2.01 - MATERIAL, Paragraph B, add the following new subparagraph:

       5. Sources of PGA are as follows:

David Johansen, Director Department of Public Works
Town of Dennis
120 Theophilus F. Smith Road
South Dennis, MA 02660
Phone: 508-760-6220
e-Mail: djohansen@town.dennis.ma.us

Reagan Bissonnette, Executive Director
Northeast Resource Recovery Association
2101 Dover Road
Epsom, NH 03234
Phone: 603-736-4401
e-Mail: rbissonnette@nrra.net

15. SECTION 02520, WICK CONSTRUCTION AND TESTING

    A. Page 02520-6, ARTICLE 1.07 – WARRANTY, delete Paragraph C. in its entirety and replace with the following new paragraph:

       C. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

16. SECTION 02725, MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES

    A. Delete the section in its entirety and replace with the new section as attached.

17. SECTION 03345, CONCRETE FLOOR TREATMENT

A. Page 03345-3, ARTICLE 2.01 – LIQUID HARDENER (LQH), delete the article in its entirety and replace with the following new article:

2.01 – LIQUID HARDENER (LQH) – Not Used

B. Page 03345-4, ARTICLE 3.02 – APPLICATION, delete Paragraph A. in its entirety and replace with the following new paragraph:

A. LIQUID HARDENER (LQH) – Not Used

18. SECTION 03450, PRECAST ARCHITECTURAL CONCRETE

A. Page 03450-1, add the following after the section name: (Filed Sub-Bid Required).

B. Page 03450-1, PART 1 – GENERAL, add the following new paragraph:

1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 03450, PRECAST ARCHITECTURAL CONCRETE is a part of DIVISION 04, MASONRY which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 04120, STONE VENEER.

B. The Work of SECTION 03450, PRECAST ARCHITECTURAL CONCRETE requires the Subcontractor to perform all Work specified under this section.

C. Page 03450-1, ARTICLE 1.01 - SCOPE, add the following new sentence to the end of Paragraph A.:

The precast cap at the top of the cultured stone veneer shall have dimensions of 3 1/2-inches x 3 1/2-inches.

19. SECTION 04120, STONE VENEER

A. Page 04120-1, PART 1 – GENERAL, delete Paragraph B. in its entirety and replace with the following new paragraph:

B. A sub-bid submitted for the Work of DIVISION 4, MASONRY shall include the complete Work specified in all of the following Sections:

1. SECTION 04120, STONE VENEER
2. SECTION 04200, UNIT MASONRY AND ACCESSORIES
3. SECTION 03450, PRECAST ARCHITECTURAL CONCRETE

20. SECTION 04200, UNIT MASONRY AND ACCESSORIES

A. Page 04200-2, ARTICLE 1.01 - SCOPE, Paragraph B., delete subparagraph 5. in its entirety and replace with the following new subparagraph:

5. Cavity wall insulation including spray foam insulation.

B. Page 04200-2, ARTICLE 1.01 - SCOPE, Paragraph B., delete subparagraph 19. in its entirety and replace with the following new subparagraph:

19. Air/Vapor Barrier Membrane provided by the General Contractor and installed by the filed sub-bid subcontractor.

21. SECTION 05120, STRUCTURAL STEEL

A. Add new SECTION 05120, STRUCTURAL STEEL, as attached.

22. SECTION 05500, MISCELLANEOUS METAL

    A. Page 05500-1, PART 1 – GENERAL, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. A sub-bid submitted for the Work of DIVISION 5, METALWORK shall include the complete Work specified in all of the following Sections:

            1. SECTION 05500, MISCELLANEOUS METAL
            2. SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS
            3. SECTION 05120, STRUCTURAL STEEL

    B. Page 05500-1, PART 1 – GENERAL, Paragraph D. add the following drawings

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 C-104 | 00 C-105 | 00 D-102 | 00 D-001 | 00 D-002 | 10 D-100 | 10 D-101 |
| 10 D-102 | 10 D-103 | 10 D-104 | 10 D-105 | 10 D-106 | 10 D-301 | 10 D-302 |
| 10 D-303 | 10 D-304 | 10 D-305 | 10 D-306 | 10 D-307 | 10 D-308 | 15 D-101 |
| 15 D-102 | 15 D-103 | 15 D-104 | 15 D-301 | 30 D-101 | 99 D-501 | 99 D-503 |

    C. Page 05500-11, ARTICLE 2.14 – HATCHES, delete Paragraph D. in its entirety and replace with the following new paragraph:

        D. Type J, Type JD and Type HL-93 hatches that are not shown connected to a drainage system shall be provided with extensions to the drainage coupling to allow drainage to the area below or sumps.

    E. Page 05500-11, ARTICLE 2.14 – HATCHES, add the following new Paragraph G.:

        G. Type HL-93 hatches shall be single leaf or double leaf, watertight, self-draining type. Door leaf shall be of 3/8-inch thick aluminum diamond pattern plates reinforced with aluminum stiffeners as required and capable of withstanding an AASHTO HL-93 wheel load. Channel frame shall be 1/2-inch thick aluminum with anchor flange around the perimeter. Each door leaf shall be equipped with a minimum of two (2) hinges, with stainless steel pins, compression spring operators enclosed in telescopic tubes to afford easy operation, and an automatic hold-open arm with release handle. Snap locks with removable handle and safety chains shall be provided. A 1-1/2-inch drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be stainless steel with factory mill finish and bituminous coating applied to exterior of frame.

    F. Page 05500-12, add the flowing new ARTICLE 2.16 – BAR RACK:

        A. Provide Manual Bar Rack, Drainage Plate and Bar Clamp in accordance with the detail shown on Drawing 99 D-501 - Details I with regards to shape, size, material and detail indicated and suitable for the purpose intended.

23. SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS

    A. Page 05511-1, add the following after the section name: (Filed Sub-Bid Required).

    B. Page 05511-1, PART 1 – GENERAL, add the following new paragraph:

        1.00 - SUBBID REQUIREMENTS

            A. The Work of SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS is a part of DIVISION 5, METAL WORK which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 05500, MISCELLANEOUS METAL.

            B. The Work of SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS requires the Subcontractor to perform all Work specified under this section.

24. SECTION 06610, FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS

    A. Add new SECTION 06610, FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS, as attached.

25. SECTION 07160, BITUMINOUS DAMPPROOFING

    A. Page 07160-2, ARTICLE 1.00 – SUBBID REQUIREMENT, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

            1. SECTION 07610, BITUMINOUS DAMPPROOFING

            2. SECTION 07840, FIRESTOPPING

            3. SECTION 07900, JOINT SEALANTS

26. SECTION 10999, BUILDING SPECIALTIES

    A. Page 10999-6, ARTICLE 2.06 - ALUMINUM FLOOR HATCHES AND FRAMES, delete the article in its entity and replace the following new article:

        2.06 - ALUMINUM FLOOR HATCHES AND FRAMES – Not Used

27. SECTION 11309, CHOPPER PUMPS AND APPURTENANCES

    A. Page 11309-13, Article 3.08, Paragraph B, delete subparagraph 3. in its entirety.

28. SECTION 11333, SEPTAGE RECEIVING STATION

    A. Page 11333-7, ARTICLE 2.01, MANUFACTURERS OF SEPTAGE RECEIVING STATION, delete Paragraph B. in its entirety and replace with the following new paragraph:

        a. The Owner has pre-selected Huber Technology, Inc as the manufacturer of the Septage Receiving Station. No Substitutions are allowed.

    B. Page 11333-14, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

29. SECTION 11365, ROTARY DRUM THICKENERS

    A. Page 11365-23, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

30. SECTION 11399, EFFLUENT DISK FILTERS

    A. Page 11399-17, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

31. SECTION 11600, SEQUENCING BATCH REACTORS

    A. Page 11600-23, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

32. SECTION 13330, PROCESS INSTRUMENTS

A. Add new SECTION 13330, PROCESS INSTRUMENTS, as attached.

33. SECTION 13330A, DATA SHEETS

    A. Add new SECTION 13330A, DATA SHEETS, as attached.

34. SECTION 13331, CONTROL SYSTEM INTEGRATION

    A. Add new SECTION 13331, CONTROL SYSTEM INTEGRATION, as attached.

35. SECTION 13350, SCADA EQUIPMENT

    A. Add new SECTION 13350, SCADA EQUIPMENT, as attached.

36. SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES

    A. Add new SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES, as attached.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 10 A-301, BUILDING SECTIONS

    A. Key Note 2, delete the words "…Retardant Treated 2 x 4 Handrails…" and replace with the words "…Retardant Treated 2" x 4" Toe Plates @ 6" A.F.F. for the Entire Length of Attic Space and 2" x 4" Handrails…"

2. DRAWING 10 S-101, FOUNDATION PLAN I

    A. Delete the words "1-1/2" Aluminum Grating El. 39.82" and replace with the words "1-3/4" FRP Grating El. 39.82".

3. DRAWING 10 S-102, FOUNDATION PLAN II

    A. Delete the words "1-1/2" Aluminum Grating El. 39.67" and replace with the words "1-3/4" FRP Grating El. 39.67".

    B. Delete the words "1-1/2" Aluminum Grating El. 39.75" and replace with the words "1-3/4" FRP Grating El. 39.75".

4. DRAWING 10 S-105, ROOF LEVEL PLAN, add the following new note:

    Note: W12 x 117 bearing detail similar to Section 11 shown on Drawing 10 S-302.

5. DRAWING 20 S-101, STORAGE FACILITY GRADE LEVEL PLAN

    A. FOUNDATION/GRADE LEVEL PLAN, add the following new Note 3.:

        3. No grading or sumps are required at the four L.P. EL 56.85 locations. The flat spots are the locations of the 4-inch floor drains shown on DRAWING 20 P-101, EQUIPMENT STORAGE FACILITY PLAN."

6. DRAWING 99 S-502, STRUCTURAL STANDARD DETAILS II

    A. TRENCH DRAIN IN SLAB WITH SLAB BLOCKOUT, add the following new note:

        Note: Refer to SECTION 15400, PLUMBING SYSTEMS for trench drain specification.

7. DRAWING 99 S-506, STRUCTURAL STANDARD DETAILS II

    A. INTERIOR TOP OF WALL CONNECTION PARALLEL TO TRUSSES, , add the following new note:

        Note: The continuous L5 x 3 x 3/16 is typical for all interior non-bearing wall. The angles do not have attachment to the CMU.

8. DRAWING 00 D-008, PROCESS FLOW DIAGRAPH III

    A. Add a 4-inch knife gate valve on the septage receiving truck connection before the pinch valve and rock trap.

9. DRAWING 10 D-104, FACILITY – UPPER PLAN I

   A. Add the following new notes:

      Notes:

      1. The framing, grating, supports, ladders, railing and the like located around the Rotary Drum Thickeners shall be designed by the fabricator and constructed of FRP. The ladders shall be integral with the railing system. Refer to Section 06610 - Fiberglass Reinforced Products and Fabrications.
      2. The hatches in the following locations shall be HL-93 rated:
         a. Truck Bay
         b. Thickened Sludge Storage Tank
         c. Post Equalization Tank
         d. Pre-Equalization Tanks

   B. Add a 4-inch knife gate valve on the septage receiving truck connection before the pinch valve and rock trap.

10. DRAWING 10 D-105, FACILITY – UPPER PLAN II

   A. Add the following new note:

      Note: The framing, grating, supports, stair, railing and the like located around the Effluent Disk Filters shall be designed by the fabricator and constructed of FRP. The stair shall be integral with the railing system. Refer to Section 06610 - Fiberglass Reinforced Products and Fabrications.

11. DRAWING 10 D-306, SECTION IV

   A. Section 7, delete the words “2 Cubic Yard Screenings Dumpster” and replace with the words “Two - 13.5 Cu. Ft. Capacity Tilt Trucks by Tough Guy, Manufacturer No. 21VK502”.

12. DRAWING 00 P-002, SCHEDULES AND CONTROLS

   A. Plumbing Fixture Schedule, delete Tag No. P-7 and replace with the following new tag number.

| Tag No. | Manufacturer & Model Number | Fixture Type | Fixture Dimensions (Where Applicable) |
|---|---|---|---|
| P-7 | Quench750 | Drinking Water Dispenser | 13.5” X 14.5” X 40.5” |

| Water Usage | Soil or Waste | Vent | Cold Water | Hot Water | Tempered Water | Remarks |
|---|---|---|---|---|---|---|
| --- | --- | --- | 1/2” | --- | --- | Break Room |

13. DRAWING 20 P-101, EQUIPMENT STORAGE FACILITY PLAN

   A. Add the following new note:

      Note: All below slab plumbing drain lines shall be concrete encased.

14. DRAWING 10 DI-603, SLUDGE TRANSFER PUMPS P&ID

   A. Delete the words “P-14” and replace with the words “P-10”.

15. DRAWING 10 E-001, WWTF – ELECTRICAL SITE PLAN - POWER

   A. Add the following new note:

      Note: Only the duct banks that contain primary service conductors (Duct Bank No. 02) are to be concrete encased.

16. DRAWING 30 E-001, WICK DISTRIBUTION VAULT – ELECTRICAL SITE PLAN

    A. Add the following new note:

       Note: Only the duct banks that contain primary service conductors from the utility (Duct Bank No. 01) are to be concrete encased.

17. DRAWING 99 E-502, ELECTRICAL DETAILS II

    A. Add the following new note:

       Note: Only the duct banks that contain primary service conductors (Duct Bank No. 02) are to be concrete encased.

18. DRAWING 00 DI-603, SYSTEM ARCHITECTURE 3

    A. Note 1, delete the note in its entirety and replace with the following new note:

       1. Pump Station PLC panels, remote communication hardwired and configuration/integration to be provided under this contract. See Pumping Station Instrumentation Drawings under Contract 2019-02, Drawing Numbers 00 DI-601, 01 DI-601, 01 DI-602, 02 DI-601, 02 DI-602, 03 DI-601, 03 DI-602 and 99 DI-601 for reference regarding I/O quantity, as attached.

19. DRAWING 00 DI-606, EFFLUENT PUMPS P&ID

    A. Delete the plug valves and replace with butterfly valves.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

1. Add new “Town of Orleans, MA, Downtown Area Collection System Layout, dated February 2020”, as attached.

**END OF ADDENDUM NO. 4**

AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559
www.aecom.com

508.833.6950 tel
508.833.6951 fax

# Attendance List

Subject **Town of Orleans, MA**
**Downtown Area WWTF and Effluent Disposal**
**Contract No. 2019-01 and SRF No. 4486**
**Non-Mandatory Pre-Bid Conference**

Project Number 60587515

Date and Time February 20, 2020, 1:00 pm

| Attendee | Affiliation | e-Mail and Telephone Number |
|---|---|---|
| Ian Catlow | Tighe & Bond | 508-471-9605 |
| Alan McCloghlen | Town of Orleans Water + Sewer Commission | 617-448-3696 |
| Tess Laffer | AECOM | Tess.laffer@AECOM.com 301-471-2398 |
| Reggie Donoghue | AECOM | Martin.Donoghue@AECOM.com 508-237-7161 |

| Attendee | Affiliation | e-Mail and Telephone Number |
|---|---|---|
| Bill Rizzo | Methuen Construction Co | estimating@methuenconstruction.com<br>603-328-2222 |
| MIKE CZEPIEL | WATERLINE IND | 603-474-7477 |
| Lauren Guba | RH white construction | (508) 277-3063 |
| Jerred Fowler | RH White Construction Co. | 508-832 3295<br>jfowler@rhwhite.com |
| William Naragon | CH Nicherson | 860 489-0455<br>bnaragon@CHNicherson.com |
| TEDD BARDELL | DANIEL O'CONNELL'S SONS | tbardell@oconnells.com<br>413-540-1375 |
| RORY MOULTON | MWH CONSTRUCTORS | rory.moulton@mwhconstructors.com<br>603-341-3541 |
| Maria Donahue | Daniel O'Connells | mconahue@oconnells.com<br>413-540-1348 |
| MICHAEL D'CASO | TECHNOLOGY SALES | MCASO@TECHSALESNE.COM<br>508-878-7441 |

| Attendee | Affiliation | e-Mail and Telephone Number |
|---|---|---|
| Todd Bodeau | Williamson Pump | ToddBe weco-group.com |
| Craig Fleming | Williamson Pump + Motors | CraigFc weco-Group.com |
| THOMAS PRIECE | AECOM | TOM.PRIECE@AECOM.COM |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# Downtown Area WWTF and Effluent Disposal

## Contract No. 2019-01 and SRF No. 4486

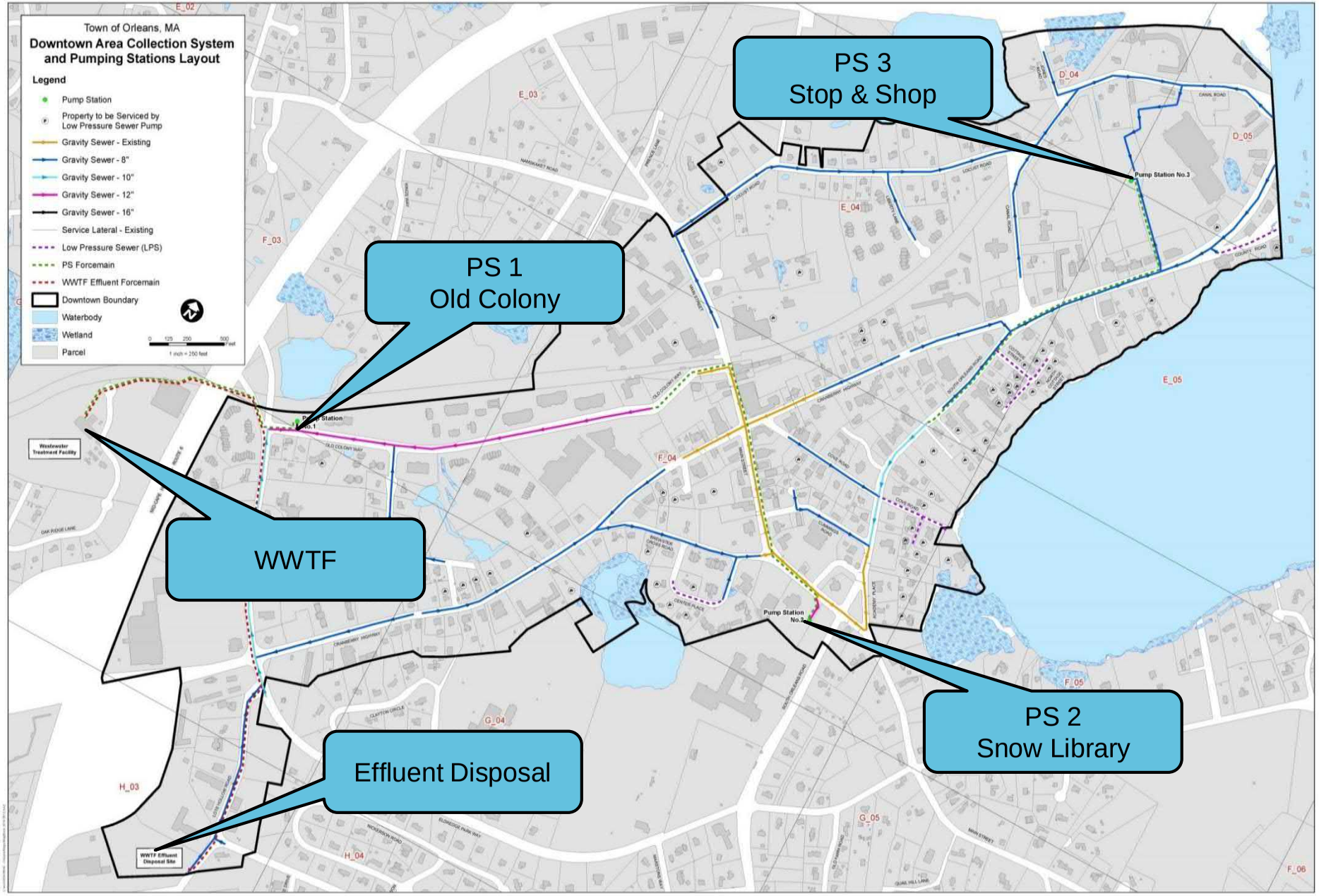
Non-Mandatory Pre-Bid Conference

February 20, 2020

1:00 pm

# Agenda

- **Welcome and Introduction**
  - Orleans, MA
  - Tighe & Bond
  - AECOM
- **Project Overview**
- **Special Attention to Specifications and Bidding Conditions**
- **Addendums**
- **Open Floor for Questions**
- **Site Visit**


Town of Orleans, MA
Downtown Area Collection System and Pumping Stations Layout
Legend
Pump Station
Property to be Serviced by Low Pressure Sewer Pump
Gravity Sewer - Existing
Gravity Sewer - 8"
Gravity Sewer - 10"
Gravity Sewer - 12"
Gravity Sewer - 16"
Service Lateral - Existing
Low Pressure Sewer (LPS)
PS Forcemain
WWTF Effluent Forcemain
Downtown Boundary
Waterbody
Wetland
Parcel
PS 3
Stop & Shop
PS 1
Old Colony
WWTF
PS 2
Snow Library
Effluent Disposal
Pump Station No.3
Pump Station No.2
Wastewater Treatment Facility
WWTF Effluent Disposal Site

# Project Overview (cont.)

- **General Scope of Work**
  - Wastewater Treatment Facility
    - 350,000 gpd Sequence Batch Reactor
    - Located at 20 Overland Way
  - Effluent Disposal
    - Five Wicks
    - Located at 32 Lots Hollow Road
- **Time for Completion – 654 Calendar Days / 372 Working Days**
- **Bidding Submission Requirements**
  - Sub-Bids Due to Orleans, MA: March 11, 2020 by 10:00 am E.S.T.
  - General Bids Due to Orleans, MA: March 25, 2020 by 2:00 pm E.S.T.
  - Attachments to the Bid

# Project Overview (cont.)

## Attachments to the Bid

- Insurance Requirements
- Statement of State Tax Compliance
- Certificate of Non-Collusion
- Acknowledgement of Principal, if a Corporation or a Partnership
- Certification of OSHA 10-Hour Training
- Massachusetts Diesel Retrofit Form
- DCAMM Certificate of Eligibility
- DCAMM Update Statement

## Post Bid Attachments

- State Revolving Loan
  - Disadvantaged Business Enterprise (DBE) Goals
    - Minimum 4.2 Percent D/MBE Participation
    - Minimum 4.5 Percent D/WBE Participation
  - Two Low Bidders to Submit Close of Business on the Third Business Day After Bid Opening
    - DBE Forms - EEO-DEP-190C and EEO-DEP-191C
    - DBE Certification of United States Citizenship Form

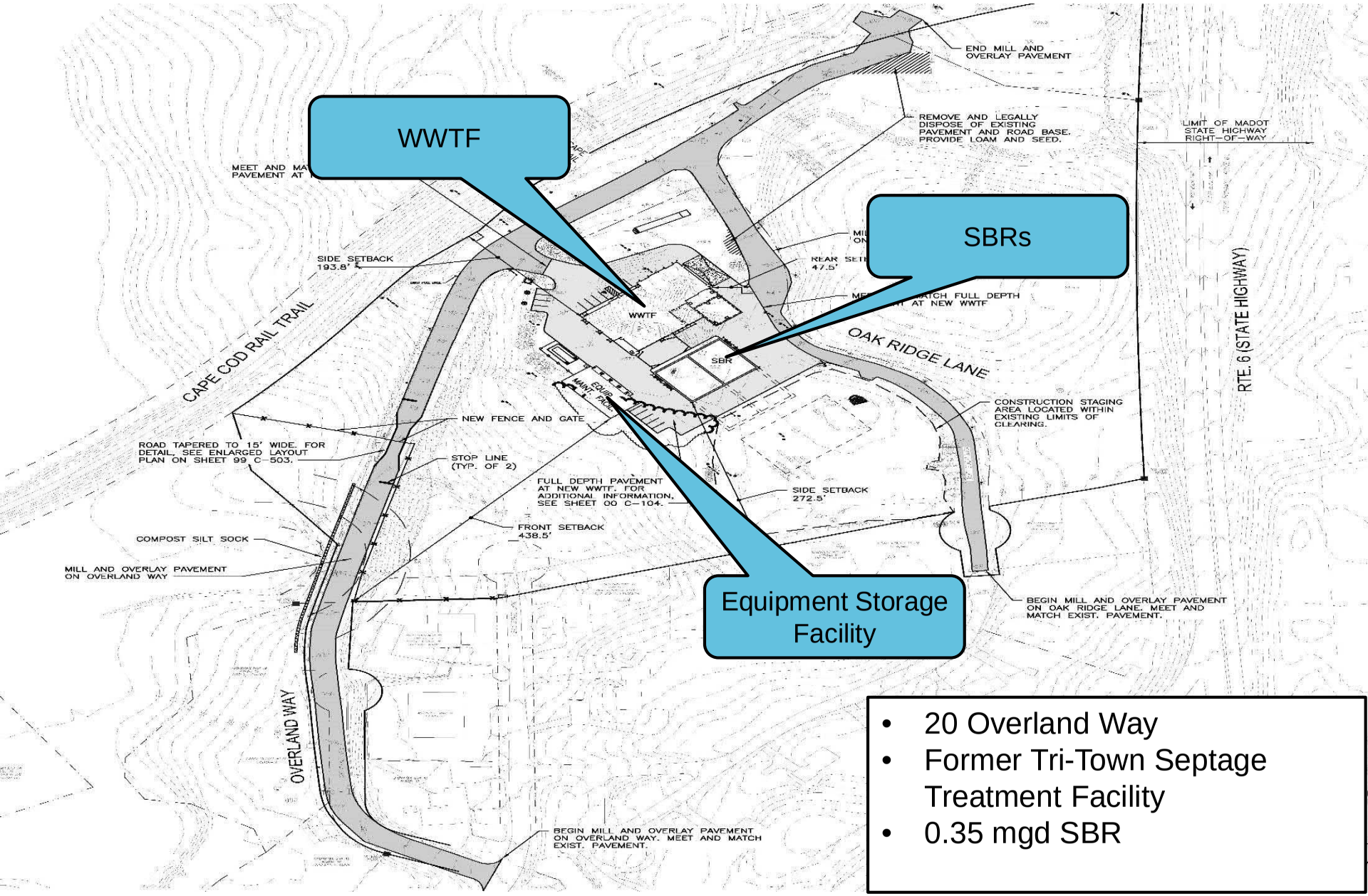
# Project Overview (cont.)

## Prequalified Filed Sub-Bid Subcontractors

- Masonry
- Miscellaneous Metal Work
- Roofing and Flashing
- Metal Windows
- Glass and Glazing
- Painting
- Plumbing
- Heating, Ventilating and Air Conditioning
- Electrical Work

## Prequalified and Other DCAMM Certified Filed Sub-Bid Subcontractors

- Waterproofing and Dampproofing
- Tile
- Fire Protection




- 20 Overland Way
- Former Tri-Town Septage Treatment Facility
- 0.35 mgd SBR

# Project Overview (cont.)
# WWTF

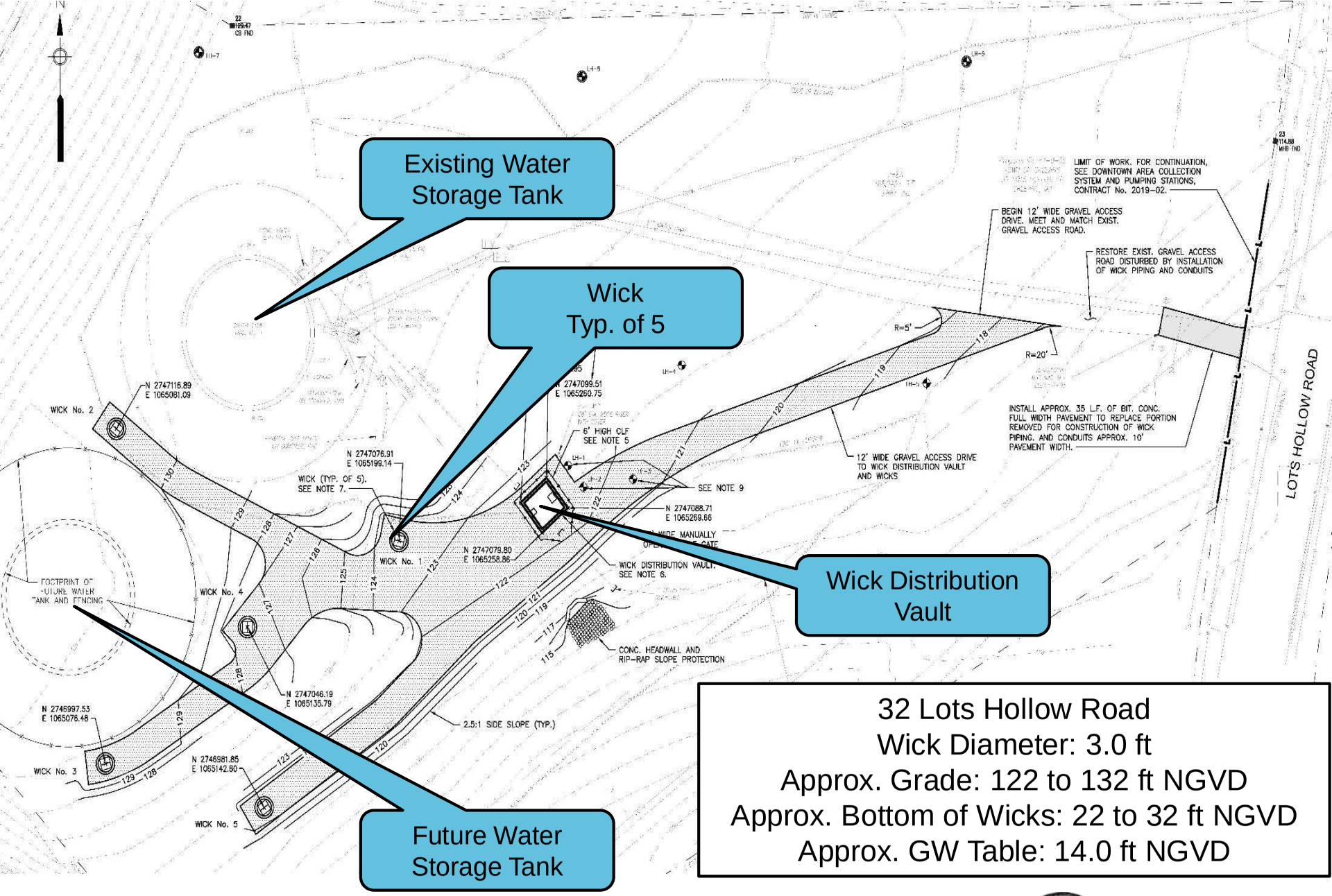
## Buildings

- WWTF
  - Administrative Spaces
  - Laboratory
  - Control Room
  - Chemical Storage Rooms
  - Mechanical and Electrical Rooms
  - Men's and Women's Rooms
  - Headworks
  - Disk Filter Room
  - Garage and Septage Receiving Area
  - Pump Room
- Equipment Storage Facility
  - Four Bays
  - Work Room / Shop

## Major Wastewater Treatment Components

- Influent Screening
- Septage Receiving Station
- Two Pre-equalization Tanks
- Two SBRs
- Two Effluent Disk Filters
- One Post-equalization Tank
- Two in-line Ultraviolet Reactors
- Two Waste Sludge Storage Tanks
- One Dual Rotary Drum Thickener
- One Thickened Sludge Storage Tank
- Chemical Storage and Feed Systems
- One Odor Control System

# Project Overview (cont.)
# WWTF




32 Lots Hollow Road
Wick Diameter: 3.0 ft
Approx. Grade: 122 to 132 ft NGVD
Approx. Bottom of Wicks: 22 to 32 ft NGVD
Approx. GW Table: 14.0 ft NGVD



AECOM
Tighe&Bond

# Special Attention to Specifications and Bidding Conditions

- **Preconstruction Requirements**
  - Submittals
  - Digital Videodisc Recording
  - Health and Safety Plan
  - Traffic Management Plan
    - Prepare and Submit to Town and Engineer for Review and Approval
    - Detours and Road Accessibility
    - Responsible for Ordering and Coordinating Traffic Details
  - Project Schedule
- **Progress Schedule - “Two-week Look Ahead”**
  - Summarizes Anticipated Construction Activities
  - Thursday of Each Week

# Special Attention to Specifications and Bidding Conditions (cont.)

- **Permits and Licenses Obtained**
  - Cape Cod Commission – Consistency Review
  - Massachusetts Historical Commission
  - MassDEP – CWMP Approval
  - MassDEP – Site Assignment
  - Orleans, MA - Conservation Commission – Determination of Applicability
  - Old King's Highway Regional Historic District Committee – Certificate of Appropriateness
- **Permits and Licenses Anticipated to be Obtained**
  - MassDEP – Groundwater Discharge Permit
- **Town Permits to be Issued After the Contract Award**

# Special Attention to Specifications and Bidding Conditions (cont.)

- **EPA Construction General Permit**
  - Prepare a SWPPP and File an NOI with EPA
  - Implement SWPPP and Perform Required Inspections
- **Hours of Operation**
  - No Outdoor Activities Permitted Before 7:00 am or After 5:00 pm
  - No Outdoor Activities Permitted Saturday, Sunday, Legal Holidays and the Two Days Preceding the Legal Holidays
- **Crushed Stone and Processed Glass Aggregate**
- **Existing Utilities and Utility Coordination**

# Special Attention to Specifications and Bidding Conditions (cont.)

- **Construction Staging Areas**
  - Compost Shed Area
  - Eastern Area of WWTF Site
  - Other Areas Subject to Owner's Approval
- **Archeological Sensitive Areas - Work Area and Site Disturbance Within the Limit-of-Work Shown**
- **Monthly Photographs**
- **Future Site Expansion**
  - Areas of the WWTF Site are Designated for Future Expansion
  - No Permanent Structures/Utilities to be Constructed These Areas

# Special Attention to Specifications and Bidding Conditions (cont.)

- **Manufacturer's Services**
  - Installation and Startup
  - Correction of Defects
  - Testing
  - Training
- **Post Construction**
  - Photographs and Record Drawings
  - Operation and Maintenance Manuals
  - Manufacturer's Services
  - Spare Parts

# Addendums

- **Addendum No. 1 – Issued on February 13, 2020**
- **Addendum No. 2 – Issued on February 19, 2020**
- **Addendum No. 3 – Issued on February 19, 2020**
- **Addendum No. 4 – Issue by March 6, 2020**
  - Bid Forms (Excel)
  - Non-Mandatory Pre-Bid Conference Attendance List
  - Applicable Questions and Answers
- **Addendum No. 5 – Issue by March 20, 2020**
  - Sub-Bid Results
  - Applicable Questions and Answers

# Site Visit

- **Effluent Disposal - 32 Lots Hollow Road**
- **WWTF - 20 Overland Way**

# Questions and Answers

**SECTION 00310**

**BID BOND**

Know all men by these presents, that we, the undersigned, _____

_____ as Principal, and _____

as Surety, are hereby held and firmly bound unto the Town of Orleans, MA, 19 School Road, Orleans, MA 02653 hereinafter called "Owner", in the penal sum of five (5) percent of the value of the Bid for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____.

The Condition of the above obligation is such that whereas the Principal has submitted to the Town of Orleans, MA, 19 School Road, Orleans, MA 02653, hereinafter called "Owner", attached hereto and hereby made a part hereof to enter into a Contract in writing for Contract No. 2019-01, Downtown Area Wastewater Treatment Facility and Effluent Disposal.

Now, therefore,

(a) If said Bid shall be rejected, or

(b) If said Bid shall be accepted and the Principal shall execute and deliver a Contract in SECTION 00520, AGREEMENT attached hereto (properly completed in accordance with said Bid) and shall furnish a Bond for its faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation, shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid and said Surety does hereby waive notice of any such extension.

In witness whereof, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

| | |
|---|---|
| Principal | Surety |
| Principal Signature | Surety Signature |

Important - Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the

**END OF SECTION**

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**SECTION 02725**

**MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES**

PART 1 - GENERAL ..... 2
1.01 - SCOPE ..... 2
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 3
1.06 - DESIGN CRITERIA ..... 3
PART 2 - PRODUCTS ..... 3
2.01 - PRECAST SECTIONS FOR MANHOLES ..... 3
2.02 - HORIZONTAL JOINTS ..... 3
2.03 - MANHOLE STEPS ..... 3
2.04 - PRECAST SECTIONS FOR ELECTRICAL MANHOLES, HANDHOLES, AND PULL BOXES ..... 3
2.05 - PIPE CONNECTIONS ..... 4
2.06 - MANHOLE FRAMES AND COVERS ..... 4
2.07 - BRICK ..... 4
2.08 - MORTAR ..... 4
2.09 - WATER ..... 4
2.10 - BEDDING MATERIAL ..... 4
2.11 - CONCRETE ..... 4
2.12 - POLYVINYL CHLORIDE PIPE ..... 4
2.13 - MID LEVEL PLATFORM ..... 4
2.14 - MANHOLE ADJUSTING RINGS – Not Used ..... 4
2.15 - MANHOLE ENCAPSULATION SYSTEM ..... 4
2.16 - CARBON ODOR CONTROL UNIT – Not Used ..... 5
PART 3 - EXECUTION ..... 5
3.01 - PRECAST REINFORCED CONCRETE STRUCTURES ..... 5
3.02 - MANHOLE COVERS AND FRAMES ..... 5
3.03 - DROP CONNECTIONS ..... 5
3.04 - LEAKAGE TESTS ..... 6
3.05 - TEST PROCEDURES ..... 6
3.06 - MANHOLE ADJUSTING RINGS – Not Used ..... 7
3.07 - MANHOLE ENCAPSULATION SYSTEM ..... 7
3.08 - VISUAL INSPECTION ..... 7
3.09 - CLEANUP ..... 7
3.10 - CONTRACT CLOSEOUT ..... 7

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to construct precast concrete manholes, catch basins, handholes, and pull boxes including bases complete with inverts, tables, steps, frames, grates and covers, mancatchers, fittings, piping and concrete encasements for drop manholes as specified herein and as shown on the Contract Drawings

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Precast concrete manholes, catch basins, handholes and pull boxes.
2. Frames, covers, and grates.
3. Horizontal joint sealing material.
4. Pipe connections.
5. Manhole steps.
6. Manhole Encapsulation System.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**PART 2 - PRODUCTS**

**2.01 - PRECAST SECTIONS FOR MANHOLES**

A. Precast reinforced concrete sections for drain manholes, sewer manholes, valve manholes, chemical or process manholes, (hereinafter referred to as "manholes") and catch basins, shall conform to the applicable requirements of ASTM C478. Sections and bases shall have a minimum wall thickness of the dimensions shown on the Contract Drawings. Unless otherwise detailed on the Contract Drawings all sections shall be of precast concrete. Flat top sections to be substituted for conical sections of manholes and catch basins in areas of low cover shall be indicated in submittals and shall conform to the requirements for precast concrete sections for handholes.

B. Unless otherwise shown on the Contract Drawings manholes shall be 4-foot in diameter for pipe up to 24-inches in diameter unless the angle between two 24-inch pipes is less than 120 degrees. In such cases and when the size of the pipe is less than 36-inches a 5-foot inside diameter manhole shall be used. Where the pipe is 36-inches in diameter or greater, the diameter of the structure shall be as shown on the Contract Drawings.

C. Exterior surfaces of all precast manholes shall be given one shop coat of bituminous waterproofing.

D. All lifting holes and areas of the factory coating that have been compromised shall be filled and/or patched with mortar and coated with one coat of bituminous waterproofing.

**2.02 - HORIZONTAL JOINTS**

A. Horizontal joints between sections of manholes, unless otherwise specified herein, shall be sealed with a self-sealing butyl rubber based flexible joint sealant in rope form. Sealant material shall be Kent-Seal No. 2 as manufactured by Hamilton-Kent Mfg. Co., Kent, Ohio; C-S146 as manufactured by Concrete Products Supply Co. Div., Press Seal Gasket Corp., Fort Wayne, Indiana; Ram-Nek as manufactured by K.T. Snyder Co., Inc., Houston, Texas. Sealant shall be installed in accordance with the manufacturers written instructions.

B. Horizontal joints between sections of precast concrete drain manholes and catch basins shall be mortared with mix specified herein.

**2.03 - MANHOLE STEPS**

A. Manhole steps shall be of steel reinforced copolymer polypropylene conforming to ASTM C478, cast-in-place or installed utilizing inserts approved by the Engineer.

B. All steps shall be 12-inches on center with abrasive step surface and safety edge, drop front design, 1-inch diameter and 16-inches wide. Metal items embedded in concrete shall be painted with a zinc chromate primer.

**2.04 - PRECAST SECTIONS FOR ELECTRICAL MANHOLES, HANDHOLES, AND PULL BOXES**

A. Refer to DIVISION 16, ELECTRICAL.

**2.05 - PIPE CONNECTIONS**

A. Premolded elastomeric sealed joints shall be used at the joints between the pipe and sewer manhole sections. Premolded elastomeric sealed joints shall be A-Lok, Res-Seal, Press-Wedge II, Lock Joints Flexible Manhole Sleeve, or Kor-N-Seal Joint Sleeve.

B. Mortar shall be used between pipe and structure in the storm drainage systems. Mortar mix shall be as specified herein.

C. Manholes shall be manufactured with knockout panels for future pipe connections/ extensions at the locations shown on the Contract Drawings.

**2.06 - MANHOLE FRAMES AND COVERS**

A. Manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

B. Bolted and gasketed manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

**2.07 - BRICK**

A. Brick shall conform to ASTM C32 and shall be new, water struck, first quality, whole, sound brick.

B. For tables and inverts, Type SS shall be used with cement mortar (no lime).

**2.08 - MORTAR**

A. Mortar shall be composed of one-part Portland cement to two parts sand with 20 percent hydrated lime.

B. Portland cement shall conform to the requirements of ASTM C150. Sand shall conform to the requirements of ASTM C144. Hydrated lime shall conform to the requirements of ASTM C207.

**2.09 - WATER**

A. Water shall be clean, fresh and free from organic matter, oil, acid, alkali, or deleterious substances.

**2.10 - BEDDING MATERIAL**

A. Bedding material under structures herein shall be as detailed and as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**2.11 - CONCRETE**

A. Concrete for tables, inverts, paved invert fillings, encasements, floor fillings and similar items shall be as specified in DIVISION 3, CONCRETE.

**2.12 - POLYVINYL CHLORIDE PIPE**

A. Polyvinyl Chloride pipe for drop manhole connections shall conform to ASTM D3034 and shall be SDR35.

**2.13 - MID LEVEL PLATFORM**

A. All manholes with a depth of 20-feet or greater from rim to invert shall have installed at the midpoint of the manhole a mid-level platform. The mid-level platform shall be installed in accordance with the details on the Contract Drawings.

**2.14 - MANHOLE ADJUSTING RINGS – Not Used**

**2.15 - MANHOLE ENCAPSULATION SYSTEM**

A. All manholes shall be installed with an external manhole encapsulation system that seals: (1) the interface between the precast concrete manhole and the frame and cover and (2) all manhole joints which are located below groundwater.

B. The manhole encapsulation system shall be designed to prevent leakage of water into the manhole and shall be either one of the following:

1. The manhole encapsulation system shall be a heat shrinkable wraparound sleeve system and shall have an overall thickness of 0.100-inches with a minimum width of 12-inches. The manhole encapsulation shall be "Wrapid Seal Manhole Encapsulation System" as manufactured by Canusa, A Division of Shaw Pipe Resources, Riser-Wrap as manufactured by Pipeline Seal and Insulator, Inc. or equal.

2. The manhole encapsulation system shall be a rubber sleeve made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils with a minimum width of 12-inches. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of ¼-inch. The manhole encapsulation shall be "Infi-Shield Seal Wrap" as manufactured by Sealing System, Inc. or equal.

**2.16 - CARBON ODOR CONTROL UNIT – Not Used**

**PART 3 - EXECUTION**

**3.01 - PRECAST REINFORCED CONCRETE STRUCTURES**

A. Precast Reinforced Concrete Structures shall be installed as shown on the Contract Drawings and at a maximum spacing of 300 linear-feet. Precast sections shall be installed so that the entire structure is vertically plumb and the steps are in a true line. All erection holes and horizontal joists shall be filled solid with non-shrinking grout. The top uppermost precast section shall be set at a grade that will allow for the installation of a minimum of two courses and a maximum of five courses of manhole adjusting rings prior to setting the cast iron frame and cover. Furnish and use suitable slings, hooks and cables for the proper handling of the sections.

B. Surfaces of sewer pipe to be bonded to cast-in-place concrete bases shall be cleaned of all dust, dirt, grease, laitance, and loose or spalling concrete and given, where applicable, a coat of bonding compound in conformance with the sealant or gasket manufacturer's recommendations.

C. Tables and inverts shall be constructed of brick and concrete for sewer manholes, and of concrete for drain manholes as shown on the Contract Drawings. The size and shape of the invert shall accurately conform to the adjoining sewer or drains pipes. Any change in size or direction shall be even and as gradual as possible. Concrete floor filling for chemical or process pullbox sumps shall be as shown on the details.

D. Knockout panels for future sewer extensions shall be manufactured into precast manhole, as specified above, at the locations shown on the Contract Drawings. Stubs shall not be used.

**3.02 - MANHOLE COVERS AND FRAMES**

A. In paved surfaces, grates, covers and frames shall be set 1/4-inch below the finish grade of the roadway utilizing cement mortar to hold the frame in place, as shown of the Contract Drawings.

B. The temporary roadway surface elevation shall be maintained and the grates, frames, and covers shall be set 3/4-inch above the grade of the temporary resurfacing utilizing either cement mortar or bituminous concrete to hold the frame in place. A slope, constructed of bituminous concrete pavement, shall be placed around the entire grate, frame and cover for a distance of 6-inches from the grate, frame and cover.

C. Any voids created in the road gravel or pavement when raising the grate, frame and cover from its temporary elevation to its permanent elevation shall be filled with concrete.

**3.03 - DROP CONNECTIONS**

A. Drop connections shall be installed for manholes, which have invert elevation differences greater than 3-feet. No exterior drop connections are allowed.

B. Drop connections for manholes shall be constructed utilizing polyvinyl chloride pipe, elastomeric sealed joints, and Type 316 stainless steel mounting hardware and materials. Drops shall be constructed in accordance with the Contract Drawings.

C. The size of the drop piping shall be 8-inches when the size of the sewer main is less than 24-inches. When the sewer main is equal to or larger than 24-inches, the drop piping shall be 12-inches in diameter.

**3.04 - LEAKAGE TESTS**

A. Leakage tests shall be made and observed by the Engineer on each sewer manhole. The test shall be an exfiltration, infiltration test or vacuum test made as described below:

1. Preparation for Testing

a. After the manhole has been assembled in place, all lifting holes and horizontal joints shall be filled and pointed with a non-shrinking mortar. The test shall be made prior to placing the tables and invert and before filling and pointing the horizontal joints.

b. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and plugs braced to prevent blow out.

2. Backfilling

a. The test may be conducted before backfilling around the manhole.

b. There will be adjustment in the leakage allowance for unknown causes including, but limited to, leaking plugs and absorption. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3. The Contractor has the option of test method depending upon the actual field conditions. The following are acceptable test methods:

a. If the measured ground water table is above the highest joint in the manhole, and if there is not leakage into the manhole as determined by the Engineer, the Contractor may perform an infiltration or vacuum test as described herein.

b. If the measured ground water table height is lower than the invert of the manhole, the Contractor may perform an exfiltration or a vacuum test.

**3.05 - TEST PROCEDURES**

A. Infiltration Test

1. The manhole interior shall be visually inspected. The manhole shall be considered acceptable for use when no infiltration of ground water is observed on the interior surfaces of the manhole.

B. Exfiltration Test

1. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole shall be considered satisfactorily watertight.

2. If the test as described above is unsatisfactory as determined by the Engineer or if the manhole excavation has been backfilled the test shall be continued. A period of time may be permitted, if the Contractor so wishes, to allow for absorption.

3. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least 8 hours shall begin. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period.

4. If the test fails, but the leakage does not exceed 3 gallons per vertical foot per day, repairs shall be made in accordance with industry standard repair methods as to bring the leakage within the allowable rate of 1 gallon per vertical foot per day. If the leakage exceeds 3 gallons per vertical foot per day, it shall be the Contractor's responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it as required, at no cost to the Owner. The manhole shall then be retested.

C. Vacuum Test

1. If the vacuum test is performed in lieu of the infiltration or exfiltration test the Contractor shall take any and all steps necessary to assure the Engineer that the water table is below the invert of the manhole throughout the test. Any and all measures necessary by the Contractor to lower the ground water table below the invert of the manhole will be at the Contractor's expense. The vacuum test shall be based on the following criteria:

   a. Manhole test pressures and time shall be as follows:

      (1) Initial test pressure, 10-inches Hg (i.e., 20-inch absolute).

      (2) Test time, 1-inch Hg drop to 9-inch Hg in 2 minutes minimum allowable, for 0 to 10-foot-deep manholes; 2-1/2 minutes minimum allowable for 10 foot to 15 foot deep manholes; 3 minutes minimum allowable for manholes greater than 15 foot in depth.

   b. If the pressure drop exceeds 1-inch Hg in 2 minutes the manhole shall be repaired and retested.

   c. If a manhole fails to meet a 1-inch Hg drop in 1 minute after repair, the manhole shall be water exfiltration tested and repaired as necessary.

   d. Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal. Vacuum testing draws together the joint and applies high pressure to the elastomeric joint material. Properly placed and sized elastomeric joint material must be used to avoid leakage or to enable sections to be separated if necessary to affect a repair.

**3.06 - MANHOLE ADJUSTING RINGS – Not Used**

**3.07 - MANHOLE ENCAPSULATION SYSTEM**

A. The external manhole encapsulation system shall be installed in accordance with the manufacturer’s written instructions. All surfaces shall be free of dirt, sharp points and preheated to remove moisture.

B. The Contractor’s personnel shall be trained by the manufacturer in the proper method of application of the external manhole encapsulation system. The Contractor shall have the manufacturer’s field service representative present during the application of external manhole encapsulation system on the first two manholes encapsulated.

**3.08 - VISUAL INSPECTION**

A. At the conclusion of the work, all manholes, catch basins, handholes and pull boxes shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All manholes, catch basins, handholes and pull boxes that are not straight and plumb shall be removed and replaced.

**3.09 - CLEANUP**

A. Upon completion, of all construction and testing, and prior to final acceptance all debris shall be removed from manholes and the tables cleaned.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 05120**

**STRUCTURAL STEEL**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 05120, STRUCTURAL STEEL is a part of DIVISION 5, METAL WORK which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 05500, MISCELLANEOUS METAL.

B. The Work of SECTION 05120, STRUCTURAL STEEL requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. The term "Structural Steel" is used as defined in accordance with the AISC Code of Standard Practice.

B. Provide structural steel as specified and as shown on contract drawings.

C. Detailing, fabrication and erection of structural steel shall comply with all applicable OSHA regulations.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submit in advance of fabrication complete information necessary for the fabrication of each component and part of the structural steel framing. Include the following:

1. Member size and length.
2. Bill of materials.
3. Material specifications.
4. Bolt hole size and bolt size.
5. Cuts, copes, and bevels.
6. Piece marks for field assembly.
7. Splices.

C. Submit erection drawings showing complete information necessary for the erection of each component part of the structural steel framing. Include the following:

1. Dimensions for alignment and elevations of each member.
2. Location of members and attachments by match-marking of piece numbers.
3. Type, location and details of each field connection.
4. Number of shear connectors on each member.
5. Anchor bolts and setting plans.

D. Do not develop shop drawings by using reproductions of contract drawings.

E. Submittals for Evidence of Conformity to Specifications: Certified mill test reports containing results of chemical and mechanical test as specified by ASTM A6 for the following material:

1. Structural steel shapes.
2. Structural steel bars.
3. Structural steel plates.

F. In addition to the certified mill test reports, the fabricator shall provide an affidavit stating that the structural steel furnished meets the requirements of the ASTM specification for the grade furnished. Qualification test reports bearing witness certification by an independent testing laboratory for each welder, welding operator and tacker to be employed in the work.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Load structural members in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

C. Protect structural steel members and packaged materials from corrosion and deterioration. Store material in a dry area.

D. Support materials stored outdoors above ground surfaces on wood runners and protected with acceptable effective and durable covers.

E. Do not place materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed by the Engineer.

**1.06 - DESIGN CRITERIA**

A. Structural Connections: AISC Specification for Structural Steel Buildings. Design connections not fully detailed on the Drawings to resist the loads shown on the Contract Drawings or specified.

B. Where beam end reactions are not shown, design the connection for one-half the total allowable uniform load in kips for beams laterally supported at the given span, as determined by the tables for allowable loads on beams in the AISC Manual of Steel Construction, in addition to any axial loads identified on the Drawings.

C. Unless otherwise noted on Contract Drawings, design connections for ASTM A325 bolts, bearing-type connection with threads included in shear plane.

**1.07 - QUALITY ASSURANCE**

A. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide structural steel in accordance with AISC Standard for Structural Steel Buildings and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.

C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the jurisdiction where the Project is located.

D. Steel fabricator shall have 5 years experience minimum in structural steel fabrications.

E. Steel erector shall have 5 years experience minimum in structural steel erection.

F. Welding Qualification and Certification:

1. Furnish written welding procedure for welds in conformance with the AWS D 1.1.

2. Each welder, welding operator and tack welder shall be certified by test to perform type of work required in conformance with AWS D 1.1.

3. If a welder or welding operator has not been engaged in a specific welding process for a period of six months or more, that individual shall be deemed unqualified and shall not perform work on the project until the individual has been qualified again by testing in conformance with AWS D 1.1.

4. Maintain duplicate qualification and certification records at the job site readily available for examination.

G. Tolerances:

1. Maintain tolerances conforming to AISC Code of Standard Practice.

2. Permissible variation tolerances conforming to ASTM A 6.

H. Field Measurements

1. The Contractor shall verify dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

2. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

**1.08 - REFERENCES**

A. American Institute of Steel Construction AISC:

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings

2. AISC Manual of Steel Construction, Thirteenth Edition

3. AISC Code of Standard Practice for Steel Buildings and Bridges

4. AISC Specification for Structural Joints using ASTM A 325 or A 490 Bolts

5. AISC Structural Steel Detailing Manual

B. American Welding Society AWS:

1. AWS D1.1: Structural Welding Code – Steel

C. ASTM International (ASTM):

1. A 6/A 6M: Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. A 36/A 36M: Specification for Carbon Structural Steel
3. A 123: Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. A 143: Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement
5. A 153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. A 194/A 194M: Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service
7. A 307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
8. A 325: Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
9. A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
10. A 385: Practice for Providing High Quality Zinc Coatings (Hot-Dip)
11. A 449: Specification for Quenched and Tempered Steel Bolts and Studs
12. A500/A500M: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
13. A 563: Specification for Carbon and Alloy Steel Nuts
14. A 572: Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
15. A 780: Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
16. A 992: Standard Specification for Steel for Structural Shapes for Use in Building Framing
17. F 436: Specification for Hardened Steel Washers
18. F 1554: Standard Specification For Anchor Bolts, Steel, 36, 55, and 105 ksi Yield

D. Occupational Safety and Health Administration (OSHA)

1. Safety and Health Standards for the Construction Industry, 29 CFR 1926 Subpart R Safety Standards for Steel Erection

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - Products**

**2.01 - STRUCTURAL STEEL**

A. W shapes in conformance with ASTM A 992 unless otherwise indicated or specified.

B. C, M, S and HP shapes in conformance with ASTM A 572, Grade 50, unless otherwise specified or shown on contract drawings.

C. Angles, plates and bars in conformance with ASTM A 36.

D. Round, square and rectangular structural tube members (HSS) in conformance with ASTM A 500, Grade B.

E. Steel pipe in conformance with ASTM A 53, Grade B.

F. Hot-Dip Galvanized Carbon Steel in conformance with ASTM A 123.

**2.02 - FASTENERS**

A. Carbon Steel Bolts, Nuts and Washers: ASTM A 307, Grade A.

B. High-strength fasteners in conformance with ASTM A325, Type 1.

C. Nuts and washers ASTM A 563 and F 436.

D. Hot-dip Galvanized Bolts, nuts and washers in conformance with ASTM A 153.

**2.03 - ANCHOR BOLTS**

A. Steel anchor bolts in conformance with ASTM F1554, grade 36.

**2.04 - WELDED STUDS:**

A. Weld studs in conformance with the requirements of ASTM A108, Grade 1015 or 1020.

**2.05 - WELDING**

A. Class E70XX electrodes.

B. Provide equipment for welding, electrodes, welding wire and fluxes capable of producing indicated welds when used by certified welders under AWS welding procedures. Provide welding materials that comply with requirements of AWS Structural Welding Code.

**2.06 - SHOP FABRICATION**

A. Fabricate each element and connection as indicated on the fabrication shop drawings accepted by the Engineer. Fabricate and shop assemble work to the greatest extent practical in conformance with following publications:

1. AISC Manual
2. AISC Specification for Structural Joints
3. AISC Detailing Manual
4. AWS Structural Welding Code

B. Perform shearing, manual flame cutting with mechanically guided torch and chipping such that it will not induce residual stress in metal being cut. Radii of re-entrant corners shall be as large as practicable but not less than 3/4 inch (19 mm). Perform flame cutting so that metal being cut is not carrying stress. Finish exposed edges.

C. Provide full cross section bearing on milled ends of columns, crane rails, monorails and bearing stiffeners.

**2.07 - CONNECTIONS**

A. Connect members with ASTM A 325 high strength bolts unless otherwise specified or shown on contract drawings. Provide clean-cut holes without torn or ragged edges and remove outside burrs.

B. Provide high-strength bolted construction assemblies in accordance with the AISC Specifications for Structural Joints.

1. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material.
2. Joint surfaces shall be free of burrs and foreign materials. Score hot-dipped galvanized contact surfaces with a wire brush or blasted prior to assembly. Grinding of surfaces is not permitted.
3. If the thickness of the material is not greater than the normal diameter of the bolt plus 1/8 inch, the holes may be punched. If the thickness of the material is greater than the normal diameter of the bolt plus 1/8 inch, drill it full size or subpunch 1/16 inch smaller than the bolt diameter and ream to full size.
4. Provide bolt hole diameters not more than 1/16 inch in excess of the nominal bolt diameter unless otherwise specified in contract drawings.

5. Provide required slotted or oversize bolt holes as specified in the AISC Specification for Structural Joints. Tighten each bolt to provide the minimum tension shown in the AISC Specification for Structural Joints for the size and grade of bolts used

6. Provide required slotted or oversize bolt holes as specified in the AISC Specification for Structural Joints.

C. Provide full cross section bearing on milled ends of columns, crane rails, monorails, and bearing stiffeners.

D. Welded Connections:

1. Weld connections indicated or specified.

2. Provide complete weather seal weldments made with 1/16 inch minimum continuous fillets to members having Type S and E Service and to welded connections that will be galvanized.

E. Make connections with ASTM A 307 carbon steel bolts only when specified or shown in contract drawings.

F. Provide ASTM F 1554 anchor bolts with washer and heavy hex nuts. Provide hot-dip galvanized anchor bolts, washers and heavy hex nuts with galvanized steel.

**2.08 - GALVANIZE**

A. Provide hot-dip galvanizing in conformance with ASTM A 123, Grade 100 to steel indicated or specified to be galvanize coated.

B. Provide hot-dip galvanizing, in conformance with ASTM A 153, to bolts, nuts and washers that will be used with galvanized steel.

C. Complete fabrication and prepare surfaces of steel by removing weld spatter, flux, residue, burrs and metal surface defects before galvanizing. Clean weldments with power wire brush prior to galvanizing.

D. Provide steel dipped into solution of zinc chloride plus ammonium chloride immediately prior to galvanizing. Do not use galvanizing process utilizing flux blanket overlaying molten zinc.

E. Chromate treat pieces that will be in contact with or encased in concrete or masonry after galvanizing.

1. Two coats of one of the following coating systems may be substituted for the chromate treatment:

a. Series 161 Tneme-Fascure by Tnemec Co. Inc.

b. CARBOGUARD 891 VOC by Carboline.

c. Valspar-Series 89 by Valspar Corp., Baltimore

d. Or accepted equivalent product.

2. Prepare the steel surface in conformance with the manufacturer's printed instructions immediately before applying the initial coat of the two coat system.

F. Tap bolt nuts after hot-dip galvanizing in conformance with ASTM A 563.

G. Inspect galvanized material for compliance with these specifications. Mark the material with a clearly visible stamp indicating the name of the galvanizer, the ASTM number and the weight of zinc coating in ounces per sq. ft.

**2.09 - GALVANIZE TOUCH-UP**

A. Galvanize Touch-Up: Where galvanizing is damaged, touch-up abraded areas, using brushed-on method, with zinc-rich coating. Touch-up repair with zinc-rich coating of not less than 3 mil and not more than 6 mil dry film thickness.

B. Touch-up damaged galvanized surfaces with one of the following zinc rich coatings:

1. Endupor, zinc-rich coating by Dampney Manufacturing Co., Everett, MA

2. ZiRP, zinc-rich coating by Duncan Galvanizing Corp., Everett, MA

3. ZRC Cold Galvanizing Compound or ZRC Galvilite by ZRC Worldwide, Division of Norfolk Corp., Marshfield, MA;

4. Or accepted equivalent product.

## PART 3 - EXECUTION

### 3.01 - ERECTION OF STRUCTURAL STEEL

A. Conform to the referenced AISC standards. Brace and secure work until permanent connections are completed. Provide accessories and fasteners to secure the work in place whether or not shown or specified.

B. Erect work plumb, square, and true to line and level and in precise positions. Provide temporary bracing and guys to counteract loads and stresses to which structure may be subjected, including those due to erection equipment and its operation.

C. Align the various members to the lines and elevations indicated within the specified erection tolerances. Make adjustments to members prior to making permanent connections. Permanently connect the work in a sequence that will minimize lock-in stress.

D. Splice members only where shown or specified. On exposed welded connections, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

E. Do not enlarge holes in members by burning or the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to place bolts. Do not use gas-cutting torches in the field for correcting fabrication errors in the structural framing.

### 3.02 - DAMAGED MEMBERS

A. Replace members that are bent, twisted, or damaged. Remove members that are impaired in appearance, strength, or serviceability and replace with new members at no additional cost to Owner.

### 3.03 - MISFITS AT BOLTED CONNECTIONS

A. Immediately notify the engineer where misfits in erection bolting are encountered. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

B. Do not enlarge incorrectly sized or misaligned holes in members by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and submit a proposed method of remedy for review by the Engineer.

### 3.04 - ANCHOR BOLTS

A. Install anchor bolts by using templates, setting drawings, and instructions provided by the fabricator. Verify positions of bolts prior to delivery of steel; report errors or deviation for adjustment. After anchor bolts have been embedded, protect threads by applying grease and by having the nuts screwed on until the metalwork is installed.

### 3.05 - COLUMN BASEPLATES AND BEARING PLATES

A. Set columns with base plates attached and bearing plates for beams and similar structural members to their proper alignment and elevation using shim packs. Tighten anchor bolts after members have been positioned and plumbed. Protruding wedges, shims, or other leveling devices shall not be removed but cut off flush with the base plate prior to packing with grout.

### 3.06 - HIGH STRENGTH BOLTS

A. Provide workmanship and techniques for bolted construction in conformance with requirements of AISC Specification for Structural Joints and as indicated or specified.

B. Install ASTM A 325 bolts with hardened washer under element being turned in tightening. Install plate washers in both outer plies when using oversize and slotted holes. Install galvanized washer under bolt head and nut when using galvanized bolts.

C. Do not reuse galvanized high-strength bolts, nuts and washers.

### 3.07 - WELDING

A. Workmanship and techniques for welded construction to conform to requirements of AWS Structural Welding Code and as indicated or specified.

B. No field welding permitted unless indicated on Engineer approved fabrication shop drawings.

C. No field welding permitted on galvanized steel.

**3.08 - CLEAN-UP**

A. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the operations, including disused equipment and implements of service, and leave the entire structure and site, insofar as the work of this section is concerned, in a neat, clean, and acceptable condition.

**3.09 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 06610**

**FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS**

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## PART 1 – GENERAL

### 1.01 - DESCRIPTION

A. This section includes:

1. FRP Grating and Treads.
2. FRP Molded Grating.
3. FRP Structural Shapes.
4. FRP Stairs.
5. FRP Railing.
6. FRP Ladders and Cages.
7. FRP Plank Covers.

B. Furnish all labor, materials, equipment and incidentals necessary to install the fiberglass polymer products specified.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Detail shop drawings indicating:

a. Dimensions.

b. Sectional assembly.

c. Location and identification mark.

d. Connections, connections to structure and fastening methods.

e. Size and location of supporting frames required.

f. Materials of construction.

g. Installation instructions.

2. Catalog data and design tables showing limits for span length and deflection under various and concentrated loads.

3. Stamped by Professional Structural Engineer registered in State where the project is located.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Store materials during and after shipment to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to materials, including damage due to over exposure to sun.

C. Remove material that is damaged from the site, at no cost to the Owner.

D. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

E. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Sustainable Design

1. Product Data for Credits MR 4.1 and Credit MR 4.2: For products having recycled content, provide documentation indicating percentages (by weight) of post-consumer and pre-consumer recycled content. For each recycled product used, include a statement indicating costs.

2. Product Certificates for Credit MR 5.1: For products extracted, harvested and manufactured within 500 miles of the project site, provide documentation indicating percentages (by weight) of regional materials that meet the criteria. For each regional product used, include a statement indicating costs.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Provide documentation showing that the Contractor doing this work has a minimum of 5 years experience in the manufacture and installation of FRP systems similar to that indicated for this project, with sufficient capacity to produce required units without causing delay of work.

C. Install materials in accordance with the manufacturer’s instructions.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. D70: Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method).

2. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

3. D635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

4. D638: Standard Test Method for Tensile Properties of Plastics.

5. D695: Standard Test Method for Compressive Properties of Rigid Plastics.

6. D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between-30 Degree C and 30 Degree C with a Vitreous Silica Dilatometer.

7. D732: Standard Test Method for Shear Strength of Plastics by Punch Tool.

8. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

9. D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
10. D2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
11. D3918: Standard Terminology Relating to Reinforced Plastic Pultruded Products.
12. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
13. G152: Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
14. G153: Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Seasafe, Inc.

B. Strongwell

C. IMCO Reinforced Plastics, Inc.

D. International Grating, Inc.

E. Fibergrate Composite Structures, Inc.

F. Creative Pultrusions, Inc.Or acceptable equivalent product.general:

G. Provide new materials free from defects and imperfections that might affect performance of finished product.

H. After fabrication, seal cut ends, holes and abrasions of FRP shapes with a compatible resin coating to prevent intrusion of corrosion and moisture.

I. Fabricate so that exposed surfaces are smooth and true to form.

J. Manufacture FRP products using vinyl ester resin with flame retardant and UV inhibitor additives. Provide synthetic surface veil covering exterior surface. Provide FRP shapes with flame spread of 25 or less in accordance with ASTM E84.

K. Provide FRP products exposed to weather with ultraviolet inhibitor and one mil thick UV coating to shield from ultra-violet light.

L. Provide Type 316L stainless steel metal accessories unless noted otherwise.

**2.02 - FRP GRATING AND STAIR TREADS**

A. Design Requirements:

1. Grating:
   a. Design grating and support system to sustain dead loads and superimposed live loads.
   b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.
2. Stair Treads:
   a. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load on an area of 4 square inches (2,600 square millimeters) located in the center of the tread, whichever produces greater stress.

3. Deflection:

   a. 1/4-inch (6 mm) maximum under uniform live load of 100 psf (4.8 kPa) for grating and stair treads.

   b. L/240 maximum for support members.

B. Fabricate grating and Stair Treads from pultruded bearing bars and cross rods. Assemble grating using a locking cross-rod design that makes a permanent connection between the cross-rod and bearing bar, and is completely bond into a one-piece panel.

C. Color shall be gray. Stair treads shall have a safety yellow nosing.

D. Provide grating with a slip resistant epoxy grit surface.

E. Use Type 316L stainless steel grating hold down clamps spaced as required by manufacturer, but not greater than 4 feet (1,200 mm) on center. Provide two at each support with a minimum of four per panel.

F. Position grating sections flat and square with ends bearing minimum 1-1/4 inches (30 mm) on supporting structure.

G. Provide embedded angle support frames with continuous integral anchor for grating set in concrete openings unless noted otherwise.

H. Maximum Grating Clearances:

1. 1/4-inches (6 mm) from vertical steel sections.

2. 1/2-inches (12 mm) from concrete and masonry walls.

3. 1/4-inches (6 mm) between sections and at ends.

**2.03 - MOLDED GRATING**

A. Design Requirements:

1. Grating:

   a. Design grating and support system to sustain dead loads and superimposed live loads.

   b. 100 psf (4.8 kPa uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.

2. Deflection:

   a. 1/4-inches (6 mm) maximum under uniform live load of 100 psf (4.8 kPa for grating and stair treads.

   b. L/240 maximum for support members.

B. Continuous glass filament reinforcement, approximately 30 percent glass to resin ratio.

C. Resin rich exterior surfaces free of air bubbles and dry glass.

D. Color shall be safety yellow gray.

E. Provide a slip resistant quartz grit applied surface.

F. Provide Type 316L stainless steel hold down clamps spaced as required by manufacturer, but not greater than 4 feet (1,200 mm) on center. Provide two at each support with a minimum of four per panel.

G. Position grating sections flat and square with ends bearing minimum 1-1/4 inches (30 mm) on supporting structure.

H. Set grating set in concrete openings with embedded angle support frames having continuous integral anchor unless noted otherwise.

I. Maximum Grating Clearances:

1. 1/4-inches (6 mm) from vertical steel sections.
2. 1/2-inches (12 mm) from concrete and masonry walls.
3. 1/4-inches (6 mm) between sections and at ends.

**2.04 - STRUCTURAL SHAPES**

A. Design requirements:

1. Design Loads:
   a. Design structural framing to sustain dead loads and superimposed live loads.
   b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.
2. Deflection:
   a. L/240 maximum.

B. Manufacture structural shapes by the pultrusion process.

C. Provide structural shapes with a UV inhibitor.

D. Provide structural shapes containing a glass fiber reinforced vinyl ester resin matrix, approximately 50 percent glass by weight with a synthetic surface veil outer layer covering the exterior surfaces. Provide glass strand rovings shall be for longitudinal strength. Provide continuous strand glass mats or stitched reinforcements shall for transverse strength.

E. Provide Type 316L stainless steel bolts and washers.

F. Abrade joint surfaces to be bonded to remove surface gloss and be free of burrs or other foreign materials that would prevent proper adhesion.

**2.05 - STAIRS**

A. Fabricate from FRP structural shapes form material as specified.

B. If rise and runs are not noted on Drawings, use OSHA standards for rise and run.

C. Provide Stair Treads from material as specified.

D. Provide handrail from material as specified.

E. Use Type 316 stainless steel bolts throughout.

**2.06 - RAILING**

A. Design requirement:

1. Design railing system to meet the configuration and loading requirements of OSHA, IBC or local buildings codes. Apply requirements of the most stringent code.

B. Fully bond all post to rail connections with an epoxy adhesive and with an internal connection for added strength and durability. Provide smooth transitions between post and rail connections.

C. Provide kickplates where required by OSHA. Kick plate shall be 4 inches by 1/2-inch (100 mm by 12 mm) thick pultruded shape attached to posts with stainless connectors.

D. Color shall be safety yellow.

E. Fabricate handrail to standard two-rail design unless noted otherwise.

1. Post Locations:

a. No greater than 12 inches (25 mm) from horizontal or vertical change in handrail direction.

b. Post centers shall be no greater than 60 inches (1,500 mm) apart on any straight run of rail.

c. Post centers shall be no greater than 48 inches (1,200 mm) apart on inclined rail section.

F. Provide side mounted, base mounted, embedded, or removable anchorage mounted handrail as noted on Drawings.

G. Accurately locate handrail sections and erect plumb and level.

**2.07 - LADDERS AND CAGES**

A. Design requirement:

1. Design ladder and cage system to meet the configuration and loading requirements of OSHA, IBC or local buildings codes. Apply requirements of the most stringent code .

B. Provide ladder side rails 2 inches by 2 inches by 0.156 inches (50 mm by 50 mm by 4 mm) minimum thickness square tubes manufactured by the pultrusion process.

C. Provide ladder rungs pultruded 1 inch (25 mm) diameter minimum solid round bar with slip resistance epoxy grit surface.

D. Install ladder fiberglass stand-off brackets at a maximum of 6 feet (1,800 mm) on center.

E. Fabricate ladder cages per OSHA, from FRP Hoops and Straps. Hoops are to be 3 inches by 1/4-inch (75 mm by 6 mm) preformed FRP. Hoop spacing shall be a maximum of 4 feet (1200 mm) on center. Straps shall be 2 inches by 3/16-inch (50 mm by 5 mm) FRP spaced at 9 inches (230 mm) on center maximum. Bond hoops and straps with epoxy adhesives and riveted with Type 316 stainless steel rivets. Attach hoops to side rails in manner that provides hand clearance throughout length of ladder.

F. Ladder and Cage shall be safety yellow.

**2.08 - PLANK COVER**

A. Design Requirements:

1. Design Loads:

a. Design structural framing to sustain dead loads and superimposed live loads.

b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, on an area of 4 square inches (2,600 square millimeters) located in the center of the plank, whichever produces greater stress.

2. Deflection:

a. 1/4-inches (6 mm) maximum.

B. Manufacture planks by the pultrusion process. Provide planks 2 inches (50 mm) deep and 24 inches (600 mm) wide with interlocking joints on outside legs of plank. The glass fiber reinforcement for the planks shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. A synthetic surface veil shall be the outermost layer covering the exterior surfaces.

C. Provide planks with UV inhibitor and a skid resistant surface.

D. Cap ends of individual plank pieces with channel caps.

E. Provide 3/8-inches (10 mm) diameter bent stainless steel rod recessed lifting handles. Provide one two handles at each end of individual pieces.

F. Set planks in concrete openings with embedded angle support frames having continuous integral anchor unless noted otherwise. Bear planks on length as required by plank manufacturer.

G. Color shall be gray.

## PART 3 - EXECUTION

### 3.01 - EXAMINATION

A. Remove and replace damaged items at no cost to Owner.

B. Examine supports for size, layout and alignment. Maintain surfaces free of debris.

### 3.02 - INSTALLATION

A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.

B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.

C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

### 3.03 - CLOSEOUT ACTIVITIES

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 13330**

**PROCESS INSTRUMENTS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide process instruments as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) shall furnish process instruments as specified and in accordance with the Contract Documents.

D. Instrument Product Sheets are in Attachment A.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Field Instrumentation

C. Submit the following shop drawings in accordance with Section 01300.

D. All submittals provided by the Contractor under this specification section shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments has been addressed and that the submittal is reviewed by the SI.

E. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

F. Submit Product Data Sheets, in accordance with ISA-S20 with the information noted below and other data pertinent to the equipment and the application.

1. Initial submission for review to accompany Shop Drawings:

a. The product manufacturer and the supplier or representative.

b. The complete model or catalogue number(s) including any special options.

c. The available adjustment range(s) and the operating range(s).

2. Second Submission during pre-commissioning, testing and calibration period:

a. Serial numbers, part numbers, dates of installation and calibration.

b. Calibration and programming procedure.

c. Calibration and programming documentation.

d. Provide linkage or range adjustments sealed by colored lacquer following calibration.

e. This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

3. Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

a. All of the above information.

b. Phone number and email address of contact person for product support/service.

G. Submit Shop Drawings for all instruments. Manufacturers' catalog cuts and product specifications shall be accepted only if the following information is clearly indicated and highlighted for the equipment proposed:

1. Submit information on each instrument to demonstrate compliance with the data sheet.

2. Tag names, quantities, options provided, full description and performance data.

3. Installation details depicting mounting assemblies, physical dimensions.

4. Termination details, clearly indicating the type and lengths of external wiring required and electrical connections.

5. Power supply rating, input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements.

6. Specific catalog model numbers for each piece of equipment and its accessory options, clearly referenced by the respective instrument or equipment tag name. Improperly tagged items shall be rejected.

7. Sales bulletins and other general publications are not acceptable as submittals except where necessary to provide supplemental technical data.

H. Submit a separate document with manufacturers' recommended list of spare parts, including individual pricing with the shop drawings.

I. Drawing submissions shall clearly show the enclosures proposed for each instrument.

J. Submit completed Calibration forms and Instrument Installation Checklist forms.

K. Submit schedule of proposed instrument nametag inscriptions.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Where possible, all equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings and on the data sheets.

D. References:

1. American Petroleum Institute (API):

    a. RP 551: Process Measurement Instrumentation

2. International Society of Automation (ISA):

    a. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

3. National Electrical Manufacturers Association (NEMA):

    a. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.07 - QUALITY ASSURANCE**

A. All instruments shall be UL listed or equivalent listing system when UL listing is not available.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. In addition, the equipment shall be warranted to be free from defects in workmanship, design and materials for a period of 5 years from shipment. If any part of the equipment should prove to be defective during the warranty period, the manufacturer at no expense to the Owner shall replace the part.

C. All installed equipment shall conform to the contract specifications and to manufacturer’s published specifications. The warranty shall begin at the substantial completion date and remain in effect for a period of one (1) year from that date. The Contractor shall repair, adjust, service and/or replace any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period. All third party warranties shall be passed through from the Contractor to the Owner.

D. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

E. The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guides and as specified herein.

**PART 2 - PRODUCTS**

**2.01 - GENERAL REQUIREMENTS**

A. Provide instruments with enclosure rating indicated on electrical drawings or in instrument Product Sheet - whichever is more stringent.

B. Instruments shall have an integral indicator to display the current process measurement, calibrated in engineering units. Blind instruments shall be provided with a separate digital indicator mounted adjacent to the instrument as specified.

C. Provide electronic instruments with linear 4-20 mA DC isolated output signals capable of driving a maximum load of 750 ohms.

D. Electronic instruments shall have integral configuration capability. Instruments without integral configuration capability shall be provided with a wireless remote handheld terminal. One handheld terminal shall be provided for each type of device in the Contract Documents.

E. Provide standard instrument process connections of 1/2 inch (12.7 mm) NPT female, other than pressure gauges which shall be 1/2-inch (12.7 mm) NPT male.

F. Instruments shall be of current manufacturer design. Obsolete equipment or equipment that has been identified for withdrawal from the market by the manufacturer before date of shop drawing submittal shall not be accepted.

G. Field measure lengths for transducer cables and similar items prior to ordering and supply adequate cable length for application.

**2.02 - MATERIALS**

A. Provide manufacturer's written certificate that the materials of construction are suitable for the service and process fluids.

**2.03 - EQUIPMENT**

A. Provide instruments in accordance with the Product Sheets, Schedules, and Special Construction notes in the attachments to this Section.

**2.04 - ACCESSORIES**

A. Provide the necessary mounting brackets and mechanical shields to secure and protect transducers and other instrumentation devices.

B. Provide all electrical connections, transducer junction boxes, power supplies, and accessory items or options required to satisfy each application.

C. Provide cable between transducers and transmitter units with adequate length based on the location of the devices as shown on the Contract Drawings. Cables shall be continuous run with no splices.

D. Mounting brackets shall be AISI 316 Stainless Steel, and design to securely fasten the devices.

E. Provide shields for outdoor mounted electronic instrument with integral displays, to provide protection against rain, ice and snow and shade from the sun.

F. Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joints or couplings in accordance with the Manufacturer's written instructions.

G. Provide identification nametags for instruments, engraved stainless steel, 3 inch x 1.5 inch x 1/16 inch. Affix to component with minimum 18 AWG minimum stainless steel wire or stainless steel screws. Provide inscription in block letters with following lines, text height as indicated:

1. Line 1: Device Tag and Name, ¼ inch.
2. Line 4: Power Source, 1/6 inch.

**PART 3 – EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - INSTALLATION**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16 - ELECTRICAL.

C. Provide proper installation of the equipment in accordance with manufacturer’s written instructions and/or as approved by the Engineer. Coordinate the proper installation of equipment with the Work of all other trades.

**3.03 - PAINTING**

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09900, PAINTING.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided for installation and startup for the equipment as follows:

1. 7 calendar days (via ## separate trips to project site).

**3.06 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided for training of Owner's personnel for the equipment at the project site as follows:

1. 3 calendar days (via ## separate trips to project site).

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Provide spare parts as indicated on the instruments’ data sheets.

**3.09 - SHOP TESTING – Not Used**

**3.10 - INSTALLATION**

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer's written instructions.
2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.
3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless Steel.
4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.
2. Orient instrument displays to be easily viewed from a standing position.
3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.
4. Unless otherwise indicated in the Contract Documents, mount instruments 55 inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.
5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.
7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.
8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless Steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.
2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.

3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.

4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.

5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

**3.11 - PRE-COMMISSIONING**

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer's written instructions.

2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.

3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless Steel.

4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.

2. Orient instrument displays to be easily viewed from a standing position.

3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.

4. Unless otherwise indicated in the Contract Documents, mount instruments 55 inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.

5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.

6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.

7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.

8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless Steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.

2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.

3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.

4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.

5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

**3.12 - COMMISSIONING**

A. Demonstrate instrument calibration and loop checks. Each loop check shall be witnessed by, and successfully demonstrated to the Engineer for sign-off.

**3.13 - MANUFACTURER SERVICES AND CERTIFICATION OF INSTALLATION**

A. Provide the services of a trained, qualified manufacturer's representative to test, program and start the instruments to ensure correctness of installation, calibration, testing, start-up, commissioning and training.

B. Manufacturer field services shall be split into three stages: inspection during installation, start up and commissioning, plant operation personnel training.

C. The qualified representative shall:

1. Provide on-site supervision of installation, commissioning and testing for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as required by the Engineer. The Engineer may order additional supervision at no additional cost to the Contract if, in their opinion, procedures are compromised.

2. Provide operation and maintenance instruction to the plant operation personnel.

D. Provide all materials, labor and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer.

E. On completion of installation and testing, provide written certification from the manufacturer confirming that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.

**3.14 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**ATTACHMENT A**
**INSTRUMENTS PRODUCT SHEETS**

| | |
|---|---|
| DATA SHEET 1.1 | pH/ORP SYSTEM SPECIFICATION |
| DATA SHEET 2.1 | DO SYSTEM SPECIFICATION |
| DATA SHEET 3.1 | pH AND DISSOLVED OXYGEN SYSTEM SPECIFICATION ADDITIONAL REQUIREMENTS |
| DATA SHEET 6.1 | PERISTALTIC TYPE AUTOMATIC SAMPLER SPECIFICATION |
| DATA SHEET 10.1 | TURBIDITY/TOTAL SUSPENDED SOLIDS ANALYZER SPECIFICATION |
| DATA SHEET 48.1 | GAS SENSOR TRANSMITTER SPECIFICATION |
| DATA SHEET 50.1 | CONTINUOUS ON-LINE MULTI-PARAMETER ANALYZER SPECIFICATION |
| DATA SHEET 416.1 | MAGNETIC FLOW METER SPECIFICATION |
| DATA SHEET 426.1 | THERMAL DISPERSION FLOW METER SPECIFICATION |
| DATA SHEET 442.1 | FLOW SWITCH (PADDLE TYPE) SPECIFICATION |
| DATA SHEET 443.1 | ROTAMETER SPECIFICATION |
| DATA SHEET 853.1 | LEVEL SWITCH (FLOAT TYPE) SPECIFICATION |
| DATA SHEET 859.1 | LEVEL TRANSMITTER (ULTRASONIC TYPE) SPECIFICATION |
| DATA SHEET 864.1 | LEVEL SWITCH MINIATURE FLOAT TYPE) SPECIFICATION |
| DATA SHEET 873.1 | SUBMERSIBLE WATER LEVEL SENSOR/TRANSMITTER SPECIFICATION |
| DATA SHEET 1451.1 | GAUGE PRESSURE TRANSMITTER SPECIFICATION |
| DATA SHEET 1452.1 | PRESSURE SWITCH SPECIFICATION |
| DATA SHEET 1454.1 | PRESSURE GAUGE SPECIFICATION |
| DATA SHEET 1457.1 | PRESSURE ISOLATOR RING SPECIFICATION |
| DATA SHEET 1662.1 | ROOM/OUTSIDE AIR TEMPERATURE SENSOR SPECIFICATION |

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**pH/ORP SYSTEM SPECIFICATION**

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**DATA SHEET 1.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | See Table Below |
| 2. | Service | : | See Table Below |
| 3. | P&ID No. | : | See Table Below |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

ELECTRODE STATION

| | | | |
|---|---|---|---|
| 5. | Type | : | SUBMERSIBLE |
| 6. | Electrodes | : | GLASS Ph, PLATINUM ORP AND DOUBLE JUNCTION REFERENCE |
| 7. | Temperature Comp. | : | AUTOMATIC |
| 8. | Range Measured | : | 0 TO 14 Ph OR ± 2000mV ORP |
| 9. | Sensitivity | : | ±0.02 pH |
| 10. | Repeatability | : | pH ±0.05 pH, ORP ±3 mV |
| 11. | Enclosure | : | SUBMERSIBLE |
| 12. | Material | : | EPOXY RESIN PLASTIC |

TRANSMITTER

| | | | |
|---|---|---|---|
| 13. | Type | : | ELECTRONIC |
| 14. | Input Power Source | : | 120VAC |
| 15. | Output Signal | : | 4 - 20 mADC, FOR PH TRANSMITTER, PROVIDE ADDITIONAL OUTPUT SIGNAL FOR TEMPERATURE |
| 16. | Local Indicator | : | LCD DISPLAY |
| 17. | Diagnostics | : | BROKEN GLASS, LIQUID LEAK, RTD-SHORT/OPEN, FAILED PREAMP, FOULED REFERANCE |
| 18. | Enclosure | : | IN ACCORDANCE WITH AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 19. | Accuracy | : | ±0.04% OF FULL SCALE |
| 20. | Repeatability | : | SAME AS ACCURACY+/-0.1 pH UNIT |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 21. | Fluid | : | SEE TABLE |
| 22. | Solution Temp. | : | -20 TO +40°C (-4 TO 100°F) |
| 23. | Operating Pressure | : | 2 TO 10 FEET WATER |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 24. | Interconn. Cable | : | 50 FEET WITH QUICK DISCONNECT |
| 25. | Manufacturer(s) | : | E+H, CERLIC, FOXBORO OR EQUAL TRANSMITTER |
| 26. | Model No.(s) | : | CPF 81/82 & CPM 153 OR 223, PHx & BB2, pH10 & 870ITP OR EQUAL |

| TAG NO. | SERVICE | FLUID | P.&I.D |
|---|---|---|---|
| AE/AIT-1005A | PRE-EQUALIZATION TANK 1 pH | INF | 10 DI-602 |
| AE/AIT-1005B | PRE-EQUALIZATION TANK 1 ORP | INF | 10 DI-602 |
| AE/AIT-1006A | PRE-EQUALIZATION TANK 2 pH | INF | 10 DI-602 |
| AE/AIT-1006B | PRE-EQUALIZATION TANK 2 ORP | INF | 10 DI-602 |
| AE/AIT-1130 | SEPTAGE RECEIVING pH | SEP | 10 DI-611 |
| AE/AIT-1021A | SBR 1 pH | SBI | 15 DI-601 |
| AE/AIT-1021B | SBR 1 ORP | SBI | 15 DI-601 |
| AE/AIT-1032A | SBR 2 pH | SBI | 15 DI-601 |
| AE/AIT-1032B | SBR 2 ORP | SBI | 15 DI-601 |

NOTES.

a. See Data Sheet 3.1 for additional requirements.

**DISSOLVED OXYGEN SYSTEM SPECIFICATION**

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**DATA SHEET 2.11**

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| | | | |
|---|---|---|---|
| GENERAL | | | |
| 1. | Tag Number | : | SEE TABLE NEXT PAGE |
| 2. | Service | : | SEE TABLE NEXT PAGE |
| 3. | P&ID No. | : | SEE TABLE NEXT PAGE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |
| ELEMENT - PROBE | | | |
| 6. | Type | : | SUBMERSIBLE LUMINESCENT TECHNOLOGY SENSOR |
| 7. | Range Measured | : | 0-20 mg/l |
| 8. | Compensation | : | AUTOMATIC FOR PRESSURE, TEMPERATURE & HUMIDITY |
| 9. | Enclosure | : | SUBMERSIBLE |
| 10. | Mounting | : | SUSPENSION ASSEMBLY HOLDER. DO NOT MOUNT ON HAND RAIL |
| 11. | Material | : | STAINLESS |
| TRANSMITTER | | | |
| 12. | Type | : | ELECTRONIC |
| 13. | Input Power Source | : | 120 VAC |
| 14. | Output Signal | : | 4 - 20 mADC |
| 15. | Display | : | DIGITAL PPM, 0-100%, TEMPERATURE AND ALARM TRIP SETTINGS |
| 16. | Key Pad | : | MEMBRANE TYPE FOR CONFIGURATION, CALIBRATION, AND PROCESS INFORMATION |
| 17. | Contacts | : | WHEN REQUIRED BY LOOP, SPDT 3 APMS AT 120 VAC |
| 18. | Accuracy | : | ±1.0% MEASURING RANGE AT CALIBRATION TEMPERATURE |
| 19. | Enclosure | : | NEMA 4X (IP65) WITH SUN SHIELD |
| 20. | Mounting | : | WALL OR STRUT |
| PROCESS CONDITIONS | | | |
| 21. | Fluid | : | SEWAGE AERATION TANKS |
| 22. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 23. | Operating Pressure | : | 2 TO 10 FEET WATER |
| MISCELLANEOUS | | | |
| 24. | Interconn. Cable | : | 50 FEET WITH WATER TIGHT IP66 QUICK DISCONNECT FITTINGS |
| 25. | Manufacturer(s) | : | HACH, E+H, CERLIC, ROSEMOUNT OR EQUAL |

NOTES.

a. See Data Sheet No. 3.1 for additional requirements.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AE/AIT 1021F | SBR 1 DISSOLVED OXYGEN | 15 DI-601 |
| AE/AIT 1031F | SBR 2 DISSOLVED OXYGEN | 15 DI-601 |

**pH, ORP AND DISSOLVED OXYGEN SYSTEM SPECIFICATION**
**ADDITIONAL REQUIREMENTS**

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**DATA SHEET 3.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE DATA SHEETS 1.1 AND 2.1 |
| 2. | Service | : | SEE DATA SHEET 1.1 AND 2.1 |
| 3. | P&ID No. | : | SEE DATA SHEET 1.1 AND 2.1 |
| 4. | Location | : | SEE DATA SHEET 1.1 AND 2.1 |

OTHER REQUIREMENTS:

5. All wetted parts must be suitable for the intended service conditions.
6. Provide field replaceable sensor, Salt Bridge, Standard Cell Solution, ORP reference solution (500mL Bottles)
7. Supply each probe with 50 feet of cable, with a weatherproof plug on each end for connection to the transmitter. Provide a cover permanently attached to protect the probe when not in use.

FOR SUBMERSIBLE SENSORS

8. Provide a suspension assembly to mount transmitter and sensor. Provide upright 316 Stainless Steel post to mount transmitter and support transverse pipe assembly with easily removed clamps. Provide transverse pipe to hold sensor assembly. Provide weather shield to protect transmitter. Provide complete assembly like E+H CYY 101 w/ immersion assembly or tube. Do not mount transmitter and or analyzer to the railings.
9. Provide each probe with a 316 stainless steel mounting brackets.

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**PERISTALTIC TYPE AUTOMATIC SAMPLER SPECIFICATION**

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**DATA SHEET 6.1**

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| | | | |
|---|---|---|---|
| GENERAL | | | |
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |
| SAMPLER | | | |
| 5. | Type | : | SELF CONTAINED REFRIDGERATED SAMPLER |
| 6. | Discrete/Composite | : | PROGRAMMABLE, DISCREET AND COMPOSITE |
| 7. | Fixed/Portable | : | FIXED |
| 8. | Refrigeration | : | REQUIRED, SAMPLE TEMPERATURE STABILITY MAINTAINED 39°F/4°C FOR OPERATING TEMP RANGE 5°F TO 104°F/-15°C TO 40°C |
| 9. | Bottle Type/Size | : | ONE 2.5 GAL BOTTLE |
| 10. | Bottle Quantity | : | SEE NOTES |
| 11. | Sample Volume | : | VACUUM PUMP - 20ml to 350ml/0.7fl oz to 12fl oz |
| 12. | Sample Frequency | : | PROGRAMABLE, USER-DEFINED TEXT, MULTIPLE SAMPLING MODES RUNNING SIMULTANEOUSLY TO ALLOW AUTOMATIC MODE CHANGE WITHOUT OPERATOR PARTICIPATION |
| 13. | Sample Mode | : | VACUUM PUMP - CONSTANT TIME/CONSTANT VOLUME, VARIABLE TIME/CONSTANT VOLUME; EVENT SAMPLING. PERISTALIC PUMP - CONSTANT TIME/CONSTANT VOLUME; VARIABLE TIME/ CONSTANT VOLUME; CONSTANT TIME/VARIABLE VOLUME; EVENT SAMPLING |
| 14. | Sample Height | : | 26 FEET |
| 15. | Power Requirement | : | 120 VAC, 60 HZ 10AMP MAXIMUM |
| 16. | Communication | : | 4-20mA |
| 17. | Sample Line Size | : | 10 mm (3/8"), 98 FT MAX LENGTH, PVC/EPDM W/ CORROSION RESISTANT STRAINER |
| 18. | Wetted Materials | : | CORROSION RESISTANT |
| 19. | Enclosure Class | : | PER AREA CLASSIFICATION SCHEDULE ON SHEET 00 E-601. |
| 21. | Exterior Finish | : | ASA-PC V0 LURAN TO UL508 , UL60950-1 |
| 22. | Battery Back-up | : | REQUIRED, EXTERNAL 24V, RECHARGEABLE; INTERNAL LITHIUM |
| SAMPLING RANGE | | | |
| 22. | Flow Proportional | : | PROCESS FLOW, PROGRAMABLE W/ AUTOMATIC MODE CHANGE |
| 23. | Time Proportional | : | PROGRAMABLE W/ AUTOMATIC MODE CHANGE, MINUTES AND HOURS |
| ENCLOSURE | | | |
| 24. | Installation | : | INDOORS |
| 25. | Material | : | ASA-PC V0 LURAN, UL94, UL60950-1, UL508 |
| 26. | Insulation | : | EPS NEOPOR, ASTM E96, C203, D2126, EXCEED ASTM C518; 2-INCH |
| 27. | Gasket | : | UPPER AND LOWER COMPARTMENTS, FRONT/REAR, WATERTIGHT |
| 28. | Doors | : | ASA-PC V0 TO MAINTAIN NEMA 4X ENCLOSURE W/ INTEGRAL KEYED LOCKS |

| | | |
|---|---|---|
| 29. | Temp Control | : THERMOSTATICALLY CONTROLLED TO 39°F IN 210 MIN, COMPRESSOR WITH BAKED ENAMEL FINIS, PROVIDE COPPER REFRIGERANT LINES W/ CONFORMAL COATING TO PROTECT AGAINST H2S ATTACK |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 30. | Fluid | : WASTEWATER |
| 31. | Sample Temperature | : 2° TO 50° C (36° TO 120° F) |
| 32. | Pressure Range | : 11 PSIG MAXIMUM FOR SAMPLING IN PRESSURIZED LINES |
| 33. | Ambient Temp. | : -15° TO 40° C (5° TO 104° F) |

OTHER REQUIREMENTS

34. Provide sample pump to sustained sample velocity of 1.9ft/s in a 3/8" line. Pump shall automatically purge the sample line after each sample is drawn. Peristaltic pump tubing shall be silicon. Where peristaltic pumps are specified, provide 4 spare pump tubing kits
35. Provide sampler with a flow assembly for sampling from pressurized lines, pressure not to exceed 11 psig. Inlet connection shall be ¾" hose barb with union coupling. Outlet connection shall be 1 ¼" hose barb with union coupling. Outlet shall vent to drain at atmosphere. Sampler connection shall be 3/8" NPT
36. Provide electronics and refrigeration located in upper compartment of the NEMA 4X sampler, and shall be accessible to the operator
37. Provide sampler with a distribution arm to allow change of sample mode from composite to discreet without field retrofit
38. Provide sampler with industrial flash drive to maintain up to eight data-logs simultaneously. The data shall be visible on the operator interface screen and capable of download without interruption of process
39. Provide inputs for up-to 2 analog and 2 discrete inputs for flow paced and event triggered sampling
40. Provide the ability to run multiple programs simultaneously, and the ability to change sampling modes without operator interface. Sampler shall allow manual override

MISCELLANEOUS

| | | |
|---|---|---|
| 41. | Manufacturer(s) | : ENDRESS+HAUSER, HACH, MANNING OR EQUAL |

NOTES.

a. Provide 2 complete sample line replacement kits including; 10M sample line ferrules, clamps and strainer.
b. Provide sampler who has local representation within 100 miles of the project site. Sample manufacturers without local representation will not be considered.
c. Provide a minimum of two (2)site visit(s) not to exceed 10 hours per visit by the sampler manufacturer's authorized technician to commission the sampler(s). Commissioning shall include inspection of installation, wiring verification, initial programming, function check, loop check, operator field and classroom training, written report
d. Contractor shall install the sampler mechanically and electrically prior to the commencement of commissioning services
e. Provide warranty from the sample such that the sampler(s) shall be free from manufacturing defects for a period of thirty six (36) months from date of commissioning and submission of written commissioning report as specified in paragraph "c" above

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AN-1002 | INFLUENT SCREENING | 10 DI-601 |
| AN-1094 | PLANT EFFLUENT | 10 DI-607 |

**TURBIDITY/TOTAL SUSPENDED SOLIDS (TSS) ANALYZER SPECIFICATION**

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**DATA SHEET 10.11**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE BELOW |
| 2. | Service | : SEE TABLE BELOW |
| 3. | P&ID No. | : SEE TABLE BELOW |
| 4. | Location | : SEE MECHANICAL DRAWINGS |

PROBE ELEMENT

| | | |
|---|---|---|
| 5. | Type | : SUBMERSIBLE INFRARED COLOR INDEPENDENT |
| 6. | Cleaning Type | : SELF CLEANING, WIPER |
| 7. | Range (TSS) | : 0.001 mg/L to 50 g/L TSS OR 0.001 mg/L to 500 g/L |
| 8. | Range (Turbidity) | : .001 to 4000 NTU |
| 9. | Body Material | : STAINLESS STEEL |
| 10. | Meas.Chamber Mat. | : STAINLESS STEEL |
| 11. | Mounting | : IMMERSION OR INLINE |

TRANSMITTER

| | | |
|---|---|---|
| 12. | Type | : ELECTRONIC |
| 13. | Input Power Source | : 120 VAC |
| 14. | Output Signal | : 4 - 20 mADC |
| 15. | Indicator | : 4 1/2 INCH DIAL OR 2 1/2 DIGIT LCD |
| 16. | Accuracy (TSS) | : <5% OF MEASURED VALUE |
| 17. | Accuracy (Turbidity) | : <1% OF THE MEASURED VALUE +/- 0301 NTU (WITH CALIBRATION) |
| 18. | Repeatability (TSS) | : <3% |
| 19. | Repeatability (Turbidity) | : <1% |
| 20. | Elec. Clas'tion | : CLASS 1 DIVISON 1 OR NEMA 4X BASED ON AREA CLASSIFICATION ON SHEET 00 E-601 |

PROCESS CONDITIONS

| | | |
|---|---|---|
| 21. | Fluid | : SEE TABLE |
| 22. | Operating Temp | : 40 TO 75 DEG. F. |

MISCELLANEOUS

| | | |
|---|---|---|
| 24. | Interconn. Cable | : 50 FEET WITH QUICK DISCONNECT FITTINGS |
| 25. | Manufacturer(s) | : HACH OR EQUAL |
| 26. | Model No.(s) | : SOLITAX SC PROBE WITH SC200 CONTROLLER, OR EQUAL. |

NOTES.

27. For open channel or tank mounted sensors, the probe lengths shall be as specified elsewhere. Furnish probe with sufficient number of swivel clamps to attach the sensor to the rail or vertical post and hold it rigidly in place. Design clamps specifically for the intended application and fit them with stainless steel set screws, dowel pins, bolts, nuts and washers.
28. Design transmitter to permit the entire electronics assembly to be removed from the enclosure as a single unit for prompt replacement from spare parts inventory in case of electronics failure or other damage.
29. Furnish one complete spare analyzer of each model, to cover the range herein specified.

30. Furnish a one year supply of spare parts, as recommended by the manufacturer, for each different model used.
31. The manufacturer of the analyzer shall furnish initial start-up and calibration services when notified by the Contractor that all units are installed, powered and ready for operation.
32. Services shall be furnished by the manufacturer to provide instruction to the operating personnel in the operation and maintenance of the analyzer.

| TAG NO. | SERVICE | FLUID | P&ID |
|---|---|---|---|
| AE/AIT 1050 | DISK FILTER 1 INFLUENT TURBIDITY | DEC | 10 DI-604 |
| AE/AIT 1060 | DISK FILTER 2 INFLUENT TURBIDTY | DEC | 10 DI-604 |
| AE/AIT 1056 | DISK FILTER 1 EFFLUENT TURBIDITY | FE | 10 DI-604 |
| AE/AIT 1066 | DISK FILTER 2 EFFLUENT TURBIDITY | FE | 10 DI-604 |
| AE/AIT 1084 | EFFLUENT TURBIDITY | EFF | 10 DI-606 |
| AE/AIT-1021E | SBR 1 TURBIDITY | SBI | 15 DI-601 |
| AE/AIT-1032E | SBR 2 TURBIDITY | SBI | 15 DI-601 |

**GAS SENSOR TRANSMITTER SPECIFICATION**

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**DATA SHEET 48.1**

---

GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE |
| 2. | Service | : SEE TABLE |
| 3. | P&ID No. | : SEE TABLE |
| 4. | Location | : SEE TABLE AND ELECTRICAL PLANS |

SENSOR

| | | |
|---|---|---|
| 5. | Type | : LEL – IR SENSOR, OXYGEN AND H2S - ELECTROCHEMICAL. SEE TABLE |
| 6. | Op Temp Range | : LEL - -40°C TO 50°C, OXYGEN AND H2S -40°C TO 40°C |
| 7. | Response Time | : LESS THEN 35 SECONDS |
| 8. | Repeatability | : +/- 5% @ TEMP OF CALIBRATION |
| 9. | Sensor Life | : 2 YEARS MINIMUM |
| 10. | Filter | : AS REQUIRED FOR DUST |

ANALYZER/TRANSMITTER

| | | |
|---|---|---|
| 11. | Range | : 0 - 100% LEL, 0-50ppm H2S, 0-25% O2 |
| 12. | Repeatability | : +/- 2.0% |
| 13. | Channels | : ONE PER ANALYZER |
| 14. | Output Signal | : 4-20 mADC |
| 15. | Indicator lights | : WARNING AND ALARM |
| 16. | Alarm Contacts | : TWO SPDT REQUIRED |
| 17. | Contact Rating | : 3 AMPS 30 VDC |
| 18. | Input Power | : 120VAC |
| 19. | Indicator | : LCD |
| 20. | Mounting | : REMOTE WALL OR PEDESTAL. MOUNT 5.5 FEET ABOVE FINISHED FLOOR. |
| 21. | Adjustments | : SET POINTS, ALARM AND CALIBRATION |
| 22. | Enclosure | : EXPLOSION PROOF FOR SENSORS AND TRANSMITTER |
| 23. | Cable Package | : AS REQUIRED |

MISCELLANEOUS

| | | |
|---|---|---|
| 24. | Manufacturer | : MSA, VULCAIN, DETECTOR OR APPROVED EQUAL |

NOTES.

a. Provide one year's supply of calibration gas. Assume each unit is calibrated once per week.

b. Provide analyzers and sensors which require only a single 3 conductor 16 AWG shielded cable per sensor between analyzer and sensor for distances up to 1000 feet between analyzer and sensor.

c. Design sensor to operate in an atmosphere of 100 ppm of hydrogen sulfide for up to 24 hours with no more than 5% reduction in sensor response time.

d. Provide system that shall be connected to controller over a multidrop 4-wire loop

e. Calibration shall be by means of a non-intrusive hand held infrared calibration controller. Sensor/transmitter LCD display shall instruct user when to apply span and zero gas during calibration. Sensor/transmitter shall automatically adjust internal settings to proper calibration values and provide "replace sensor" indication when sensor nears its end-of-life. Time and date stamp of last successful calibration shall be retained in sensor/transmitter internal memory along with minimum, maximum and average gas values.

f. Provide a total of two (2) hand held calibrator/controllers for all sensor transmitters.

**GAS DETECTION LOCATION GUIDELINES**

| GAS | LOCATION | TYPE SENSOR | PROPERTIES |
|---|---|---|---|
| LEL-GASOLINE | 18" ABOVE FF | CATALYTIC BEAD | Heavier then air |
| LEL-METHANE | CEILING | CATALYTIC BEAD | |
| H2S | 18" ABOVE FF | ELECTROCHEMICAL | Heavier then air |
| O2 | 5-6' ABOVE FF | ELECTROCHEMICAL | |

**SET-POINT VALUES**

| GAS/VAPOR | CAUTION | WARNING | ALARM |
|---|---|---|---|
| LEL | 10.0% | 20.0% | 25.0% |
| H2S | 3 ppm | 5 ppm | 6 ppm |
| O2 | 19.0% | 18.5% | 17.0% |

| TAG NO. | SERVICE | LEL | H2S | O2 | P&ID |
|---|---|---|---|---|---|
| AE/AIT-1311A | HEADWORKS | X | | | 99 DI-601 |
| AE/AIT-1311B | HEADWORKS | | X | | 99 DI-601 |
| AE/AIT-1311C | HEADWORKS | | | X | 99 DI-601 |
| AE/AIT-1312A | TRUCK BAY WEST | X | | | 99 DI-601 |
| AE/AIT-1312B | TRUCK BAY WEST | | X | | 99 DI-601 |
| AE/AIT-1312C | TRUCK BAY WEST | | | X | 99 DI-601 |
| AE/AIT-1312D | TRUCK BAY EAST | X | | | 99 DI-601 |
| AE/AIT-1312E | TRUCK BAY EAST | | X | | 99 DI-601 |
| AE/AIT-1312F | TRUCK BAY EAST | | | X | 99 DI-601 |
| AE/AIT 1313 | BASEMENT | X | | | 99 DI-601 |

**CONTINUOUS ON-LINE MULTI-PARAMETER ANALYZER SPECIFICATION**

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**DATA SHEET 50.14**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

INTEGRATED CONTROL UNIT ANALYZER (TRANSMITTER)

| | | | | |
|---|---|---|---|---|
| 5. | Type | : | MICROPROCESSOR BASED. | |
| 6. | Range | : | PARAMETER | RANGE |
| | | : | AMMONIA-NITROGEN | 0.1-1000 mg/l |
| | | : | NITRATE-NITROGEN | 0.1-1000 mg/l |

USER INTERFACE (Separate Transmitter for Nitrate and Ammonia Probe)

| | | | |
|---|---|---|---|
| 7. | Display | : | GRAPHIC DISPLAY W 320X240 PIXEL RESOLUTION. |
| 8. | Key Pad | : | 5 OPERATING KEYS FOR MEASUREMENT, CALIBRATION SET, SYSTEM SETTINGS, SWITCHING MENU AND ESCAPE. |
| 9. | Input Power | : | 120-230 VAC, 50/60 HZ |
| 10. | Output Signal | : | 4 - 20 mADC |
| 11. | Protection | : | EMI/RFI, LIGHTENING SURGE |
| 12. | Enclosure | : | SEE AREA CLASSICIATION SCHEDULE ON 00 E-601. |
| 13. | Operating Temp | : | -20~55℃ |

NITRATE ($NO_3$) PROBE

| | | | |
|---|---|---|---|
| 14. | Type | : | IN-SITU NITRATE SENSOR WITHOUT SAMPLE PREPARATION. LIGHT ABSORPTION IN PROPORTION TO CONCENTRATION |
| 15. | Measuring Principle | : | SPECTRAL MEASUREMENT IN THE UV/VIS RANGE (190 TO 230nm). |
| 16. | Probe | : | OPTICAL NITRATE PROBE, PATH LENGTH 1mm. |
| 17. | Range | : | 0.01 TO 25 mg/l, 0.1 TO 100mg/l |
| 18. | Flow Velocity | : | LESS THAN 3 m/s. |
| 19. | Operating Tem. | : | 0~45℃. |
| 20. | PH Range | : | 4~9 |
| 21. | Salt Content | : | LESS THAN 5000mg/l IN MEDIUM. |
| 22. | Automatic Cleaning | : | VALVE MODULE FOR AUTOMATIC COMPRESSED AIR CLEANING, 3~7 BAR. |
| 23. | UV/VIS Module | : | CONNECTION MODULE FOR UV/VIS SENSOR. |
| 24. | Accuracy | : | < ±3% OF MEASURED VALUE |

AMMONIA PROBE

| | | | |
|---|---|---|---|
| 25. | Type | : | IN-SITU AMMONIA SENSOR WITH OUT SAMPLE PREPARATION |
| 26. | Electrodes | : | INTEGRATED MEASURING AND COMPENSATION ELECTRODE |
| 27. | Temperature Compensation | : | REQUIRED |

| | | | |
|---|---|---|---|
| 28. | Matrix Adjustment | : | YES |
| 29. | pH Range | : | 4-9 |
| 30. | Measuring Range | : | 0.2-1290 mg/l |
| 31. | Accuracy | : | < ±5% OF MEASURED VALUE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 32. | Fluid | : | WASTEWATER MIX LIQUOR |
| 33. | Operating Temp. | : | 5 TO 100° C (40 TO 100° F) |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 34. | Manufacturer | : | WTW, ENDRESS + HAUSER, HACH OR APPROVED EQUAL |
| 35. | Model | : | VARION PLUS SET WITH IQ SENSOR NET; STAMOSENS; AISE/NITRAX WITH SC200 CONTROLLER |

NOTES.

a. All wetted parts shall be suitable for the intended service conditions.

b. Provide initial calibration and commissioning. Commissioning shall require as a minimum 3−days of operation w/ factory trained technician to operate and maintain system. MTTR greater then 30 minutes shall restart the commissioning time.

c. Provide training for staff during commissioning period in addition to training specified in other sections of specifications.

d. The Manufacturer of the analyzer(s) shall furnish one year's service starting from the completion of the initial commissioning and calibration. This service shall be rendered in a maximum of three site visits and shall include replacement parts as needed to keep the analyzer in proper operation. The start-up, calibration, spare parts and extended service shall be included in the Contractor's price.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AE/AIT 1021C | SBR 1 Ammonia | 15 DI-601 |
| AE/AIT 1021D | SBR 1 Nitrate | 15 DI-601 |
| AE/AIT 1031C | SBR 2 Ammonia | 15 DI-601 |
| AE/AIT 1031D | SBR 2 Nitrate | 15 DI-601 |

**MAGNETIC FLOW METER SPECIFICATION**

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**DATA SHEET 416.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag No. | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

CONNECTIONS

| | | | |
|---|---|---|---|
| 5. | Line Size | : | SEE TABLE |
| 6. | Line Material | : | DUCTILE IRON |
| 7. | Conn. Type | : | FLANGED |
| 8. | Conn. Materials | : | CARBON STEEL |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 9. | Fluid | : | WATER WITH ~40% PROPYLENE GLYCOL |
| 10. | Maximum Flow | : | SEE TABLE |
| 11. | Max. Flow Velocity | : | SEE TABLE |
| 12. | Minimum Flow | : | SEE TABLE |
| 13. | Min. Flow Velocity | : | SEE TABLE |
| 14. | Operating Temp. | : | 40 TO 250 °F. |
| 15. | Operating Pressure | : | 57 PSI |

METER

| | | | |
|---|---|---|---|
| 16. | Meter Size | : | SEE TABLE |
| 17. | Tube Material | : | 304 STAINLESS |
| 18. | Housing | : | WELDED STEEL |
| 19. | Liner Material | : | INJECTION MOLDED HARD RUBBER OR EQUIVALENT |
| 20. | Electrode Type | : | FLUSH MOUNT |
| 21. | Electrode Material | : | 316 STAINLESS OR EQUIVALENT |
| 22. | Terminal Box | : | DIE CAST ALUMINUM |
| 23. | Enclosure Class | : | NEMA 4X OR CLASS 1 DIV 1 – SEE AREA CLASSICIATION SCHEDULE ON 00 E-601 |
| 24. | Power Supply | : | 120 VAC, 60 HZ |
| 25. | Grounding Type | : | STRAP AND RING |

TRANSMITTER

| | | | |
|---|---|---|---|
| 26. | Type | : | INTELLIGENT, MICROPROCESSOR BASED |
| 27. | Mounting | : | WALL MOUNTED |
| 28. | Transmitter Range | : | SEE TABLE BASED ON INSTRUMENT SPAN |
| 29. | Power Supply | : | 120 VAC, 60 HZ |

| | | |
|---|---|---|
| 30. | Analog Output | : 4 - 20 mADC |
| 31. | Elect. Class | : SEE AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 32. | System Accuracy | : +/- 0.5% OF FLOW RATE AT VELOCITIES ABOVE 1 FOOT PER SECOND |
| 33. | Sys. Repeatability | : +/- 0.1% OF FULL SCALE |
| 34. | Empty Pipe Detect. | : REQUIRED |
| 35. | Local Display | : MULTI-LINE LC FOR MEASURED VARIABLE, DIAGNOSTICS PLUS BAR GRAPH AND KEY PAD |
| 36. | Local Totalizer | : REQUIRED, 6 DIGIT, NON RESET |
| 37. | Cable Length | : APPROX. 50 FEET PROVIDED BY METER MANUFACTURER |

MISCELLANEOUS

| | | |
|---|---|---|
| 39. | Manufacturer(s) | : FOXBORO, E+H, KROHNE OR SIEMENS |
| 40. | Model No. | : 2000 SERIES, PROMAG W, ENVIROMAG OR MAG 5100 |

NOTES.

a. Provide grounding ring from meter manufacturer. Fabricated grounding rings from a third party shall not be accepted.

b. Provide meter manufacturers cable between the meter and the transmitter.

c. Wet calibrate all meters (at 3 points over the specified flow range) by gravimetric or volumetric methods that are traceable to NIST (National Institute Standard Testing).

d. Provide certificate of wet calibration to the engineer/owner prior to meter installation.

e. Provide, by the meter manufacturer, insitu calibration of all meters prior to system acceptance. Submit written calibration report from the manufacturer to the engineer.

f. **PROVIDE 316 STAINLESS STEEL MOUNTING HARDWARE** including all nuts and bolts connecting the meter to the process pipe.

g. Contractor to provide all power and signal cable in rigid conduit or liquid-tight conduit. See electrical specification for product specifications.

h. Contractor to provide grounding from ground rings to meter and meter to ground, using green size 10 AWG (6mm) ground wire. The Contractor shall install ground as directed by the meter manufacturer or to nearest water pipe. Contractor is responsible for all connections.

i. Remote communication must not interfere with the analog output signal. Use frequency shift keying (FSK) technique for communication.

| TAG NO. | SERVICE | LINE SIZE (in) | FLUID | MAX FLOW (gpm) | MAX VEL (fps) | Min FLOW (gpm) | Min VEL (fps) | METER SIZE (in) | P&I D |
|---|---|---|---|---|---|---|---|---|---|
| FE/FIT-1015 | SBR INFLUENT FLOW | 6 | SBI | | | | | 6 | 10 DI-603 |
| FE/FIT 1060 | DISK FILTER 1 INFLUENT FLOW | 14 | DEC | | | | | 14 | 10 DI-604 |
| FE/FIT 1070 | DISK FILTER 2 INFLUENT FLOW | 14 | DEC | | | | | 14 | 10 DI-604 |
| FE/FIT 1085 | EFFLUNT FLOW TO UV | 8 | EFF | | | | | 8 | 10 DI-606 |
| FE/FIT 1105 | PLANT WATER FLOW TO DISTRIBUTION | 6 | PW | | | | | 6 | 10 DI-608 |
| FE/FIT 1107 | FOAM SPRAY WATER TO SBRS | 6 | FSW | | | | | 6 | 10 DI-608 |
| FE/FIT 1130 | SEPTAGE RECEIVING INFLUENT* | 4 | SEP | | | | | 4 | 10 DI-611 |
| FE/FIT 1140 | WAS FLOW TO WASTE SLUDGE STORAGE TANKS | 4 | WAS | | | | | 4 | 10 DI-612 |
| FE/FIT 1160 | RDT-1 INFLUENT | 3 | SL | | | | | 3 | 10 DI-614 |
| FE/FIT 1170 | RDT-2 INFLUENT | 3 | SL | | | | | 3 | 10 DI-614 |
| FE/FIT 1173 | THICKENED SLUDGE TO OFF SITE DISPOSAL | 6 | TSL | | | | | 6 | 10 DI-615 |
| FE/FIT 3001 | FLOW TO WICK WELL 1. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3002 | FLOW TO WICK WELL 2. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3003 | FLOW TO WICK WELL 3. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3004 | FLOW TO WICK WELL 4. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3005 | FLOW TO WICK WELL 5. | 6 | EFF | | | | | 6 | 30 DI-601 |

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**THERMAL DISPERSION FLOW METER SPECIFICATION**

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**DATA SHEET 426.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | THERMAL DISPERSION PRINCIPLE WITH AUTOMATIC REAL-TIME TEMPERATURE COMPENSATION |
| 6. | Material | : | 316 STAINLESS STEEL |
| 7. | Oper Press | : | 0 TO 17 BAR 0 TO 250 PSIG |
| 8. | Oper Temp | : | -40° TO 177°C (-40°F TO 350°F) |
| 9. | Process Conn | : | 50mm (2-INCH ) FULL PORTED 316 SS BALL VALVE W/ 1.25-INCH MNPT PROBE W/ RETRACTABLE PACKING GLAND |
| 10. | Insert Length | : | BASED ON PROCESS PIPE SIZE |
| 11. | Line Size | : | SEE TABLE |
| 12. | Enclosure | : | NEMA 4X FOR NON HAZARDOUS LOCATIONS |

TRANSMITTER

| | | | |
|---|---|---|---|
| 13. | Mounting | : | WALL MOUNT |
| 14. | Output Range | : | SEE TABLE |
| 15. | Power Requirement | : | 120 VAC |
| 16. | Digital Comm | : | NONE REQUIRED. |
| 17. | Output | : | 4 - 20 mADC |
| 18. | Accuracy | : | +/- 1% FLOW + 0.5% FULL SCALE |
| 19. | Repeatability | : | +/- 0.5% READING |
| 20. | Turndown | : | 10:1 to 100:1 WITHIN CALIBRATED FLOW RANGE |
| 21. | Enclosure | : | NEMA 4X FOR NON-HAZARDOUS,<br>NEMA 7 (XP) FOR HAZARDOUS AREA. |
| 22. | Indicator | : | REQUIRED, 2 LINES 16 CHARACTERS / LINE LCD |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 23. | Fluid | : | SEE TABLE |
| 24. | Operating Temp. | : | 40 TO 150°C (100 TO 300°F). |
| 25. | Operating Pressure | : | UPTO 1.5 BAR (20 PSIG) |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 26. | Manufacturer(s) | : | FCI, FOX, SAGE, SIERRA OR EQUAL |
| 27. | Model No.(s) | : | ST98, 10A, SI, 640S OR EQUAL |

NOTES.

a. Provide a minimum of two [2] hand held calibrators.

b. Provide meter calibration curves for three [3] points of the flow curve. Calibration shall be NIST traceable.

| TAG NO | SERVICE | RANGE | P&ID |
|---|---|---|---|
| FE/FIT 1125 | AIR FLOW TO SBRS | | 10 DI-610 |

**FLOW SWITCH (PADDLE TYPE) SPECIFICATION**

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**DATA SHEET 442.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | PADDLE TYPE FLOW ACTUATED ELECTRIC SWITCH |
| 6. | Materials | : | ALL WETTED PARTS 316 STAINLESS UNLESS OTHERWISE SPECIFIED. |
| 7. | Body | : | 316 STAINLESS STEEL |
| 8. | Bellows | : | SEAMLESS 321 STAINLESS STEEL |
| 9. | Flex Tube | : | (EXPLOSION PROOF APPLICATIONS) 316 SS |
| 10. | Stem-Paddle | : | 316 SS |
| 11. | Bearings | : | 440C SS MICRO BALL |
| 12. | Enclosure | : | MEET ELECTRICAL CLASSIFICATION IN PROCESS AREA. NEMA 4X MINIMUM. |

CONTACTS

| | | | |
|---|---|---|---|
| 13. | Form | : | SPDT |
| 14. | Open/Close | : | CLOSE |
| 15. | On Flow Incr/Decr | : | INCREASING |
| 16. | Rating | : | 10 AMPS AT 120 VAC |
| 17. | Input Power | : | 120 VAC, 60 HZ |
| 18. | Switch Setting | : | NO FLOW |
| 19. | Output Signal for | : | PUMP CONTROL AND ALARM |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 20. | Fluid | : | WATER |
| 21. | Flow Rate | : | 0-3 GPM |
| 22. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 23. | Operating Pressure | : | 10 TO 50 PSIG |
| 24. | Line Size | : | ½” |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 25. | Mounting | : | TEE OR WAFER MOUNT |
| 26. | Elec. Class. | : | SEE AREA CLASSICIATION SCHEDULE ON 00 E-601. ELECTRICAL DRAWINGS |
| 27. | Manufacturer(s) | : | PEECO, HONSBERG, KOBOLD OR EQUAL |

| TAG NO | SERVICE | P&I D |
|---|---|---|
| FSH 1011 | SBR.TP-1 SEAL WATER | 99 DI-601 |
| FSH 1012 | SBR.TP-2 SEAL WATER | 99 DI-601 |
| FSH 1013 | SBR.TP-3 SEAL WATER | 99 DI-601 |
| FSH 1171 | TSL.P-1 SEAL WATER | 99 DI-601 |
| FSH 1172 | TSL.P -2 SEAL WATER | 99 DI-601 |

**ROTAMETER SPECIFICATION**

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**DATA SHEET 443.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL |
| 5. | Line No./Size | : | SEE MECHANICAL OR AS REQUIRED FOR EQUIPMENT PROVIDED BY OTHERS |

METER

| | | | |
|---|---|---|---|
| 6. | Type | : | VARIABLE AREA |
| 7. | Size | : | SEE TABLE |
| 8. | Scale Length | : | BASED ON METER SIZE |
| 9. | Scale Type | : | GRADUATED |
| 10. | Scale Range | : | SEE TABLE |
| 11. | Accuracy | : | ±2% OF FULL SCALE |
| 12. | End Conn. Type | : | UNION W/O-RING OF EPDM, VITON OR FEP BASED ON FLUID |
| 13. | End Conn. Orient. | : | UPWARD FLOW |

MATERIALS OF CONSTRUCTION

| | | | |
|---|---|---|---|
| 14. | Tube Material | : | NON-METALLIC POLYSULFONE OR AS REQUIRED FOR FLUID |
| 15. | Float Material | : | 316 SS AS REQUIRED FOR FLUID |

SERVICE CONDITIONS

| | | | |
|---|---|---|---|
| 16. | Fluid | : | SEE TABLE |
| 17. | Max. Flow Rate | : | SEE TABLE |
| 18. | Min. Flow Rate | : | SEE TABLE |
| 19. | Normal Flow Rate | : | SEE TABLE |
| 20. | Oper. Pressure | : | SEE TABLE |
| 21. | Oper. Temperature | : | 40° TO 75° F |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Flow Adj Valve | : | REQUIRED; EXTERNAL NEEDLE TYPE |
| 23. | Manufacturer(s) | : | BLUE-WHITE, CHEMLINE, KING OR APPROVED EQUAL |

| TAG NO | SERVICE | FLUID | SIZE (in) | RANGE (GPM) | PRESS (PSIG) | P&I D |
|---|---|---|---|---|---|---|
| FI 1183 | SODIUM HYPOCHLORITE CARRIER WATER | W3 | ¾ | 1-10 | | 10 DI-616 |
| FI 1193 | PACL CARRIER WATER | W3 | ¾ | 1-10 | | 10 DI-617 |
| FI 1011C | SBR.TP-1 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1012C | SBR.TP-2 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1013C | SBR.TP-3 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1171C | TSL.P-1 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1172C | TSL.P -2 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |

**LEVEL SWITCH (FLOAT TYPE) SPECIFICATION**

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**DATA SHEET 853.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE ELECTRICAL DRAWINGS |

FLOAT

| | | | |
|---|---|---|---|
| 5. | Dimensions | : | APPROX. 6 INCH DIAMETER |
| 6. | Material | : | POLYPROPYLENE |

SWITCH

| | | | |
|---|---|---|---|
| 7. | Type | : | MICRO SWITCH STEEL BALL ACTIVATED |
| 8. | Contact | : | SPDT |
| 9. | Rating | : | 5 AMPS AT 120 VAC |
| 10. | Enclosure | : | ENCAPSULATED |
| 11. | Open/Close | : | CLOSE ON INCREASING, OPEN ON DECREASING |
| 12. | Mounting | : | ADJUSTABLE CLAMP ON 1 INCH STAINLESS PIPE |
| 13. | Elec. Classification | : | SEE ELECTRICAL DRAWING 00 E-601 FOR AREA CLASSIFICATION SCHEDULE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 14. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 15. | Operating Pressure | : | ATMOSPHERIC |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 16. | Interconn. Cable | : | REQUIRED APPROX. 50 FEET |
| 17. | Manufacturer(s) | : | COX OR KARI NO OR EQUAL |
| 18. | Model No.(s) | : | OPTI-FLOAT OR KA SERIES NO OR EQUAL |

NOTES

a. Provide 1-inch diameter SCH 40 316L SS pipe to mount the float switch(s).
b. Provide COX or KARI level switches as specified. Other manufacturers shall not be accepted based on performance.
c. Provide detailed instructions for proper installation of switches, enclosures and mounting hardware.
d. Provide 316 SS brackets and hardware to attach pipe to side of well or tank.
e. Provide a minimum of 3 brackets spaced a maximum of 10'-0" OC.
f. Provide all 316 SS mounting hardware to mount float switch(s) to 1-inch pipe. Mounting hardware shall allow for float level adjustment with hand tools.
g. Provide single sealed well/tank penetration for float switch(s) cables.
h. Provide 316 SS NEMA 4X or cast aluminum termination enclosure (based on area electrical classification). The enclosure shall provide termination for the float(s) and include isolation relays and intrinsic safety barriers.
i. Provide termination enclosure mounted on 316 SS UNISTRUT® supports for wall or floor mounting.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LSHH 1070 | POST EQUALIZATION TANK HIGH-HIGH LEVEL | 10 DI-605 |
| LSLL 1070 | POST EQUALIZATION TANK LOW-LOW LEVEL | 10 DI-605 |
| LSHH 1100 | PLANT WATER TANK HIGH-HIGH LEVEL | 10 DI-608 |
| LSLL 1100 | PLANT WATER TANK LOW-LOW LEVEL | 10 DI-608 |

**LEVEL TRANSMITTER (ULTRASONIC TYPE) SPECIFICATION**

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**DATA SHEET 859.1**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE |
| 2. | Service | : SEE TABLE |
| 3. | P&ID No. | : SEE TABLE |
| 4. | Location | : SEE MECHANICAL DRAWINGS |
| 5. | Type | : ULTRASONIC, TRANSDUCER |

TRANSMITTER

| | | |
|---|---|---|
| 6. | Type | : ELECTRONIC |
| 7. | Display | : REMOTE LCD IP65 NEMA 4X |
| 8. | Display Units | : 4 DIGIT W/ DECIMAL POINT |
| 9. | Measuring Range: | SEE MECHANICAL, BASED ON TANK DIMENSION. |
| 10. | Agitator Filters | : REQUIRED |
| 11. | Input Power | : 120 VAC |
| 12. | Output | : 4 - 20 mADC ISOLATED |
| 13. | Resolution | : 2.5mm (0.1 INCH) |
| 14. | Accuracy | : +/- 0.5% OF SPAN |
| 15. | Adjustments | : DIRECT SETTING BCD IN INCHES |
| 16. | Alarms | : LOSS OF ECHO AND NEAR ZONE USER CONFIGURABLE FOR HIGH OR LOW LEVEL CURRENT |
| 17. | Material : | CAST ALUMINUM |
| 18. | Mounting | : REMOTE – SEE INSTRUMENTATION DRAWINGS |
| 19. | Temp | : -40° TO 70°C (-40° TO 160°F) |
| 20. | Enclosure | : PER AREA CLASSIFICATION ON 00 E-601. |

TRANSDUCER

| | | |
|---|---|---|
| 21. | Enclosure | : RATED APPROPRIATELY AS PER AREA CLASSIFICATION SCHEDULE ON DRAWING 00 E-601. |
| 22. | Material | : CPVC, PFA |
| 23. | Mounting | : 50mm (2-INCH) NPT CONDUIT CONNECTION OR FLANGE |
| 24. | Beam Angle | : 10° AT -3dB |
| 25. | Frequency | : 53 KHz |
| 26. | Temperature Comp | : INTEGRAL WITH TRANSDUCER |
| 27. | Oper Temp Limits | : -40° TO 70°C (-40° TO 160°F) FOR CPVC AND -40° TO 95°C (-40° TO 200°F) FOR PFA. |
| 28. | Protection | : FM APPROVAL FOR CLASSIFIED AREA |

PROCESS CONDITIONS

| | | |
|---|---|---|
| 29. | Operating Temp. : | -30° TO 50°C (-20° TO 125°F). |
| 30. | Operating Pressure | : ATMOSPHERIC |

MISCELLANEOUS

31. Intercon Cable : 30M (100 FEET) OR GREATER SO THE TRANSMITTER CAN BE MOUNTED FOR OPERATOR ACCESS

32. Manufacturer(s) : FLOWLINE, DREXELBROOK, KROHNE, SIEMENS OR EQUAL

NOTES.

a. Provide all mounting hardware.

b. Provide detailed instructions for installation of sensor, transmitter and mounting hardware.

c. Provide 316 SS wall sleeve w/ 150mm (6-inch) flange for mounting in top of tanks or wells.

d. Provide barrier for intrinsically safe applications

e. Provide lightning and surge protection

f. Provide detailed installation wiring diagrams specific to the installation application.

g. Provide 316 SS (fiberglass for chemical applications) UNISTRUT® floor or wall bracket for indicator or remote mount transmitter.

h. Provide linearization functions to measure flow in open channels or weirs. Provide linearization calculations to determine tank volumes.

i. Other transmitter housing material may be considered for non-hazardous area application.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LE/LIT-1011A | RWW.SCR-1 UPSTREAM * | 10 DI-601 |
| LE/LIT-1011B | RWW.SCR-1 DOWNSTREAM * | 10 DI-601 |
| | (*) PROVIDED BY SCREEN MFG | |
| LE/LIT-1005A | PRE-EQUALIZATION TANK 1 | 10 DI-602 |
| LE/LIT-1005B | PRE-EQUALIZATION TANK 1 | 10 DI-602 |
| LE/LIT-1006A | PRE-EQUALIZATION TANK 2 | 10 DI-602 |
| LE/LIT-1006B | PRE-EQUALIZATION TANK 2 | 10 DI-602 |
| LE/LIT 1070 | POST EQUALIZATION TANK | 10 DI-605 |
| LE/LIT 1100 | PLANT WATER STORAGE TANK | 10 DI-608 |
| LE/LIT 1141A | WASTE SLUDGE TANK NO. 1 | 10 DI-612 |
| LE/LIT 1141B | WASTE SLUDGE TANK NO. 1 | 10 DI-612 |
| LE/LIT 1142A | WASTE SLUDGE TANK NO. 2 | 10 DI-612 |
| LE/LIT 1142B | WASTE SLUDGE TANK NO. 2 | 10 DI-612 |
| LE/LIT 1170A | THICKENED SLUDGE STORAGE TANK | 10 DI-615 |
| LE/LIT 1170B | THICKENED SLUDGE STORAGE TANK | 10 DI-615 |

**LEVEL SWITCH (MINIATURE FLOAT TYPE) SPECIFICATION**

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**DATA SHEET 864.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

FLOAT

| | | | |
|---|---|---|---|
| 5. | Dimensions | : | APPROX. 13/16 INCH DIAMETER |
| 6. | Material | : | POLYPROPYLENE |
| 7. | No. of Floats/Disp. | : | ONE |

SWITCH

| | | | |
|---|---|---|---|
| 8. | Contact | : | SPST |
| 9. | Rating | : | 0.07 AMPS AT 120 VAC |
| 10. | Enclosure | : | ENCAPSULATED |
| 11. | Open/Close | : | CLOSE |
| 12. | On Level Incr/Decr | : | INCREASING |
| 13. | Mounting | : | STEM MOUNT |
| 14. | Tank Connection | : | ½" NPT PIPE THREAD |
| 15. | Elec. Class'tion | : | GENERAL PURPOSE |
| 16. | Conduit Connection | : | ½ INCH NPT |

MOUNTING STEM

| | | | |
|---|---|---|---|
| 17. | Material | : | POLYPROPOLENE |
| 18. | Length | : | APPROX. 2IN |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 19. | Fluid | : | SEE TABLE |
| 20. | Specific Gravity | : | APPROXIMATELY |
| 21. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 22. | Operating Pressure | : | ATMOSPHERIC |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 23. | Manufacturer(s) | : | MADISON OR EQUAL |
| 24. | Model No.(s) | : | M8700 OR EQUAL |

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LSH 1317A | CHEMICAL ROOM 1 SUMP | 99 DI-601 |
| LSH 1317B | CHEMICAL ROOM 2 SUMP | 99 DI-601 |
| LSH 1317C | CHEMICAL ROOM 3 SUMP | 99 DI-601 |

**SUBMERSIBLE WATER-LEVEL SENSOR/TRANSMITTER SPECIFICATION**

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**DATA SHEET 873.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE TABLE |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | HYDROSTATIC HEAD-PRESSURE TRANSDUCER |
| 6. | Wetted Parts | : | 316 STAINLESS STEEL, VITON OR TITANIUM BASED ON CORROSIVE FLUID |
| 7. | Diaphragm | : | 316 STAINLESS STEEL OR HASTELLOY OR PLATINUM BASED ON CORROSIVE FLUID |
| 8. | Analog Coms | : | 4 - 20 mADC / 10-30 VDC |
| 9. | Digital Coms | : | NONE REQUIRED. |
| 10. | Cable | : | PROVIDED BY SENSOR MANUFACTURE |
| 11. | Cable Connection | : | WATERTIGHT |
| 12. | Cable Type | : | POLYURETHANE |
| 13. | Cable Length | : | AS REQUIRED FOR INSTALLATION |
| 14. | Pressure Range | : | BASED ON TANK OR VESSEL DIMENSIONS W/ 200% OVER RANGE PROTECTION |
| 15. | Oper. Temperature | : | -20 TO 190 DEG. F. |
| 16. | Zero Point Shift | : | 90% OF MEASURING RANGE |

INDICATING DISPLAY.

| | | | |
|---|---|---|---|
| 17. | Type | : | BLIND |
| 18. | Display | : | LCD |
| 19. | Power | : | LOOP POWERED |
| 20. | Housing | : | CAST ALUMINUM |
| 21. | Calibration | : | FIELD |
| 22. | Enclosure | : | IP66 NEMA 4X MINIMUM AND AS REQUIRED FOR ELECTRICAL AREA CLASSIFICATION ON 00 E-601. |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 23. | Elec. Class | : | SEE ELECTRICAL DRAWING 00 E-601. |
| 24. | Manufacturer(s) | : | ENDRESS HAUSER (E+H) AMERICAN SENSOR TECHNOLOGIES (AST) OR APPROVED EQUAL |

NOTES.

a. Provide lighting and surge protection

b. Provide manufacturers mounting hardware for transmitter and level transducer mounting. Submit mounting details with shop drawings.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LE/LT 3011 | WICK VAULT 1 LEVEL | 30 DI-602 |
| LE/LT 3012 | WICK VAULT 2 LEVEL | 30 DI-602 |
| LE/LT 3013 | WICK VAULT 3 LEVEL | 30 DI-602 |
| LE/LT 3014 | WICK VAULT 4 LEVEL | 30 DI-602 |
| LE/LT 3015 | WICK VAULT 5 LEVEL | 30 DI-602 |

**GAUGE PRESSURE TRANSMITTER SPECIFICATION**

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**DATA SHEET 1451.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

TRANSMITTER

| | | | |
|---|---|---|---|
| 5. | Type | : | INTELLIGENT, MICROPROCESSOR BASED |
| 6. | Element | : | CAPACITANCE CELL, RESONANT WIRE OR PIEZORESISTIVE SENSOR |
| 7. | Remote Calibration | : | ZERO AND SPAN VIA HANDHELD TERMINAL, WITHOUT ADDITIONAL HARDWARE, AT ANY TERMINATION POINT IN LOOP |
| 8. | Trans/Term | : | TWO WAY COMMUNICATION VIA LOOP WIRING SEE NOTE a |
| 9. | Self-Diagnostics | : | CONTINUOUS |
| 10. | Amb Temp. Comp. | : | AUTOMATIC |
| 11. | Power Supply | : | 24 VDC, LOOP POWERED |
| 12. | Output Signal | : | 4 - 20 mADC OR DIGITAL |
| 13. | Dir/Rev Acting | : | DIRECT |
| 14. | Turn Down | : | 6: 1 |
| 15. | Span | : | SEE TABLE |
| 16. | Accuracy | : | +/- 0.1% OF CALIBRATED SPAN |
| 17. | Repeatability | : | +/- 0.05% |
| 18. | Local Indicator | : | REQUIRED |
| 19. | Indicator Display | : | DIGITAL; ENGINEERING UNITS, SIGNAL OUTPUT AND DIAGNOSTICS |
| 20. | Bypass Manifold | : | REQUIRED, 2 VALVE TYPE, 316 SS SEE NOTE b |
| 21. | Span (Elev/Suppr) | : | UP TO 500% OF CALIBRATED SPAN |
| 22. | Enclosure | : | NEMA 4X/IP65/NEMA 7 CLASS I DIV 1 GROUPS A, B, C, D LOCATIONS, AND NONINCENDIVE FOR CLASS I DIV 2, GROUPS A, B, C, D LOCATIONS |
| 23. | Elec. Class | : | SEE ELCTRICAL DRAWING 00 E-601 FOR AREA CLASSICIATION SCHEDULE |
| 24. | Mounting | : | WALL OR PEDESTAL |
| 25. | Process Connections | : | ½ INCH NPT |

MATERIALS OF CONSTRUCTION

| | | | |
|---|---|---|---|
| 26. | Body | : | LOW COPPER ALUMINUM |
| 27. | Wetted Parts | : | 316 SS. FOR CORROSIVE CHEMICALS PROVIDE TANTALUM DIAPHRAGM AND TEFLON GASKETS AND HASTELLOY BODY, PROCESS FLANGE AND SENSOR WITH TEFLON GASKETS. |
| 28. | Fill | : | SILICON OIL. FOR OXYGEN SERVICE USE FLUORINERT. |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 29. | Fluid | : SEE TABLE |
| 30. | Specific Gravity | : APPROX. 1.0 |
| 31. | Max. Static Pressure | : SEE TABLE |
| 32. | Operating Temp. | : -20 TO 180 DEG. F. SEE NOTE d |
| 33. | Ambient Temp. | : 0 TO 100 DEG. F. |

MISCELLANEOUS

| | | |
|---|---|---|
| 34. | Manifold | : ANDERSON GREENWOOD, NOSHOK, PGI OR APPROVED EQUAL |
| 35. | Manufacturer(s) | : E+H, FOXBORO, SIEMENS OR APPROVED EQUAL |
| 36. | Model No.(s) | : CERABAR, IGP25, SITRANS OR APPROVED EQUAL |

NOTES.

a. Provide standard manifold mounting bracket. Mount the manifold not the transmitter such that the transmitter may be removed for service by removing the four transmitter bolts and disconnecting the signal leads. Provide block/bleed/vent/drain and equal to AGCO M4TP.

b. Provide block/bleed/vent/drain equal to AGCO M4TP SS body, AMS SS mount and H5VIS-22 drain valve.

c. Provide 316 SS ½-inch rigid tubing for connection between process measurement primary and process transmitter/manifold. All tubing shall be cut and bent with tube manufacturer approved tools

NOTES

e. Provide SS tubing connectors

f. Provide cleaning and preparation for oxygen service as required based on process application.

| TAG NO. | SERVICE | RANGE (psig) | FLUID | P&ID |
|---|---|---|---|---|
| PE/PIT 1093 | EFFLUENT PRESSURE | | EFF | 10 DI-607 |
| PIT 1104 | PLANT WATER EFFLUENT PRESSURE*<br>*by skid manufacturer | | PW | 10 DI-608 |

**PRESSURE SWITCH SPECIFICATION**

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**DATA SHEET 1452.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SWITCH

| | | | |
|---|---|---|---|
| 5. | Actuation Element | : | BASED ON PRESSURE ACTUATION REQUIREMENTS |
| 6. | Wetted Parts | : | 316L MINIMUM OR AS REQUIRED FOR CORROSIVE FLUIDS |
| 7. | Output | : | DUAL OUTPUT SPDT |
| 8. | Rating | : | 5 AMPS AT 120 VAC |
| 9. | Set Point | : | INTERNAL LOCKING SCREW SET POINT AND DEAD BAND |
| 10. | Manual Reset | : | REQUIRED EXCEPT FOR CLASSIFIED ELECTRICAL AREAS |
| 11. | Range SP | : | SEE TABLE BELOW |
| 12. | Repeatability | : | +/- 1.0% RANGE SET-POINT |
| 13. | Proof Pressure | : | 400% OF RANGE PROOF |
| 14. | Deadband | : | BASED ON SWITCH RANGE |
| 15. | Material | : | BASED ON PROCESS FLUID |
| 16. | Process Connection | : | 1/4 INCH NPT MINIMUM |
| 17. | Enclosure | : | NEMA 4X (IP66) MINIMUM AND AS REQUIRED FOR ELECTRICAL AREA CLASSIFICATION |
| 18. | Housing | : | CAST ALUMINUM OR STAINLESS STEEL BASED ON ELECTRICAL AREA CLASSIFICATION AND ENVIRONMENTAL REQUIREMENTS |

SERVICE CONDITIONS

| | | | |
|---|---|---|---|
| 19. | Fluid | : | SEE TABLE BELOW |
| 20. | Operating Temp. | : | 40 TO 100 DEG F. |
| 21. | Ambient Temp. | : | 45 TO 90 DEG. F |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Pressure Seals | : | REQUIRED |
| 23. | Manufacturer(s) | : | ASHCROFT BARKSDALE OR EQUAL |

NOTES.

a. Provide pressure switch assembly with type 316L SS pipe and fittings, and a tee with ball valve with female outlet and arranged to allow field checking with a 4½-inch test gauge.

b. Provide pressure switch complete with factory-mounted protective diaphragm attachment which shall allow cleaning of lower diaphragm assembly without breaking seal or refilling and requiring no calibration of gauge.

c. Provide diaphragm of 316 SS with 316 SS upper and lower housing for non-corrosive or solids bearing fluids.

d. Provide alternate diaphragm or isolation ring solution and materials for corrosive or solids bearing fluid.

e. Provide 316L SCH 40 SS pipe and fittings

f. Provide 316 SS ball valves
g. Provide SS ID tag
h. Set Point shall be determined during startup and testing

| TAG NO. | SERVICE/FLUID | RANGE (psig) | P&ID |
|---|---|---|---|
| PSH 1081 | EFF.P-1 DISCHARGE | | 10 DI-606 |
| PSH 1082 | EFF.P-2 DISCHARGE | | 10 DI-606 |
| PSH 1083 | EFF.P-3 DISCHARGE | | 10 DI-606 |
| PSH 1181 | SH.MP-1 DISCHARGE | | 10 DI-616 |
| PSH 1182 | SH.MP-2 DISCHARGE | | 10 DI-616 |
| PSH 1191 | PACL.MP-1 DISCHARGE | | 10 DI-617 |
| PSH 1192 | PACL.MP-2 DISCHARGE | | 10 DI-617 |

**PRESSURE GAUGE SPECIFICATION**

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**DATA SHEET 1454.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE CONTRACT MECHANICAL PROCESS DRAWINGS. |

GAUGE

| | | | |
|---|---|---|---|
| 5. | Type | : | GEARLESS DIRECT-DRIVE NON-LIQUID FILLED |
| 6. | Element | : | HELICALLY WOUND BOURDON TUBE |
| 7. | Element Material | : | INCONEL X-750 |
| 8. | Range | : | SEE TABLE |
| 9. | Overpress. Limit | : | FULL VACUUM AND/OR 150% OF MAX RANGE |
| 10. | Accuracy | : | ± 0.5% AT MID SCALE |
| 11. | Repeatability | : | ± 0.025% FULL SCALE |
| 12. | Zero Adjustment | : | EXTERNAL |
| 13. | Span | : | FACTORY SET |
| 14. | Linearity | : | FACTORY SET |
| 15. | Shaft Attachment | : | DIRECT SENSING COIL AND POINTER |
| 16. | Shaft Bearing | : | SYNTHETIC SAPPHIRE BOTH ENDS |
| 17. | Fittings | : | 316 SS OR AS REQUIRED BY PROCESS |
| 18. | Joints | : | NICRO-BRAZED OR T.I.G. HELIARC WELDED |
| 19. | Case Type | : | SWIVEL FITTING WITH MOVEABLE FLANGE |
| 20. | Case Material | : | ABS PLASTIC |
| 21. | Case Front | : | REAR BLOWOUT |
| 22. | Dial Diameter | : | 4-1/2 INCHES |
| 23. | Socket Material | : | 316 STAINLESS STEEL |
| 24. | Process Connection | : | ½ INCH NPT |
| 25. | Lens | : | ACRYLIC |
| 26. | Mounting | : | BACK SWIVEL FLANGE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 27. | Fluid | : | SEE TABLE |
| 28. | Operating Temp. | : | SEE TABLE |
| 29. | Operating Pressure | : | SEE TABLE |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 30. | Diaphragm | : | PROVIDE EXTERNAL ISOLATION RING, PIPING AND VALVES, AS INDICATED ON THE CONTRACT MECHANICAL PROCESS DRAWINGS AND DETAILS. SEE DATA SHEET 1457. |
| 31. | Snubber | : | PROVIDE INTERNAL TO STEM |
| 32. | Pulsation Damper | : | INTERNAL TO STEM |
| 33. | Manufacturer(s) | : | 3D, PERMA-CAL OR EQUAL |

| TAG NO. | SERVICE | RANGE | FLUID | P&ID |
|---|---|---|---|---|
| PI 1011A | SBR.TP-1 SUCTION | | SBI | 10 DI-603 |
| PI 1011B | SBR.TP-1 DISCHARGE | | SBI | 10 DI-603 |
| PI 1012A | SBR.TP-2 SUCTION | | SBI | 10 DI-603 |
| PI 1012B | SBR.TP-2 DISCHARGE | | SBI | 10 DI-603 |
| PI 1013A | SBR.TP-3 SUCTION | | SBI | 10 DI-603 |
| PI 1013B | SBR.TP-3 DISCHARGE | | SBI | 10 DI-603 |
| PI 1081A | EFF.P-1 SUCTION | | EFF | 10 DI-606 |
| PI 1081B | EFF.P-1 DISCHARGE | | EFF | 10 DI-606 |
| PI 1082A | EFF.P-2 SUCTION | | EFF | 10 DI-606 |
| PI 1082B | EFF.P-2 DISCHARGE | | EFF | 10 DI-606 |
| PI 1083A | EFF.P-3 SUCTION | | EFF | 10 DI-606 |
| PI 1083B | EFF.P-3 DISCHARGE | | EFF | 10 DI-606 |
| PI 1101A | W3.P-1 SUCTION* | | W3 | 10 DI-608 |
| PI 1101B | W3.P-1 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1102A | W3.P-2 SUCTION* | | W3 | 10 DI-608 |
| PI 1102B | W3.P-2 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1103A | W3.P-3 SUCTION* | | W3 | 10 DI-608 |
| PI 1103B | W3.P-3 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1151A | SL.TP-1 SUCTION | | SL | 10 DI-613 |
| PI 1151B | SL.TP-1 DISCHARGE | | SL | 10 DI-613 |
| PI 1152A | SL.TP-2 SUCTION | | SL | 10 DI-613 |

| TAG NO. | SERVICE | RANGE | FLUID | P&ID |
|---|---|---|---|---|
| PI 1152B | SL.TP-2 DISCHARGE | | SL | 10 DI-613 |
| PI 1171A | TSL.P-1 SUCTION | | TSL | 10 DI-615 |
| PI 1171B | TSL.P-1 DISCHARGE | | TSL | 10 DI-615 |
| PI 1172A | TSL.P-2 SUCTION | | TSL | 10 DI-615 |
| PI 1172B | TSL.P-2 DISCHARGE | | TSL | 10 DI-615 |
| PI 1181 | SH.MP-1 DISCHARGE | | SH | 10 DI-616 |
| PI 1182 | SH.MP-2 DISCHARGE | | SH | 10 DI-616 |
| PI 1191 | PACL.MP-1 DISCHARGE | | PACL | 10 DI-617 |
| PI 1192 | PACL.MP-2 DISCHARGE | | PACL | 10 DI-617 |
| PI 1011C | SBR.TP-1 SEAL WATER | | SBI | 99 DI-602 |
| PI 1012C | SBR.TP-2 SEAL WATER | | SBI | 99 DI-602 |
| PI 1013C | SBR.TP-3 SEAL WATER | | SBI | 99 DI-602 |
| PI 1171C | TSL.P-1 SEAL WATER | | TSL | 99 DI-602 |
| PI 1172C | TSL.P -2 SEAL WATER | | TSL | 99 DI-602 |

*Furnished By Vendor

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**PRESSURE ISOLATOR RING SPECIFICATION**

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**DATA SHEET 1457.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE DATA SHEET 1454 |
| 2. | Service | : | SEE DATA SHEET 1454 |
| 3. | P&ID No. | : | SEE DATA SHEET 1454 |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

A. Pressure Sensor Rings:

1. Manufacturers:
   a. Onyx
   b. Or an acceptable equivalent product.
2. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-lb (Class 150).
3. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated. For chemical system provide full flange, threaded connections are not acceptable.
4. Face to face length of the sensor: Conform to Specification MSS-SP67.
5. Type: Flow through design with flexible sleeve around full circumference. The centersection shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.
6. Rigidly support all pressure instruments by a post at least 7/8-inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum. 1/4-inch NPT fittings are not acceptable.
7. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
8. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
9. Provide the needle fitting with both 1/4-inch NPTF threads and 1/2-inch NPTM threads.
10. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
11. Attach pressure instruments to the isolator with a hand tightened lock ring.
12. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
13. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
14. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum per lines tested above 150 psi.

15. Materials:
    a. Process water:
        (1) Center – 316 stainless
        (2) End Plates – 316 stainless
        (3) Elastomer – EPDM
        (4) Fluid – silicone
        (5) Stinger – 316 stainless
        (6) Pipe – 316L stainless
    b. 15% sodium hypochlorite (sg 1.20)
        (1) Center – Kynar coated carbon steel
        (2) End Plates – Kynar
        (3) Elastomer – Viton
        (4) Fluid – silicone
        (5) Stinger – 316 stainless
        (6) Pipe – 316L stainless

**ROOM/OUTSIDE AIR TEMPERATURE SENSOR SPECIFICATION**

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**DATA SHEET 1662.1**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE |
| 2. | Service | : SEE TABLE |
| 3. | P&ID No. | : SEE TABLE |
| 4. | Location | : SEE ELECTRICAL DRAWINGS |

SENSOR

| | | |
|---|---|---|
| 5. | Type | : RTD SENSOR WALL MOUNT INTEGRAL TO TRANSMITTER |
| 6. | Housing | : NEMA 4X AND 7 — CLASS I DIV 1 AND CLASS II DIV 2. SEE AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 7. | Material | : CAST ALUMINUM |

TRANSMITTER

| | | |
|---|---|---|
| 8. | Type | : ELECTRONIC |
| 9. | Power | : 24 VDC, LOOP POWERED |
| 10. | Output Signal | : 4 - 20 mADC INTO 550 OHMS |
| 11. | Range | : -45° TO 135°C (-50° TO 275°F) |
| 12. | Linearity | : +/- 0.1% WITH SPAN |
| 13. | Calibration | : MATCH RTD |
| 14. | Indicator | : 1-INCH HIGH LCD ±999.9 |

PROCESS CONDITIONS

| | | |
|---|---|---|
| 21. | Fluid | : AIR |

MISCELLANEOUS

| | | |
|---|---|---|
| 22. | Manufacturer(s) | : MICON, WEED, DEVAR OR EQUAL |

NOTES.

a. Provide complete temperature monitor assembly w/ all hardware for wall mounting.

b. Provide outside temperature monitor w/ all hardware and sun shields.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| TIT 1316A | BASEMENT | 99 DI-601 |
| TIT 1316B | ELECTRICAL ROOM | 99 DI-601 |
| TIT 1316C | SODIUM HYPORHCLORITE AND POLYALUMINUM CHLORIDE ROOM | 99 DI-601 |
| TIT 1316D | POLYMER ROOM | 99 DI-601 |
| TIT 1316E | SODA ASH ROOM | 99 DI-601 |

**SECTION 13331**

**CONTROL SYSTEM INTEGRATION**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Control System Integration as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) is responsible for making all components of the system operate as a whole. This includes but is not limited to:

1. Configuring equipment software provided under SECTION 13350, SCADA EQUIPMENT.

2. Program all network hardware provided under SECTION 13345, DATA NETWORK.

3. Program the SCADA system to display and control the WWTF operation system.
4. Program the WWTF and Collection System PLCs provided under SECTION 13340, PLC CONTROL PANELS to implement the controls and the WWTF operation system.
5. Provide coordination and support the installation and programming of the instruments, provided under SECTION 13330, PROCESS INSTRUMENTS.
6. Provide witness testing for equipment shop testing and performing field testing as specified.
7. Review of shop drawings submittals of process equipment and PLC based control panels provided under other divisions.
8. Provide configuration direction to the Contractor for all process equipment control panels supplied with equipment.
9. Create HMI screens to replicate screens of the process equipment control panels supplied under other divisions.
10. Provide coordination and support, including control panel shop drawing review, for the instrumentation and control systems for all OEM packages.
11. Provide classroom and hands-on training to the owner's staff on operation of the system.

D. The Contractor shall be responsible for the assistance of the SI with the coordination of equipment furnished in this contract with the overall control system requirements.

E. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Detailed network architecture drawings howing all network components.

2. Submit print outs of all SCADA screens for Owner and Engineer’s review and comment.

3. Submit red-line markup of P&ID that reflects all changes to the design throughout the construction process.

4. Table of IP addresses for all devices.

5. Submit PLC program.

6. Submit Network switch, firewall, and gateway configuration files.

7. Record and submit the configuration of each networked devices.

8. Project narrative.

9. Test Results

10. Test Plans.

C. All submittals provided by the Contractor shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments have been addressed and that the submittal is reviewed by the SI.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in resection of the entire submittal with no further review and consideration.

E. Operation and Maintenance Manuals:

1. Submit operating and maintenance instructions. Incorporate functional description of entire system.

F. Submit "record copy" of all drawings previously submitted for review within 30 days after completion of system installation as part of operating and maintenance instructions. Show all changes and modifications made during installation. Define special maintenance requirements particular to system along with special calibration and test procedures.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Where possible, all equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Work of SI service personnel shall be coordinated by the Contractor.

B. Coordinate with mechanical and electrical systems suppliers to identify any signal isolation, signal boosting devices or auxiliary relays that may be required to complete the system.

C. System energizing not allowed prior to receipt of certified statement from Contractor and SI approving system and authorizing energizing of system.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**1.09 - REFERENCES**

A. American Petroleum Institute (API):

1. RP 551: Process Measurement Instrumentation

B. International Society of Automation (ISA):

1. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided for installation and startup for the equipment as follows:

1. 7 calendar days (via ## separate trips to project site).

**3.03 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided for training of Owner's personnel for the equipment at the project site as follows:

1. 3 calendar days (via ## separate trips to project site).

**3.04 - SPARE PARTS – Not Used**

**3.05 - GENERAL INSTALLATION**

A. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be coordinated by the contractor and the SI during development and fabrication of systems.

B. Provide PLC programming services and control system integration as specified and indicated.

**3.06 - SHOP TESTING**

A. The SI shall attend, witness and coordinate shop testing activities of instrumentation and control system equipment as referenced in their respective specification sections.

**3.07 - FIELD TESTING**

A. All field testing activities shall be coordinated and led by the SI with the Contractor support.

B. Calibration and loop testing.

1. The SI shall provide supervision of all calibration and loop testing by the contractor.

2. Instrument calibration shall be provided by the instrument manufacturer. The field calibration shall be provided with a NIST traceable calibrator. The calibration report shall include;

a. Factory calibration sheet

b. Field (not hand written) calibration sheet

c. Picture of installed instrument

3. The calibration records shall include the instrument serial number and the project instrument tag on all documents. The calibration records shall be submitted electronically so they may be incorporated into the Owners asset data base.

4. The SI shall provide supervision for continuous loop testing. Loop testing shall occur following instrument calibration. The test shall check Continuity of all wiring from devices in the field to the control system IO terminations. Next send and receive inputs and outputs from the field to the HMI (this does not mean simulate w/ a signal generator). Valves should be opened and closed, analyzers should be placed in known solution strengths and discrete devices cycled on and off. Note - before chemical tanks are filled w/ chemicals their levels should be check with water - this can be completed during the leak testing process.
5. The Loop Diagrams will be included in the loop testing. The loop diagrams will checked against field conditions to confirm:
    a. Analog range
    b. Terminal numbers
    c. All control wiring
    d. Power source, grounding, isolation and lightning protection
    e. Signal ground shield showing cutting and taping in field

C. As a minimum, the control system testing shall include the following:
1. Operational Readiness Test (ORT).
2. Application Software Operational Readiness Test (ASORT).
3. Field Acceptance Test (FAT).

D. The test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Engineer.

E. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist. Each specific test to be performed and shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

F. Signed copies of the test procedures prepared by SI, forms and checklists will constitute the required test documentation.

G. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

H. The SI shall coordinate all testing with the Owner and Engineer.

I. The Owner and Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures with no additional cost.

J. The Owner's and Engineer’s decision shall be final regarding the acceptability and completeness of all testing.

K. The SI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

L. Operational Readiness Test (ORT):
1. General: Prior to the Field Acceptance Test, the entire system shall be certified (inspected, tested and documented) that it is READY for operation.
2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop by loop and component by component basis by the SI following field installation, to demonstrate and document the system is in conformance with related submittals and these specifications. The Contractor is required to confirm that the system is properly wired, terminated and tagged from the field wiring nearest to the primary elements or equipment to the PLC I/O.

3. The SI shall maintain the Loop Status Reports and Components Calibration sheets at the jobsite and make them available to the Owner and/or Engineer at all times.

4. The Engineer reserves the right to witness and sign off all tests conducted by the SI. The Engineer shall review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries periodically and upon completion of the tests. Any deficiencies found shall be corrected. Final versions of these test sheets shall be submitted to the Owner and/or Engineer at all times.

M. Application Software Operational Readiness Test (ASORT):

1. During the entire ASORT, all panels and HMI equipment shall be powered, fully interconnected per the approved control system architecture drawing, and ready for testing.

2. The SI shall be responsible for testing all control and monitoring loops by simulation of field inputs and outputs. These inputs/outputs shall be simulated at the point nearest to the field element or equipment after conduit and wire have been installed and tagged as specified and indicated, but prior to transition of the wiring of field devices from the existing control system to the new control system. Field I/O will be simulated as follows:

   a. Discrete Input: Jumper at field input to simulate contact closure.

   b. Discrete Output: Relay and plug-in mounting base with matching coil voltage and indicating light to confirm output signal.

   c. Analog Input: 4-20mADC current source to simulate field analog transmitters.

   d. Analog Output: Multi-meter with mA range to confirm analog output from source.

3. Working with the Contractor's assistance to provide simulated field inputs/outputs as described above, the SI will confirm the PLC programming and HMI configurations and controls for each loop. Closed loop controls, such as wetwell level control, shall be simulated by manual simulation of feedback signal to confirm expected response.

4. The SI shall provide, or coordinate with the Contractor to provide, copies of all approved shop drawings; copies of all as-built drawings; PLC and HMI manufacturer's literature.

N. Field Acceptance Test:

1. Prior to the Field Acceptance Test, the entire installed instrument and control system shall be certified by the SI that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete. The intent of the FAT is for all responsible parties, working together, to prove the installed system operates in accordance with the Specifications. Each party is responsible for verifying the completeness of all system components furnished, installed, and configured by their respective firm or subcontractors.

2. A witnessed Field Acceptance Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop, and site by site basis.

3. Loop specific and non loop specific tests shall be the same as specified under factory testing, WFT and AST.

4. In the event of rejection of any part or function of a SI furnished system, the Contractor and SI shall perform repairs or replacement within 10 days and at no additional cost to Owner.

5. Updated versions of the documentation specified to be provided for during the field acceptance tests shall be made available to the Owner and Engineer at the job sites both before and during the tests. In addition, one copy of all O & M Manuals shall be made available to the Owner and Engineer at the job sites both before and during testing.

**3.08 - FUNCTIONAL START-UP TESTING**

A. After completion of the Field Acceptance Test, the Instrumentation and Control System shall be tested as a component of the Functional Start-up Testing. All furnished hardware and software shall operate for a period of 14 consecutive days, under conditions of full plant process operation, without a single non field repairable malfunction.

B. During this test, Owner operations personnel and SI personnel shall be present as required. The Contractor and the SI are expected to provide personnel for this test who have an intimate knowledge of the hardware and the SI provided software of the system. Coordinate staffing requirements during the test to coincide with normal shift operations as much as possible. Off-shift emergencies shall be fully supported by Contractor and SI staff. Provide staff with cell phones and/or pagers to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

C. While the start-up testing is proceeding, the Owner shall have full use of the system.

D. Any malfunction to the system during the tests shall be analyzed and corrected. The Owner shall determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction during the Start-up Testing which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non field repairable malfunction.

F. Upon completion of repairs, the associated test shall be repeated as specified herein.

G. In the event of rejection of any part or function, perform repairs or replacement within 10 days and at no additional cost to the Owner.

H. The total availability of the system shall be greater than 90% during this test period. Availability shall be defined as:

AVAILABILITY = (TOTAL TIME – DOWN TIME)/(TOTAL TIME) * 100%

I. Upon successful completion of the startup operation test and subsequent review and approval of complete system final documentation, the system shall be considered Substantially Complete, after approval by the Owner and Engineer.

**3.09 - TRAINING**

A. Upon completion of the start-up, provide competent training personnel for a period of not less than three, 8-hour working days, excluding travel time, for training of personnel in the use, operation and maintenance of the instrumentation and control system. Training to utilize the submitted operation and maintenance manuals and record copy drawings as reference materials. Training to be for 6 personnel in each class. Each class to be of a 4 hour duration.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 13350**

**SCADA EQUIPMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide SCADA equipment as specified and in accordance with the Contract Documents. The equipment shall include, but not limited to, servers, uninterruptable power supplies (UPSs), human machine interface (HMI) equipment, and all software packages required to provide a complete and functional control and communication system.

B. Equipment Product Sheets are in Attachment A.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to, the following.

1. SCADA Network Hardware

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

D. Submit Manufacturer Product Data Sheets, with the information noted below and other data pertinent to the equipment and the application.

1. The product manufacturer technical data sheets.

2. The complete model or catalogue number(s) including any special options.

E. Licensing documentations for all software packages.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTIONS 01610, DELIVERY, STORAGE AND HANDLING and SECTION 13300, PROCESS INSTRUMENTS.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**PART 2 - PRODUCTS**

**2.01 - SOFTWARE**

A. Provide Qty (2); Client software packages for new Thin Clients to match existing.

**2.02 - UNINTRUPTABLE POWER SUPPLY (UPS)**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.03 - THIN CLIENT**

A. General:

1. The Thin Client system shall be based on Microsoft terminal services (remote desktop services) solution, with applications presented to user stations based on thin client hardware. The management of this architecture, including servers, thin client terminals, users, applications and security shall be centrally and securely handled by the proposed Management Software.

2. The Thin Client software will operate on the SCADA server as a virtual machine. Provide Thin Client in the Primary Server and backup Thin Client in the SCADA backup server.

B. Thin Client Hardware shall conform to the following:

1. Thin Client hardware shall be Thin Manager ready and shall not require modification from the manufacturer's standard offering.
2. Hardware shall be capable of using Microsoft Remote Desktop Protocol (RDP) and the associated data compression and encryption.
3. Hardware shall be capable of supporting Network Level Authentication (NLA).
4. Hardware shall be compatible with the supplied Management software.
5. Hardware shall support terminal side USB mouse and keyboard.
6. Hardware shall support local serial ports.
7. Hardware shall support high color, high resolution, and be capable of supporting screen resolutions up to 3840x2160 (UHD).
8. Hardware shall neither require nor contain cooling fans.
9. Hardware shall neither require nor contain local permanent storage (i.e. no flash or hard drive shall be necessary or installed).
10. Hardware shall not require a local operating system to boot.
11. Hardware shall have the ability to boot from the server over a standard network.
12. Hardware shall support standard Ethernet network infrastructures.
13. Hardware shall support using either DHCP, static IP configuration, or terminal profile based IP assignment.
14. In conjunction with the Management Software, the ability to configure hardware shall be supported.
15. Hardware shall support the ability to utilize a single keyboard and mouse to control multiple thin clients.
16. Hardware shall support the ability to utilize a single thin client with up to 5 monitors to drive multiple stations, each with their own display, keyboard and mouse.
17. Hardware shall support the ability to move applications from one monitor to another with a thin client that supports multiple monitors. This should be fully configurable.
18. Hardware shall support automatic login to a predetermined terminal server and start a session without operator input.
19. Hardware shall be capable of interfacing with smart card readers.
20. Hardware shall be capable of redundant networking.
21. Hardware shall be able to utilize multiple network interfaces on the Thin Client for different LAN segments.
22. Hardware shall be capable of interfacing with any touch screen controller.
23. Thin Client Terminals:
    a. Thin Clients shall be set-up to run a terminal session of the HMI by connecting to the SCADA Terminal Server.

C. Thin Client Terminals

1. Compact, fanless, tower form factor with flexible mounting options; desktop or panel mount as indicated on the Contract Drawings.
2. 500 MHz processor minimum.
3. 256 MB of RAM minimum.
4. Video graphics card capable of 1600 x 900 pixels, 60Hz refresh rate and 16-bit color minimum. VGA output.

5. Operating temperature of 10 degrees Celsius to 50 degrees C
6. 110 Ports & devices
    a. Minimum of two USB 2.0 ports supporting USB mouse and keyboard.

D. Interface devices
1. Generic USB keyboard, no hot keys or number pad onboard
2. Two button USB optical mouse with scroll wheel
3. Monitor
    a. LCD flat panel 20-inch nominal size minimum
    b. UHD support for 3840 x 2160 resolution
    c. 16 ms response time maximum
    d. 250 nits (cd/m2) brightness
    e. 400 to 1 contrast ratio minimum
    f. Vertica1 viewing angle of 85 degrees minimum
    g. Horizontal viewing angle of 85 degrees minimum
    h. Analog GRB, Digital DVI-D
    i. Adjustable height stand for desktop applications
    j. Panel mount option for installations in PLC panels as indicated with screen minimum size of 15 inches. Screen shall be touch type unit.

E. Networking:
1. The onboard network interface shall have the following features
    a. Support for latest Microsoft operating system.
    b. Fast Ethernet port accepting standard CAT-6 cables for Ethernet communications
    c. IEEE 802.3ab support for gigabit networking standard
    d. IEEE 802.Q VLAN support
    e. Auto sensing 10/100 Mbps or faster
    f. Support either DHCP or static IP configuration.

F. Power supply shall be capable of providing necessary power. Thin Client and monitor shall be I20VAC from UPS.

G. Thin Client Hardware
1. Qty (2) Thin Client Terminals shall be Arista; Microbox 7824B-B01-003-DR, no equal, to match existing.
2. Qty (2) 24” Panel mount video monitors shall be Arista; ADM-1824AP-001, no equal, to match existing.

**2.05 - MANAGEMENT SOFTWARE:**

A. The Management Software shall be able to support configuration of Servers, Thin Clients ('terminals') and Applications from a central interface.
1. Software shall allow centralized configuration of all aspects of the proposed architecture. No client based configuration shall be required.
2. Software shall support connectivity, configuration and interoperability with Microsoft Terminal Services operating systems from Windows 2003 Server through to the latest offering (currently Windows Server 2016).
3. Management software shall be capable of running on the operating systems specified.

4. Software shall support management of the overall terminal services architecture.
5. Software shall permit terminals to be remotely configured and reset from the central interface without the need for the administrator to be at the physical location of the terminal.
6. Software shall permit Windows authentication with auto-login features.
7. Software shall permit automatic login to a predetermined terminal server and start a session without operator input.
8. It shall be possible to configure multiple terminal servers to be used in a load balancing manner without implementing clustering.
9. Load balancing shall be automatically handled by the software and shall be tunable based on CPU utilization, Memory usage and Process usage on the server.
10. Software shall support the ability to queue access requests to the server and complete when resources are available.
11. Software shall support the ability to configure multiple terminal servers to be used and provide the ability to 'failover' to the backup terminal server if the current terminal server fails.
12. Software shall support Shadowing of terminals from management software (Shadowing refers to the ability to view, with authorization, any terminal screen on the managed network).
13. Software shall support the ability to Shadow one terminal on one or more terminals.
14. Software shall have monitoring capabilities to detect and display terminal server assignment, login status, terminal load, and terminal server load.
15. Should a thin client fail, the software should provide the ability to allow quick replacement of the failed client with a spare, with no required configuration changes.
16. Should a thin client fail, the replacement terminal shall be automatically reconnected to the existing (disconnected) terminal session.
17. Software shall support the automatic logout of a session after a configurable period of inactivity.
18. Software shall support the integration of IP camera video as either an overlay on an existing terminal screen or as a separate client application.
19. Software shall support software decoding of IP camera streams as well as hardware decoding (with appropriate thin client hardware).
20. Multiple video streams shall be able to be configured onto a single client display.
21. Software shall permit configuration permitting sound from an application, or from multiple applications, to be played from the thin client device.
22. Software shall support easy backup and restoration of the configured architecture.
23. Software shall be extensible, preferably utilizing an ActiveX control or .NET component.
24. Software shall support the delivery of applications from multiple terminal servers to a single thin client and visualize the sessions simultaneously.
25. Software shall support the management of applications being delivered to a PC based platform.
26. Software shall support industrial and commercially available thin client hardware.
27. The Management Software shall be able to be used from a portable, network connected mobile device.
28. Software shall support remote configuration with an iOS device such as an iPad or iPhone, or Android device.
29. Thin client emulation software shall be available to provide operator level functionality from a network connected iOS or Android devices.

30. The thin client emulation software shall not permit the operator to configure or otherwise interact in an administrative capacity with the network.
31. The thin client emulation software shall support delivery of applications to the mobile device based on location.
32. The thin client emulation software shall support location-based resolvers including Quick Response (QR) Codes, Bluetooth Beacons, Global Positioning System (GPS) and WiFi Access Points.
33. Upon location-based resolution, the thin client emulation software shall support different actions based on the user's access group, including Interactive Shadow, Non-interactive Shadow, Manual Transfer, Force Transfer and Clone.
34. The thin client emulation software shall support the combination of location resolvers to create a geo-fence for application delivery.
35. Security of the configuration and access to servers shall be managed and configured with the Management Software.
36. Software shall support but not require different levels of access for security based on user identity.
37. Users shall be able to be placed into security groups for easy management.
38. Software shall support Application access based on user identity.
39. Software shall support configuring of Applications such that only the Application window is presented to the user (i.e. no desktop or Start menu), thereby denying access to unauthorized programs.
40. User level access shall be able to be configured independent of any operating system-based authentication, such as Active Directory, and shall not require access to such for configuration.
41. User level access using Microsoft Active Directory or other operating system-based authentication shall however be supported.
42. The software shall support synchronization with Microsoft Active Directory organization units (OU).
43. Software shall support the storage of credentials that can be pushed to Microsoft Active Directory.
44. Software shall support automatic password generation at a configurable interval while maintaining Microsoft Active Directory complexity requirements.
45. Software shall support the delivery of applications based on a user's assignment to a Microsoft Active Directory security group.
46. Software shall permit automatic launching of programs without operator input.
47. Software shall support the ability for a supervisor to access their authorized applications and desktop from any configured terminal.
48. Software shall support the ability to permit or deny users, or groups of users, access to applications unless suitably authorized and authenticated.
49. Software shall support blocking of interrupt key sequences such as CTL+ALT+DEL and CTL+ESC.
50. Local terminal USB ports shall not be connected to the server.
51. The Management Software shall be able to manage licensing within the central interface.
52. Licensing shall be flexible based on the number of clients managed on the network.
53. The number of servers managed as a part of the architecture shall not be restricted by the management software license.
54. It shall be possible to add more client licenses to the network without disturbing the connected clients.
55. There shall be a level of licensing which permits an unlimited number of clients to be connected and managed without the need to purchase additional client licenses.

**2.06 - SPARE PARTS**

A. Provide recommended spare parts list with unit prices.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide, install, test and commission SCADA Equipment and all peripheral devices necessary in accordance with the Contracts Documents.

B. The SI shall install, configure and setup all software packages provided.

**3.02 - FIELD TESTING**

A. Demonstrate system functional operation after completion of installation and prior to plant start up. Refer to SECTION 13331, CONTROL SYSTEM INTEGRATION for control system field testing requirements.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

See Attachment A, Product Sheets

**ATTACHMENT A**

**PRODUCT SHEETS**

DATA SHEET 702.1 UNINTERUPTIBLE POWER SUPPLY

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**UNINTERRUPTIBLE POWER SUPPLY SPECIFICATION**

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**DATA SHEET NO. 702.1**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag No.: | UPS-10.1, UPS-20.1, UPS-50.1, UPS-60.1 and UPS-80.1 |
| | Service: | LINE POWER CONDITIONING AND BACKUP POWER FOR PLC/SCADA SYSTEM |
| 2. | Location: | IN BUILDINGS 10, 20, 50, 60 AND 80 |
| 3. | Input Voltage: | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 20% |
| 4. | Output Voltage: | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 3% SINE WAVE, +/- 1% VOLTAGE BALANCE |
| 5. | Input Current Total Harmonic Distortion (THD): 3% AT 100% LOAD – 5% AT 50% LOAD | |
| 6. | Output Voltage Harmonic Distortion: 2% MAX. AT 100% LOAD – 5% MAX. AT 50% LOAD | |
| 7. | Power Factor: | 0.90 AT 100% LOAD – 0.90 AT 50% LOAD |
| 8. | Operating Temp.: | 50 TO 104 DEG. F. |
| 9. | Surge Protection: | 6000 VOLT AND MEET IEEE C62.41 CATEGORIES A AND B |
| 10. | Backup Time: | MINIMUM OF 10 MINUTES MINIMUM AT 120% OF FULL LOAD |
| 11. | KVA Size: | 10 KVA MINIMUM AND IN ACCORDANCE WITH SIZING CALCULATIONS REQUIREMENT SPECIFIED. |
| 12. | Low Battery Ind.: | REQUIRED |
| 13. | Brownout Protection: | REQUIRED |
| 14. | UPS Type: | VOLTAGE REGULATION LINE INTERACTIVE |
| 15. | Efficiency: | 92% MINIMUM |
| 16. | Transfer Time: | LESS THAN ONE MILLISECOND |
| 17. | Communication: | RS-232 AND MODBUS ETHERNET COMMINUCATION |
| 18. | Digital Display: | TOUCH SCREEN |
| 19. | Local Alarms: | LEDs AND AUDIBLE |
| 20. | Digital Alarm Contacts: | LOW BACKUP TIME, OVERLOAD, REPLACE BATTERY, LOW BATTERY, LOAD ON INVERTER, LOAD ON BYPASS LCD FAULT, UPS FUALT |
| 21. | Audible Noise: | LESS THAN 50 dB @ 3 FT |
| 22. | Certificate: | UL LISTING |

BATTERY

| | | |
|---|---|---|
| 1. | Type: | SEALED, LEAD ACID MAINTENANCE FREE |
| 2. | Battery Protection: | THERMAL, OVERVOLTAGE AND OVERCURRENT |

MISCELLANEOUS

| | | |
|---|---|---|
| 1. | Manufacturer(s): | EATON, BEST, SOLA, APC OR EQUAL |

NOTES.

a. Provide UPS system such that upon failure of the UPS feeder, batteries provided with UPS immediately take over as the power source.

b. Provide external bypass switch with three circuit breakers Make-Before-Break system. Provide bypass to isolate the UPS equipment for maintenance. Provide bypass with switch test so the switch may be tested without the risk of dropping the load caused by static switch failure.

c. Provide static transfer switch to transfer load upon loss of power at the output of the UPS.

d. Provide UPS sizing documentations in the shop drawing submittal. UPS shall supply power to PLCs, RIOs, SCADA severs, Thin Client nodes, network communications equipment workstations and field instruments. Provide sizing documentations analysis which are based on required load plus minimum of 10% spare capacity.

**SECTION 15855**

**FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Fiberglass Reinforced Plastic Duct Dampers and Appurtenances as specified and/or as shown on drawings.

B. Provide duct and dampers for odor abatement systems with all appurtenances to make it operable, as indicated and in compliance with Contract Documents.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accoirdance with the provisions of the DOCUMENT 00700, GENEREAL CONDITIONS, and SECTION 01300, SUBMITTALS.

1. Submittals required under this section include, but are not limited to the following.

a. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

b. Certified shop and working drawings. Drawings for the duct and dampers shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

c. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

d. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

e. Files shall be drawn to scale.

f. Drawings shall be in conformance with all other requirements as specified in this specification.

2. A letter from the resin supplier stating that the material used for this project will comply with the specification and meet all corrosion requirements.

3. Design calculations performed by the manufacturer and stamped by a Professional Engineer for record purposes.

4. Samples, representative of the ductwork, construction method and material used to be supplied on this project.

5. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

6. Manufacturer's literature and specifications. Show catalog dates.

7. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

10. Four copies of manufacturer's recommended regeneration instructions, procedures and safety precautions. Provide detailed instructions for particular system as required.

11. List of 5 operating installations to demonstrate compliance with the requirements of Paragraph 1.07.H.

    a. Provide current (verified) contact information for each installation.

12. Paint manufacturer's product data and specifications indicated conformance to shop painting requirements specified including statement of compliance for compatibility.

13. Manufacturer's literature as needed to supplement certified data.

14. Two (2) sample cutouts demonstrating 100 mils ( liner, and filament wound structural laminate. Samples to be a minimum of 8-inch diameter cut out, and a 12-inch diameter piece of duct at least 12 inches (300 mm) long complying with RTP-1 visual level I.

15. Copies of burial calculations for at least 3 sizes of duct between 12-inch and 48-inch .

16. Submit details of:

    a. Resin Type

    b. Types and amounts of filler

    c. Corrosion liner description

    d. Reinforcement types for hand lay-up or chopped laminates

e. For filament-wound laminates:

(1) Helix angle

(2) Glass content range

(3) Strand yield

(4) Strand by inch in the winding band

(5) Ply thickness

(6) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.

f. For all Fabricated parts:

(1) Construction type

(2) Laminate thickness

(3) Ply sequences

(4) Glass content range

g. For all secondary overlays (both interior and exterior):

(1) Laminate thickness

(2) Ply sequences and widths

(3) Construction details for all other special configurations and fabricated parts.

17. Shop test results.
18. Motor shop test results.
19. Qualifications of field service technician.
20. Schematic control and power wiring diagrams.
21. Shop and Field inspections reports.
22. List of recommended spare parts other than those specified.
23. Recommendations for short and long term storage.
24. Special tools.
25. Shop and field testing procedures and equipment to be used.
26. Number of service technician days provided and per diem field service rate.
27. Manufacturer’s product data, specifications, and color charts for shop painting.
28. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
29. The most recent ISO 9001 series certification.
30. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

31. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

    a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

32. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

B. Provide components to manufacturer's standard for service intended unless otherwise required.

C. Provide components and accessories of manufacturers' latest and proven design.

D. The drawings and specifications direct attention to certain required features of the tanks, but do not purport to cover details entering into its design, construction and installation; nevertheless, provide tanks so that systems will be complete and ready for operation.

E. Provide field services as required for installation, with factory-trained technician to assist in determining location.

F. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

G. Upon completion of the installation, provide services of above serviceman for field testing.

H. Turn on no form of energy to any part of system prior to receipt by Engineer of certified statement of approval of installation from Contractor containing his supplier's authorization to energize system unless done by the supplier's servicemen may do so for purposes of checkout.

**1.08 - REFERENCES**

A. Air Movement and Control Association (AMCA):

1. 500D: Laboratory Methods of Testing Dampers for Rating.

B. American Society of Mechanical Engineers (ASME):

1. B-16.5: Pipe Flanges and Flanged Fillings NPS 1/2 Through NPS 24 Metric/Inch Standard.
2. RTP-1: Reinforced Thermoset Plastic Corrosion Resistant Equipment.

C. American Society for Testing and Materials (ASTM):

1. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
2. D2310: Standard Classification for machine-Made “Fiberglass” Pipe.
3. D2412: Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. D2996: Standard Specification for Filament Wound “Fiberglass” (Glass Reinforced Thermosetting-Resin) Pipe.
5. D3567: Practice for Determining Dimensions of Fiberglass (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.
6. D3982: Standard Specification for Contact Molded Fiberglass Duct and Hoods.
7. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Bureau of Standards (NBS):

1. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

E. NSF International (NSF):

1. 61: Drinking Water System Components - Health Effects

F. Occupational Safety and Health Association (OSHA):

1. 29 CFR Part 1910.27: Fixed Ladder
2. 29 CFR Part 1926.104: Safety Belts, Life Lines and Lanyards
3. 29 CFR Part 1926.500: Fall Protection
4. 29 CFR Part 1926.501: Fall Protection
5. 29 CFR Part 1926.502: Fall Protection

G. Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):

1. 1884: Fiberous Glass Duct Construction Standards.

**PART 2 - PRODUCTS**

**2.01 - FRP DUCT**

A. Materials and Fabrication:

1. Type: Filament wound rated at design pressures as specified and indicated.
2. Minimum wall thickness, in accordance with SMACNA Table 5-7 and as specified:
    a. 2-inch through 14-inch: 0.145-inch.
    b. 16-inch through 22-inch: 0.180-inch.
    c. 24-inch through 30-inch: 0.220-inch.
    d. Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.
    e. Rectangular ductwork thickness: As specified in SMACNA and as specified and indicated. In no case shall the rectangular duct thickness be less than substituting the long side of the rectangular duct for the round equivalent thickness.
3. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.
4. Provide all ducts designed for not less than 20 inches water column pressure, and 15 inches water column vacuum.
5. The design, applicable construction, and inspections shall be in accordance with SMACNA, and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.
6. Provide a minimum structural safety factor of 4 in the design of all ducting.
7. Maximum deflection of rectangular ducts under deadload and operating conditions: Not to exceed 1 percent of the width of the longest side.
8. Resin: Hetron FR992, Derakane (Ashland Inc.) 510 or equal, selected to meet the exposures and temperatures of the air to be exhausted.
9. Minimum barcol hardness: 36.
10. Fillers other than antimony trioxide added for flame retardancy are not acceptable and should not exceed 5 percent by weight.
11. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment.
12. Flame spread rating: 25 or less per ASTM E84.
13. Catalyst: DHD9 or Hi-Point 90 per resin manufacturer.
14. Corrosion liner:
    a. Inner surface: One ply of 10 mils thick minimum C-glass surfacing veil saturated with vinylester resin.
    b. Provide the surface veil overlapped a minimum of 1 inch with two (2) layers of 1-1/2 oz./sq. ft. chopped strand mat following the surface veil layers.
    c. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours.
    d. Total liner thickness: 100 mils minimum.
    e. No thixotropic agent or fire retardant additive is to be used in the liner resin.

f. Corrosion liner: Not less than 20 percent or more than 30 percent glass by weight.

g. Provide liner passing ASME RTP-1 Table 6, level II visual inspection. Total glass content 25 percent to 30 percent.

15. Structural layer: Filament wound of Hetron FR992, or Derakane 510 premium grade, vinylester resin and Type E 250 strand yield continuous glass roving.

a. Band width: 2.25 inches using (7) strands per inch.

b. Filament winding cycle thickness: 0.06 inches maximum.

c. Glass content 55 percent to 65 percent.

d. Winding angle: 65 degrees ± 2 degrees for increased vacuum service.

16. Provide the exterior of all laminates containing sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections.

17. Provide an ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements.

18. Provide ductwork located outdoors with an exterior colored surface coat.

a. Color: White or as selected by Owner.

19. Provide ductwork located indoors with two (2) coats of PPG Speedhide 42-7 Intumescent paint to provide a class 1 flame and smoke rating.

20. ASTM E84 Steiner Tunnel test results shall be attached as part of the submittal packet.

21. Standard lengths: Provide in accordance with the manufacturers published product data sheets and accepted shop drawings.

22. Duct stiffness: Minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions.

23. Markings on duct and spool pieces shall be in accordance with shop drawings.

**2.02 - FITTINGS AND JOINTS**

A. Fittings:

1. Hand-layup construction fabricated from the same resin and have the same strength as the FRP ductwork.

2. Internal diameter of all fittings: Equal to the adjacent duct.

3. Tolerance on angles of all fittings: +/- 1 degree for 24 inch diameter and smaller and +/- 1/2 degree for 30 inch diameter and larger.

B. Elbows:

1. Radius: 1.5 times the diameter.

2. 24-inch and smaller: Smooth radius.

3. 30-inch and larger: Mitered.

4. Bends 30 degrees and less: 1 miter, 2 piece

5. Bends 31 degrees to 60 degrees: 2 miter, 3 piece

6. Bends 61 degrees to 90 degrees: 4 miter, 5 piece

C. Turning Vanes:

1. Provide turning vanes and splitters at all single mitered bends 46 degrees and greater and similar fittings that are not one-piece smooth radius fittings per SMACNA standards.

2. Turning Vanes: Filament wound and reinforced with unidirectional glass, metallic vanes are not acceptable.

D. Flange Joints:

1. Provide flanged connections at flexible connectors, expansion joints, vessels, grease filters, fans, and other locations as indicated.

2. Flanges:

a. Hand lay-up construction with dimensions in accordance with NBS PS 15-69 and the Duct Dimension Schedule.

b. Flanges 24-inch and smaller: One piece integral, SMACNA Thermoset Duct construction manual and supplied undrilled for field drilling and alignment.

3. Flanges shall be drilled in accordance with NBS PS 15-69 -Table 2. acks of flange face shall be flat so that washer seats fully on bolt face and flange backing.

4. Flange Faces: Perpendicular to the axis of the duct within 1/2 degree.

5. Flange Faces: Flat to within +/- 1/32 inch for sizes 18-inch and smaller and flat within +/- 1/16 inch for sizes 20-inch and larger.

6. Gaskets: EPDM, full face, minimum 1/8-inch thick.

7. Hardware: Type 316 stainless steel.

E. Duct Joints:

1. Butt and wrap joint type connections.

2. Fittings: Butt and wrap joint type connections.

3. Apply adhesive material for field joining in rolls and resin containers no larger than five gallons.

4. Provide all joints per SMACNA standard, and per manufacturer's laminate schedule and procedures.

**2.03 - EXPANSION JOINTS**

A. Expansion Joints:

1. Provide expansion joints where indicated and where required for flexibility and to accommodate the duct support system.

2. Provide flanged joints where connecting ductwork to vessels, grease filters, fans, equipment and other locations as indicated.

3. Provide slip-type joints where flanges joints are not specified or indicated.

4. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified and indicated.

5. Material: EPDM

6. Backing Rings: 3/8-inch thick, 2 inches wide, Type 316 stainless steel.

7. Extension: 3 inches .

8. Compression: 2.5 inches .

9. Lateral Offset: 2.5 inches .

10. Thickness: 1/4-inch minimum.

11. Bolts, Nuts and Washers: Type 316 stainless steel.

B. Manufacturers:

1. RM-Holz (Holz Rubber Company, Inc.)
2. Metraflex, Inc.
3. Garlock (EnPro Industries)
4. Mercer Rubber Company

**2.04 - DUCT DRAINS**

A. Provide 1 inch minimum CPVC pipe and CPVC ball valve trapped duct drains on all low points in all main, branch and riser ducts to allow removal of condensate.

1. Provide piping in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and valves in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

B. For ducts located outdoors insulate the drains, trap and piping with 1-inch (25 mm) of insulation in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

**2.05 - DAMPERS**

A. Provide factory fabricated dampers conforming to AMCA 500D requirements and as specified.

B. Provide FRP dampers manufactured from the same materials and resin as specified for duct.

C. Materials and Construction:

1. Blades: Two (2) piece, molded including blade stiffeners. Provide damper blade offset 5 degrees in the closed position to form a normal stop.
2. Axle: Pultruded FRP made of the same resin as specified for the duct and continuous strand roving.
3. Control Shaft: Provide axle extending 6 inches (150 mm) beyond frame, full length vinylester with Type 316 stainless steel pins embedded transverse of axle.
4. Bearings: Molded PTFE with 10 percent carbon and graphite fill.
5. O-Rings: Viton.
6. Metallic parts in contact with the air stream are not acceptable.

D. Provide the following type of dampers for the service specified:

1. Balancing:
   a. Opposed multi-blade type.
2. Isolation:
   a. Butterfly type constructed of one gauge heavier than respective duct.
   b. Provide dampers equipped with full circumference extruded double tadpole blade seals.
   c. Butterfly damper leakage: Not to exceed 2.9 cfm/sq. ft. against 26 inches W.C.
3. Volume damper:
   a. Butterfly type, locking quadrant of same material as duct.

E. Provide manual dampers with lever type, locking quadrant operator Identified with OPEN and CLOSE positions.

F. Where indicated, provide electric motor operators as specified herein.

G. Dampers shall be of self-supporting construction and shall not deflect or deform while free standing.

H. Dampers shall have flanged ends for connection to ductwork and equipment.

I. Manual Operators:

1. Dampers 16-inch and larger: Provided gear operators with an epoxy coating.

2. Dampers 14-inch and smaller: Provide hand quadrant actuators fabricated of Type 316 stainless steel with a 5-stage locking quadrant indicator.

J. Balancing Dampers:

1. Manual: Provide a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill and pin-in place" once system is balanced so handle cannot vibrate loose.

2. Electric: Provide as specified.

K. Chain wheel operators: Provide galvanized steel chainwheels with galvanized steel chain and chain guides for all dampers with operator or gear operators higher than 6.5 feet above operating floor level.

1. Provide chain that reaches to within 3 feet of the operating floor level.

2. For dampers with gear operator mount with chainwheel in the vertical position.

3. Provide in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

L. Electric Motor Actuators:

1. Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

2. For fan inlet service provide modulating actuators.

**2.06 - AIR INLETS**

A. Material compatible with ductwork system specified.

B. Provide Type 316L stainless steel wire mesh bird screen for all fresh air intakes.

C. Each air exhaust from each of the tanks shall have a volume damper as indicated and specified.

**2.07 - DUCT SYSTEM SUPPORTS**

A. Duct Support:

1. Provide supports for all ducts designed and furnished by the duct system supplier in accordance with SECTION 15056, PIPE SUPPORTS and as specified herein.

2. Provide hanger spacing as indicated in ASTM D3982.

3. Provide ductwork supported from structure by straps or rods. Provide Type 316L stainless steel angle iron brackets to support ducts where structure is not available.

4. For exterior duct, design and provide free standing duct supports to meet specified duct spacing requirements and specified loads.

5. Provide anchors, inserts or clamps to secure hangers to structures. Provide Type 316 stainless steel anchors, screws and bolts. Provide in accordance with manufacturers recommendations and Factory Mutual limitations and restrictions.

B. Provide all duct supports shall be designed to withstand seismic loads as indicated and specified.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – Not Used**

**3.02 - INSTALLATION**

A. General:

1. Install ducts, dampers and appurtenances in accordance with manufacturer's recommendations.

2. Prior to installation, inspect each duct length and all fittings, flush clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

3. Provide all materials and equipment required.

**3.03 - PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

D. After installation and accepted testing by the Engineer Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleand from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING – Not Used**

**3.07 - LUBRICATIONS REQUIREMENTS- Not Used**

**3.08 - SPARE PARTS**

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

C. Provide the following spare parts, all identical and interchangeable with similar parts installed in Work:

1. Two spare gaskets of all types, materials and sizes.

2. One (1) set of all special tools.

**3.09 - DUCTWORK**

A. Assemble per SMACNA, Standards as specified hereinbefore.

B. Do not exceed 6-feet spacing of hangers on horizontal ducts; 4-feet on vertical ducts.

C. Support ductwork from structure by 16-gauge straps. Use hanger material compatible with ducts; use angle brackets to support vertical ducts.

D. Use anchors, inserts or clamps to secure hangers to structures; use stainless steel anchors if drilled-in type are installed.

E. Install duct connections to masonry openings airtight. Pack the space between the sleeve and framed prepared opening and the duct and the duct insulation with mineral wool or other FM approved fire resistant material.

F. Flanged connections to equipment, 3-inch minimum length.

G. FRP ductwork:

1. Joints, finished joints in accordance with NBS PS 15-69 Standards.

**3.10 - SYSTEM TESTING**

A. Test at 1.5 times the system design pressure specified and indicated.

B. Determine leakage by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

**3.11 - SYSTEM BALANCING**

A. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

B. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

C. Submit report to the Owner outlining balancing procedures used; report to include:

1. Type of measuring devices used.

2. Air quantities at each outlet, damper and fan.

3. Fan speeds.

4. Fan suction and discharge pressures.

5. Air quantities through fan, by test and by summation of air quantities at outlets.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of<br>$ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of<br>$ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of<br>One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ 125,000.00 |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ 30,000.00 |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ 30,000.00 |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ 30,000.00 |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as speficied, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ 400,000.00 |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as speficied, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ 450,000.00 |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as speficied, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ 550,000.00 |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishng Section 11365 - Rotary Drum Thickeners, as speficied, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ 225,000.00 |
| | $ | 225,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ 1,840,000.00** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work and Section 05511, Pre-Engineerd Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD** - The OWNER's present funding constraint limits award of this contract to $22,350,000. The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraint will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding the total of $22,350,000. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in May 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**One Million Eight Hundred Forty Thousand Dollars and No Cents**

**$ 1,840,000.00**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**One Million Eight Hundred Forty Thousand Dollars and No Cents**

**$ 1,840,000.00**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**One Million Eight Hundred Forty Thousand Dollars and No Cents**

**$ 1,840,000.00**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive**

**One Million Eight Hundred Forty Thousand Dollars and No Cents**

**$ 1,840,000.00**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | **One Million Eight Hundred Forty Thousand Dollars and No Cents** | | **$ 1,840,000.00** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | **One Million Eight Hundred Forty Thousand Dollars and No Cents** | | **$ 1,840,000.00** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | **One Million Eight Hundred Forty Thousand Dollars and No Cents** | | **$ 1,840,000.00** |

Company's Name

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

Date:

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

## PART I - BASE BID

1. The work of the Subbidder for all Work of the Project other than that covered by other items, as specified, the lump sum of

$ - l.s.

2. The Work of the Subbider including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of

$ - l.s.

## TOTAL OF PART I - BASE BID

$ -

## PART II - ALTERNATIVES

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

$ - l.s.

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

$ - l.s.

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

$ - l.s.

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

$ - l.s.

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

$ - l.s.

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

$ - l.s.

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

___ may be used by any General Bidder except:

_____

___ may only be used by the following General Bidders:

_____

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

_____

Class of Work:

_____

Bid Price:

$ -

2 Name:

_____

Class of Work:

_____

Bid Price:

$ -

3. Name:

Class of Work:

Bid Price:
$ -

4. Name:

Class of Work:

Bid Price:
$ -

5. Name:

Class of Work:

Bid Price:
$ -

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name _____

2. Ever failed to complete any work awarded? _____

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project

Engineer or Architect

General Contractor

Amount of Contract

$ -

b) Project

Engineer or Architect

General Contractor

Amount of Contract

$ -

c) Project

Engineer or Architect

General Contractor

Amount of Contract

$ -

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

Town of Orleans, MA

# Downtown Area Collection System Layout

**Legend**

- WWTP
- Property to be Serviced by Low Pressure Sewer Pump
- Pump Station
- PS Forcemain
- WWTF Effluent Forcemain
- Low Pressure Sewer (LPS)
- Gravity Sewer - Existing
- Gravity Sewer - 8"
- Gravity Sewer - 10"
- Gravity Sewer - 12"
- Gravity Sewer - 16"
- Gravity Sewer - 18"
- Service Lateral - Existing
- Downtown Service Area
- Parcel
- Waterbody
- Wetland

0 125 250 500 Feet

AECOM

February 2020

Wastewater Treatment Facility 20 Overland Way

Route 6 Crossing

84 Old Colony Way

Pump Station No:1

WWTF Effluent Disposal Site 32 Lots Hollow Rd

Downtown Service Area

Pump Station No.3

Cranberry Cove Plaza

Snow Library

Pump Station No.2

Cedar Pond

Boland Pond

Town Cove

EASTHAM

E_02 E_03 E_04 E_05 D_04 D_05 F_03 F_04 F_05 F_06 G_03 G_04 G_05 H_03 H_04

NAMSKAKET ROAD
PRINCE LANE
CEDAR POND ROAD
JONES ROAD
CANAL ROAD
KINGS WAY
LOCUST ROAD
LIBERTY LANE
MAIN STREET
CAPE COD RAIL TRAIL
OLD COUNTY ROAD
OLD COLONY WAY
CRANBERRY HIGHWAY
SOUTH ORLEANS ROAD
COTTAGE STREET
NORTH COTTAGE STREET
MID-CAPE HIGHWAY - ROUTE 6
OAK RIDGE LANE
WEST ROAD
OLD TOTE ROAD
COVE ROAD
DOANE TERRACE
CUMMINGS ROAD
BREWSTER CROSS ROAD
CENTER PLACE
ACADEMY PLACE
CLAYTON CIRCLE
NICKERSON ROAD
ELDREDGE PARK WAY
FINLAY ROAD
LOTS HOLLOW ROAD
MARSTONS WAY
OLD FARM ROAD
QUAIL HILL LANE

I:\acm\605\Work - Orleans\Maps\Downtown Area CSS, 02-24-2020\Dwy.mxd

## INSTRUMENT TYPE IDENTIFICATION LETTERS

THIS TABLE APPLIES ONLY TO THE FUNCTIONAL IDENTIFICATION OF INSTRUMENTS

| | FIRST LETTER | | SUCCEEDING LETTERS | | |
|---|---|---|---|---|---|
| | MEASURED OR INITIATING VARIABLE | MODIFIER | READOUT OR PASSIVE FUNCTION | OUTPUT FUNCTION | MODIFIER |
| | | | | | |
| A | ANALYSIS | ANALOG | ALARM | | |
| B | BURNER FLAME | | USER'S CHOICE | USER'S CHOICE | USER'S CHOICE |
| C | CONDUCTIVITY (ELECTRICAL) | | | CONTROL | |
| D | DENSITY (MASS) OR SPECIFIC GRAVITY | DIFFERENTIAL OR DIGITAL | | | |
| E | VOLTAGE (EMF) | | PRIMARY ELEMENT | | |
| F | FLOW RATE | RATIO (FRACTION) | | | |
| G | GAGING (DIMENSIONAL) | | GLASS | | |
| H | HAND (MANUALLY INITIATED) | | | | HIGH |
| I | CURRENT (ELECTRICAL) | | INDICATE OR INPUT | | |
| J | POWER | SCAN | | | |
| K | TIME OR TIME SCHEDULE | | | CONTROL STATION | |
| L | LEVEL | | LIGHT (PILOT) | | LOW |
| M | MOISTURE OR HUMIDITY | | | | MIDDLE OR INTERMEDIATE |
| N | USER'S CHOICE | | USER'S CHOICE | USER'S CHOICE | USER'S CHOICE |
| O | USER'S CHOICE | | ORIFICE (RESTRICTION) | | |
| P | PRESSURE OR VACUUM | | POINT (TEST CONNECTION) | | |
| Q | QUANTITY OR EVENT | INTEGRATE OR TOTALIZE | | | |
| R | RADIOACTIVITY | RELIEF | RECORD OR PRINT | | |
| S | SPEED OR FREQUENCY | SAFETY | | SWITCH | |
| T | TEMPERATURE | | | TRANSMIT | |
| U | MULTIVARIABLE | | MULTIFUNCTION | MULTIFUNCTION | MULTIFUNCTION |
| V | VIBRATION | | | VALVE, DAMPER OR LOUVER | |
| W | WEIGHT OR FORCE | | WELL | | |
| X | UNCLASSIFIED | | UNCLASSIFIED | UNCLASSIFIED | UNCLASSIFIED |
| Y | USER'S CHOICE | | | RELAY OR COMPUTE | |
| Z | POSITION | | | DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT | |

## MISCELLANEOUS ABBREVIATIONS

| | | | |
|---|---|---|---|
| I/P | CURRENT TO PNEUMATIC CONVERTER | GBT | GRAVITY BELT THICKENER |
| E/I | VOLTAGE TO CURRENT CONVERTER | DO | DISSOLVED OXYGEN |
| ∑ | ADD OR TOTALIZE | H2S | HYDROGEN SULFIDE |
| √ | SQUARE ROOT | O2 | OXYGEN |
| X | MULTIPLY | pH | HYDROGEN ION CONCENTRATION |
| ⊘ | DIVIDE | LP | LOCAL PANEL |
| > | HIGH SELECT | VFD | VARIABLE FREQUENCY DRIVE |
| MV | MEASURED VARIABLE | △ | DIFFERENCE |
| < | LOW SELECT | I/O | INPUT/OUTPUT |
| S.P. | SET POINT | ER | ELECTRICAL ROOM |
| PLC | PROGRAMMABLE LOGIC CONTROLLER | LEL | LOWER EXPLOSIVE LIMIT |
| f(x) | CHARACTERISTIC | DW | DEWATERING |
| P | PROPORTIONAL CONTROL MODE | OC | ODOR CONTROL |
| D | DERIVATIVE | WW | WASTE WATER |
| ∫ | INTEGRAL CONTROL MODE | SSL | ZERO SPEED SWITCH |

SEE MECHANICAL LEGEND FOR ADDITIONAL ABBREVIATIONS AND PROCESS STREAM NAMES

## SYMBOLS

HYDRAULIC CONTROL LINES

ELECTRIC INSTRUMENT LINES

PNEUMATIC SIGNAL

PROCESS FLOW

CAPILLARY TUBING

INTERNAL LINK SIGNAL

CONE CHECK VALVE

BALL VALVE

BALL CHECK VALVE

SWING CHECK VALVE

BUTTERFLY VALVE, DAMPER, OR LOUVER

PLUG VALVE

GATE VALVE

DIAPHRAGM VALVE

GLOBE VALVE

RESTRAINED FLEXIBLE COUPLING

FLOAT VALVE

3-WAY MIX VALVE

3-WAY DIVERTER VALVE

3-WAY SOLENOID VALVE

4-WAY MIX VALVE

4-WAY SOLENOID VALVE

ANGLE VALVE

SOLENOID VALVE

SELF-OPERATING BACK PRESSURE REGULATOR VALVE

SELF-OPERATING PRESSURE REGULATOR VALVE

PRESSURE REDUCING REGULATOR VALVE W/EXTERNAL PRESSURE TAP

PRESSURE RELIEF VALVE

VACUUM RELIEF VALVE

KNIFE GATE VALVE

PINCH VALVE

STOP LOG

SLUICE GATE

PREFABRICATED SLIDE GATE

MULTI-BLADE DAMPER

ACCUMULATOR

AERATOR

BAR SCREEN

CALIBRATION STANDPIPE

CHEMICAL SEAL

IN LINE SEAL (NOTE 2)

CONCENTRIC REDUCER

DRAIN

DUPLEX FILTER

ECCENTRIC REDUCER

FLEXIBLE HOSE

GRINDER

LOAD CELL

MIXER

VERTICAL SHAFT MIXER

PULSATION DAMPENER

QUICK DISCONNECT

RADIO, ULTRASONIC, OR ACOUSTIC SIGNAL

RUPTURE DISC (PRESSURE RELIEF)

RUPTURE DISC (VACUUM RELIEF)

STRAINER

CONE CHECK VALVE

DOUBLE DISC CHECK VALVE

FLAME ARRESTOR

INTRINSICALLY SAFE BARRIER

SUBMERSIBLE LEVEL TRANSDUCER

DIFFUSER

STATIC MIXER

TANK VENT

UNION

WEIR

CYLINDER ACTUATOR

DIAPHRAGM ACTUATOR WITH POSITIONER

HAND OPERATOR

HYDRAULIC OPERATOR

MOTOR OPERATOR

PNEUMATIC OPERATOR

SOLENOID OPERATOR

TERMINAL STRIP IN LOCAL PANEL FOR INTERFACE WITH COMPUTER/MUX

FLOW RATE CONTROLLER

FLOW ELEMENT (VENTURI)

INSERT FLOW ELEMENT (VENTURI)

MAGNETIC FLOWMETER

ORIFICE PLATE

PARSHALL FLUME

ROTAMETER

ACOUSTIC OR DOPPLER INLINE FLOWMETER

"V" NOTCH WEIR

VERTICAL TURBINE SOLIDS HANDLING PUMP

INLINE MIXER

WEIR GATE

WEIR

BLOWER

SUBMERSIBLE PUMP

CENTRIFUGAL PUMP

CENTRIFUGE AND SLUDGE CAKE PUMP

DIAPHRAGM PUMP

HOSE PUMP

METERING PUMP

POSITIVE DISPLACEMENT PUMP

PLUNGER PUMP

PRESSURE PUMP

PROGRESSIVE CAVITY PUMP

ROTARY LOBE PUMP

VARIBLE INLET VANE DAMPER

INSERTION MASS FLOW METER

LIMITS OF WORK (TRADE, CONTRACT, ETC.)

POINT OF CONNECTION NEW WORK TO EXISTING WORK

## GENERAL NOTES

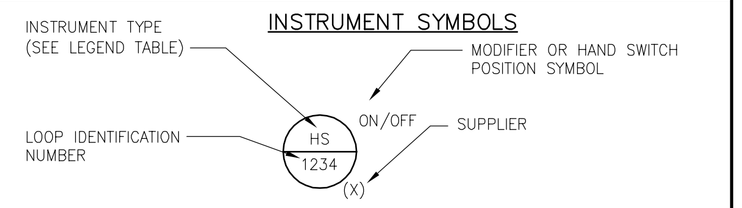
1. INSTRUMENT SUFFIX:

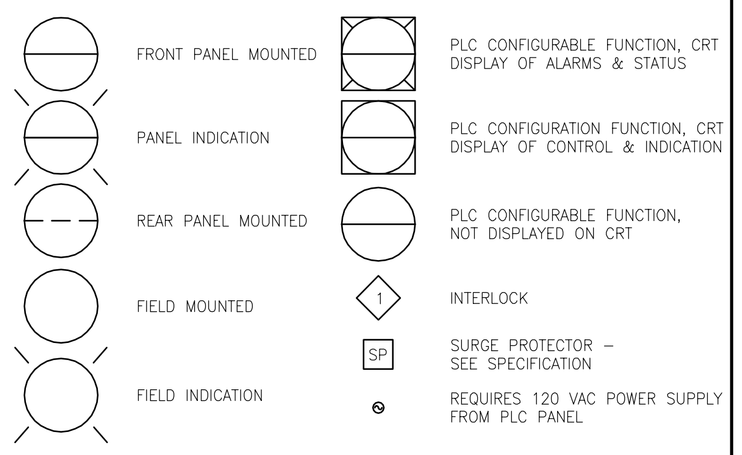
   NUMERIC SUFFIXES IDENTIFY INSTRUMENTS WITH DIFFERENT FUNCTIONS (E.G., A RUN AND AN OUT OF SERVICE LIGHT) ARE PRECEDED BY A DECIMAL POINT (E.G., AA:MIL-343.1 AND AA:MIL-343.2

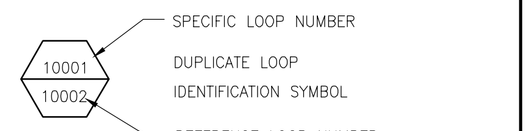
   ALPHABETIC SUFFIXES IDENTIFY MULTIPLE OCCURRENCES OF INSTRUMENTS WITH THE SAME FUNCTION (E.G.,TWO VALVE INDICATORS IN DIFFERENT PANELS, (E.G. AA:ZIL-161.1A, AND AA:ZIL-161.1B).

2. SEE MECHANICAL FOR ISOLATION RING DETAIL

## INSTRUMENT SYMBOLS




## SUPPLIERS

ALL INSTRUMENTS ARE SPECIFIED BY INSTRUMENTATION (I) UNLESS INDICATED BY;

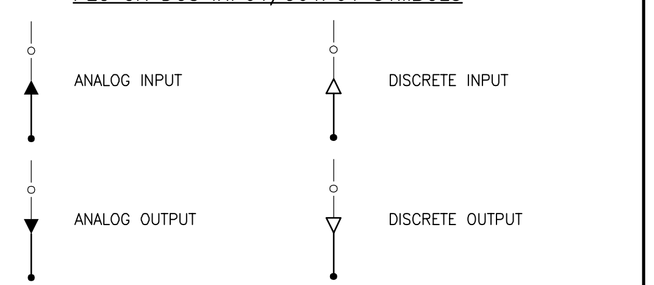
(E) SPECIFIED BY ELECTRICAL (X) EXISTING

(M) SPECIFIED BY MECHANICAL (H) SPECIFIED BY HVAC

(F) FURNISHED WITH EQUIPMENT (P) SPECIFIED BY PLUMBING

CONTRACTOR SHALL PROVIDE ALL INSTRUMENTS AS SPECIFIED ON DATA SHEETS ATTACHED TO SPECIFICATION SECTION 13300

## PLC OR DCS INPUT/OUTPUT SYMBOLS




## HAND SWITCH POSITION SYMBOLS

(UNLABELLED SWITCHES ARE TO BE ON-OFF)

| | | | |
|---|---|---|---|
| A | AUTOMATIC | SBY | STANDBY |
| C | CLOSE | F/R | FORWARD/REVERSE |
| F | FAST OR FORWARD | L/R | LOCAL/REMOTE |
| H | HAND | LOR | LOCAL/OFF/REMOTE |
| J | JOG | HOR | HAND-OFF-REMOTE |
| L | LOCAL | HOA | HAND-OFF-AUTO |
| M | MANUAL | OSC | OPEN/STOP/CLOSE |
| O | OPEN OR OFF | FSR | FORWARD/STOP/REVERSE |
| R | RUN OR REMOTE | TSM | THRU/STOP/MIX |
| S/S | START/STOP | OSF | OFF/SLOW/FAST |
| E/S | EMERGENCY STOP | OTC | OPEN/TRAVEL/CLOSE |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**PROJECT**

DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2019-02
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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**REGISTRATION**

Jan 24 2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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**PROJECT NUMBER**

60587515

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|---|---|
| Designed By: | **S. PAPAZIAN** |
| Drawn By: | **S. PAPAZIAN** |
| Dept Check: | **Y. RIZK** |
| Proj Check: | **T. PARECE** |
| Date: | **JANUARY 2020** |
| Scale: | **AS NOTED** |

**DISCIPLINE**

**INSTRUMENTATION**

**SHEET TITLE**

# INSTRUMENTATION LEGEND, SYMBOLS, AND GENERAL NOTES

**SHEET NUMBER**

# 00 DI-001


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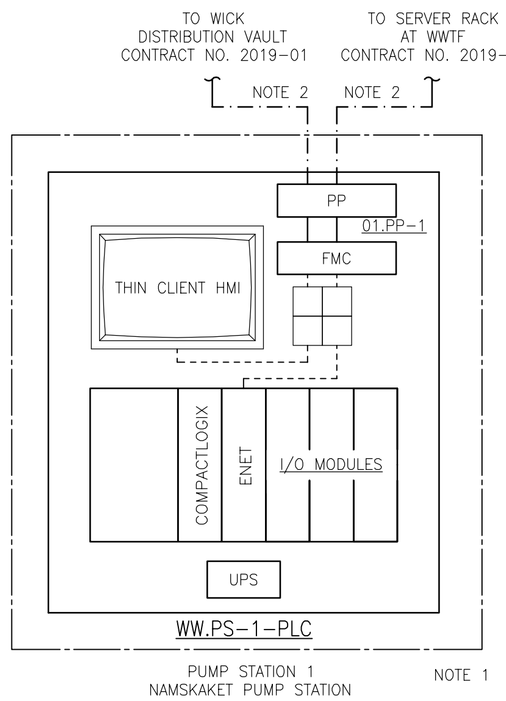
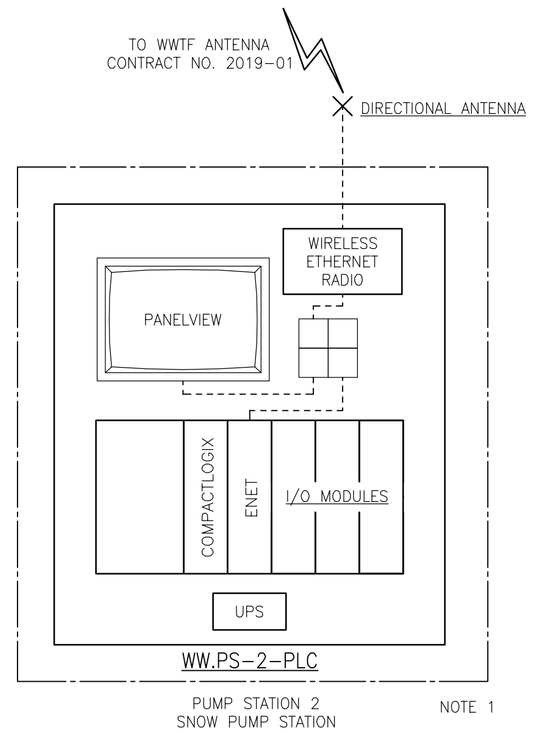
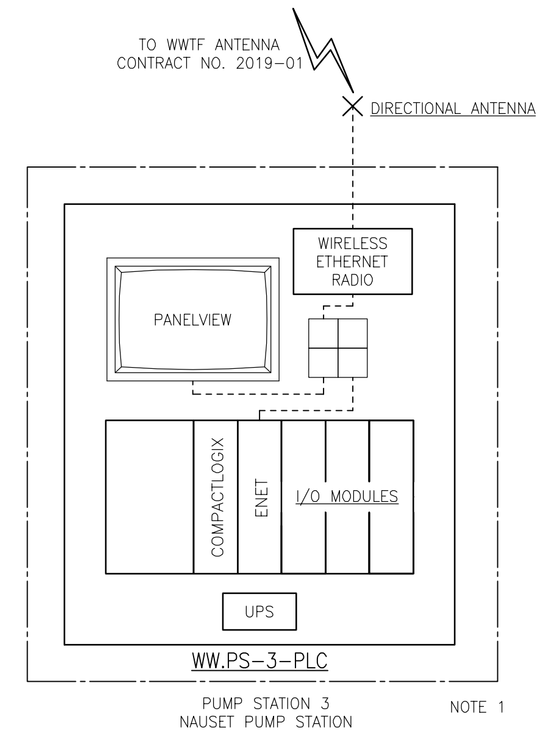
Filename: P:\60476644 - ORLEANS DOWNTOWN PUMP STATIONS\SHEETS\DI\00 DI-001 INSTRUMENTATION LEGEND, SYMBOLS, AND GENERAL NOTES.DWG




NOTES:

1. PUMP STATION PLC PANELS, REMOTE COMMUNICATION HARDWARE AND CONFIGURATION/INTEGRATION TO BE PROVIDED UNDER THE WWTF CONTRACT AND HAVE BEEN SHOWN HERE FOR CLARITY.
2. FIBER OPTIC CABLE, ANCILLARY HARDWARE, AND ASSOCIATED TERMINATIONS AND TESTING ASSOCIATED WITH THE REMOTE PUMP STATIONS TO BE PROVIDED UNDER THE WWTF CONTRACT.

LEGEND

| | |
|---|---|
| ---------- | ETHERNET |
| —·—·—·— | FIBER MEDIA |
| | MANAGED ETHERNET SWITCH |
| FPP | FIBEROPTIC PATCH PANEL |
| FMC | FIBER MEDIA CONVERTER |
| UPS | UNINTERRUPTIBLE POWER SUPPLY |

NOTES:

1. PLC BASED CONTROL PANELS TO BE PROVIDED UNDER CONTRACT NO. 2019-1, DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL.

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**DISCIPLINE**

INSTRUMENTATION

**SHEET TITLE**

# SYSTEM ARCHITECTURE

**SHEET NUMBER**

# 00 DI-601

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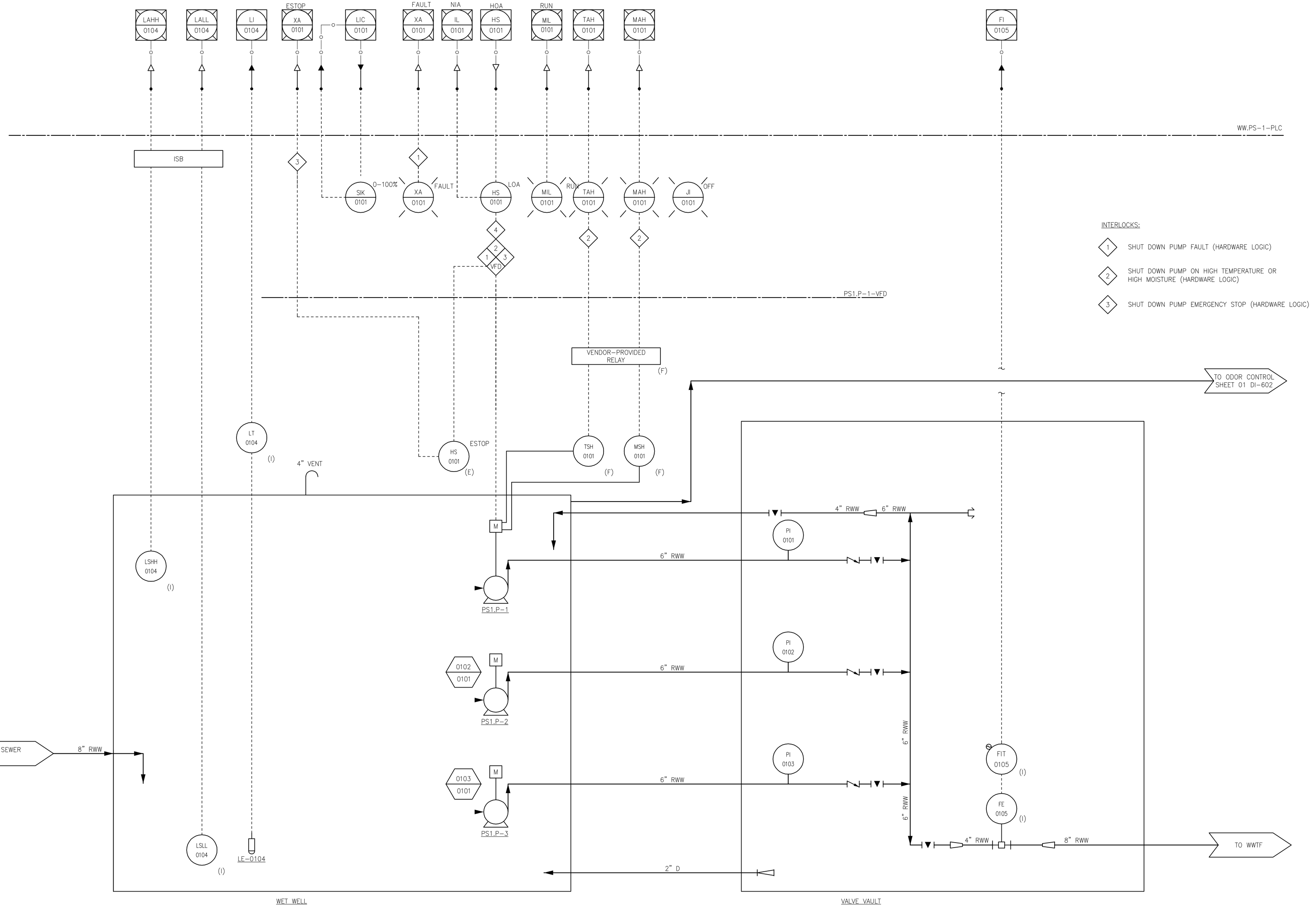


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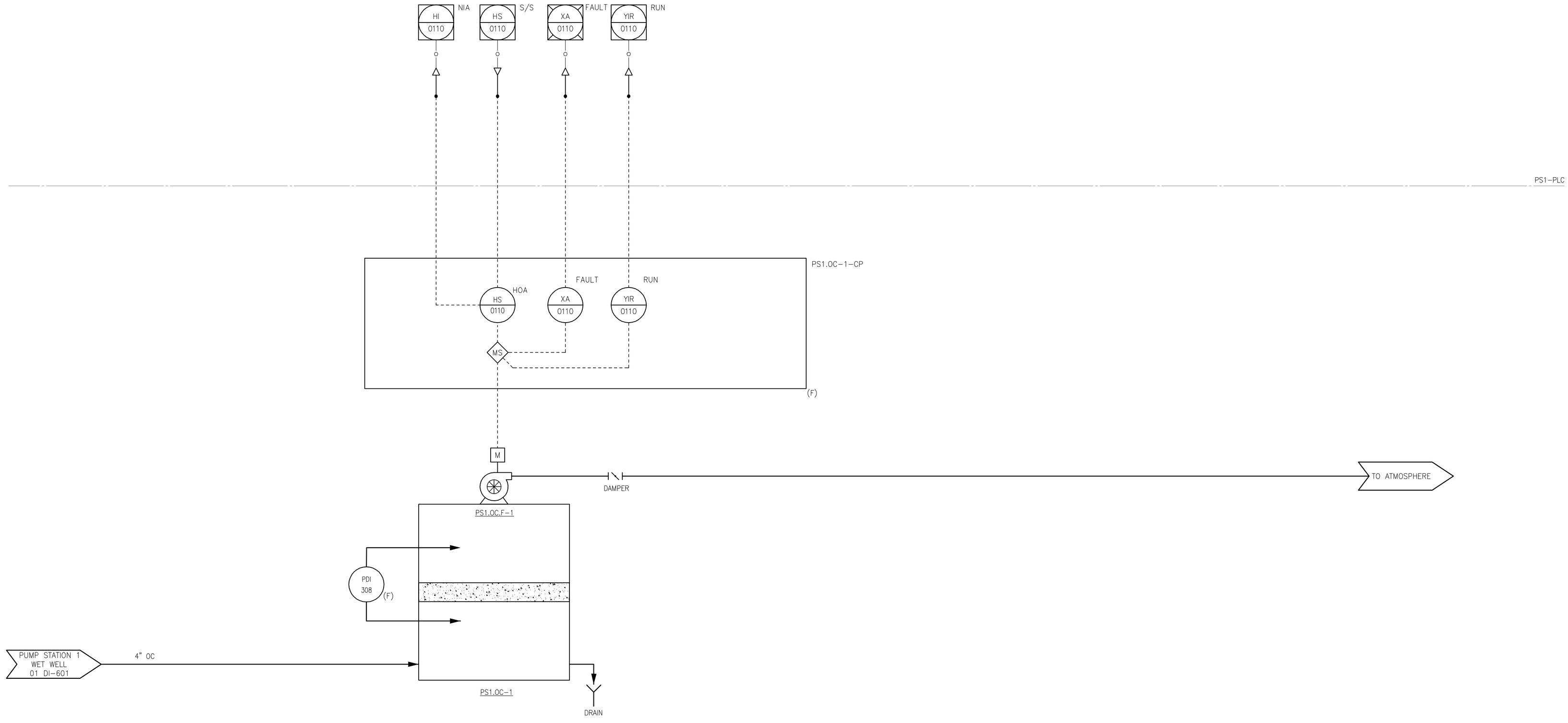
**SHEET TITLE**

# PUMP STATION 1 P&ID

**SHEET NUMBER**

# 01 DI-601

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**SHEET TITLE**

# PUMP STATION 1 ODOR CONTROL P&ID

**SHEET NUMBER**

# 01 DI-602

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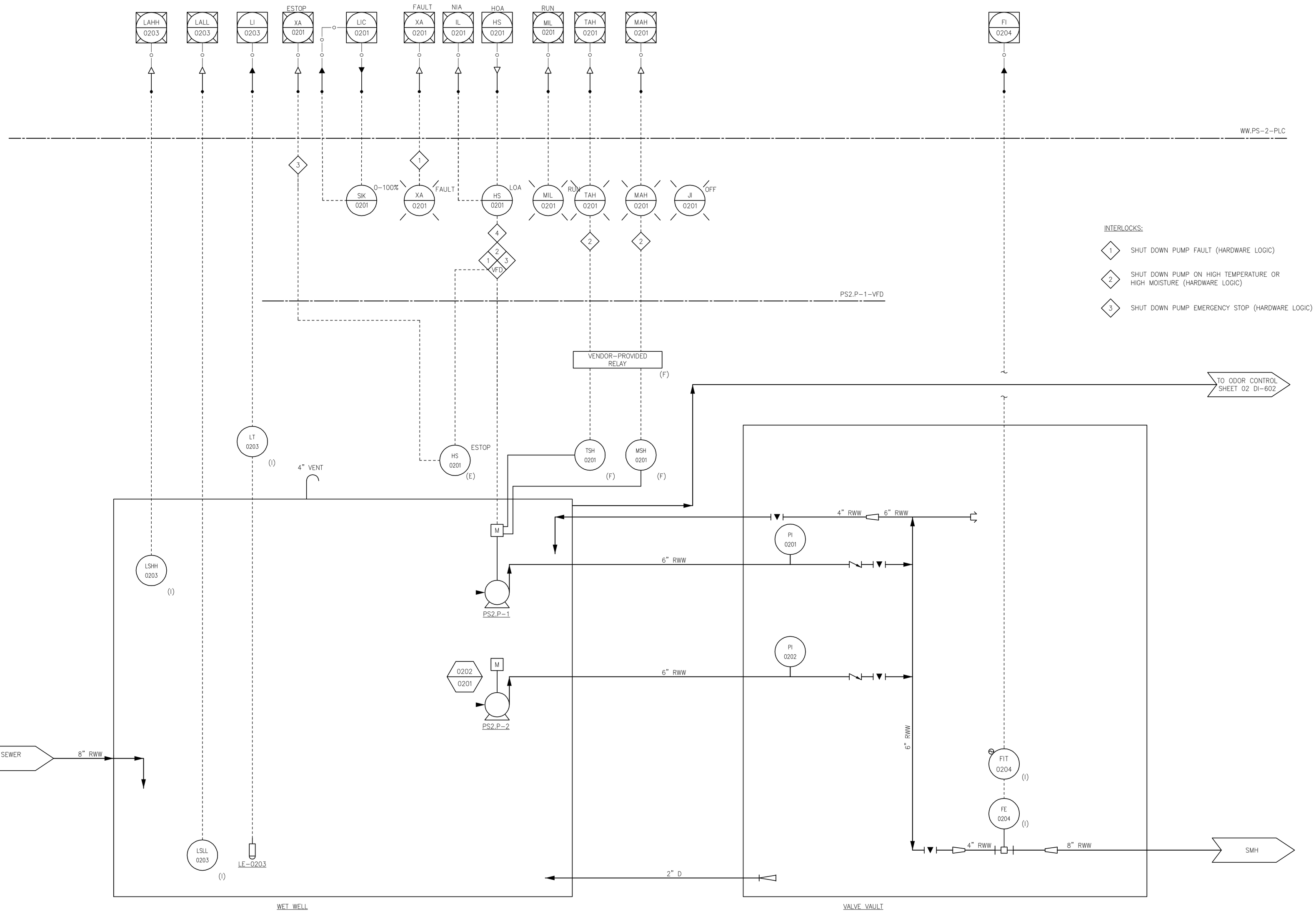


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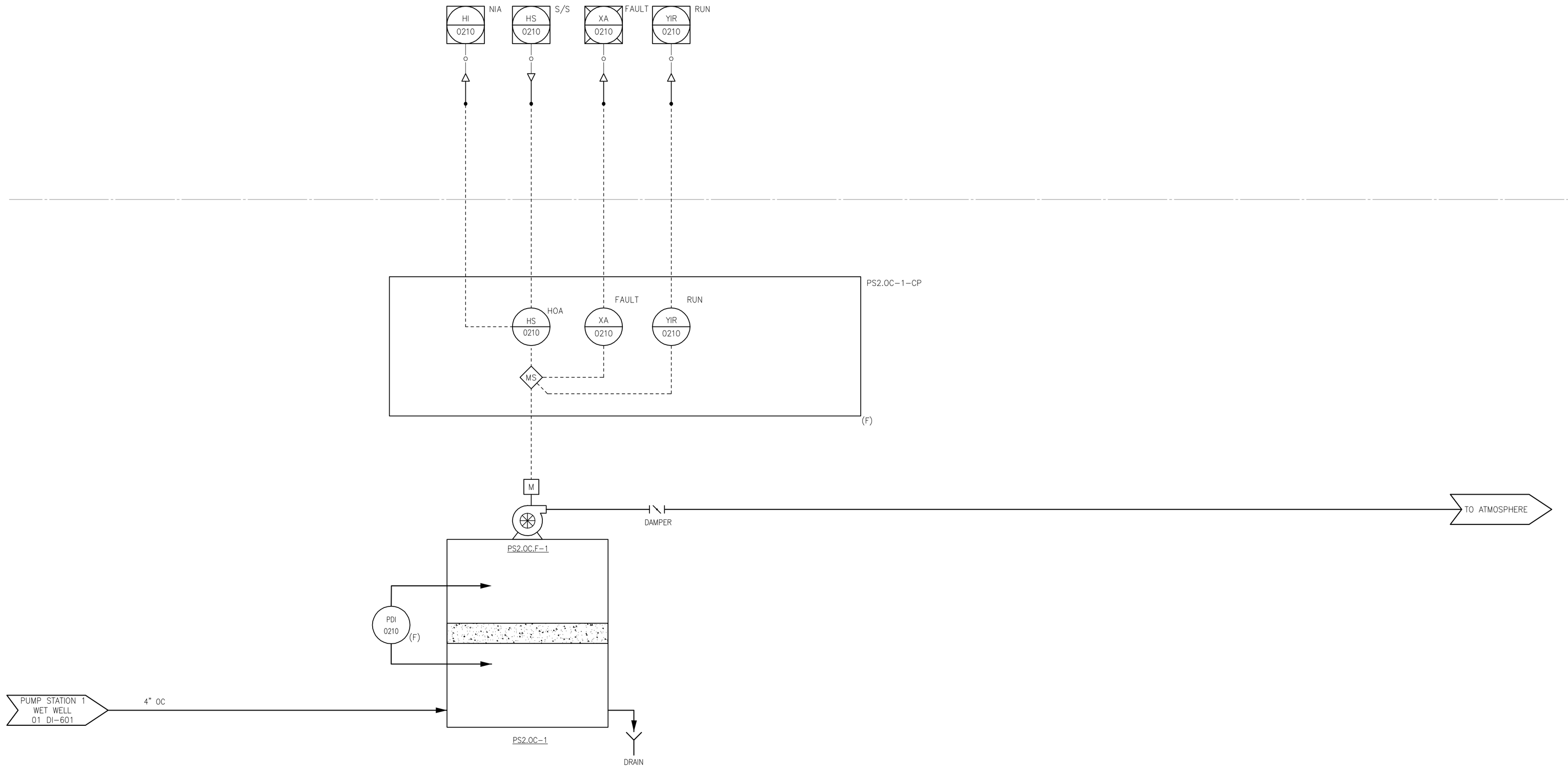
**SHEET TITLE**

# PUMP STATION NO. 2 P&ID

**SHEET NUMBER**

# 02 DI-601

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# PUMP STATION 2 ODOR CONTROL P&ID

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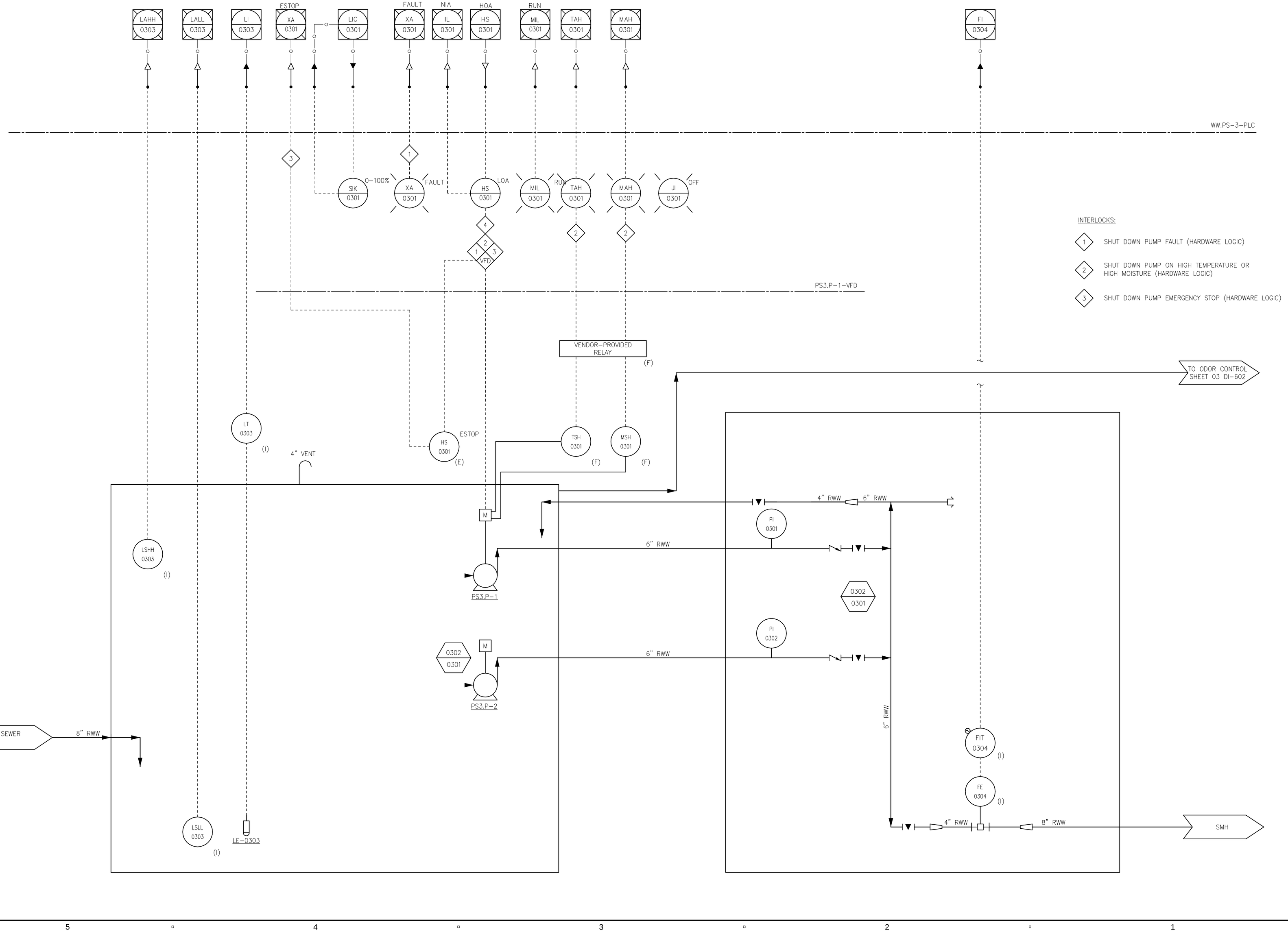


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**DISCIPLINE**

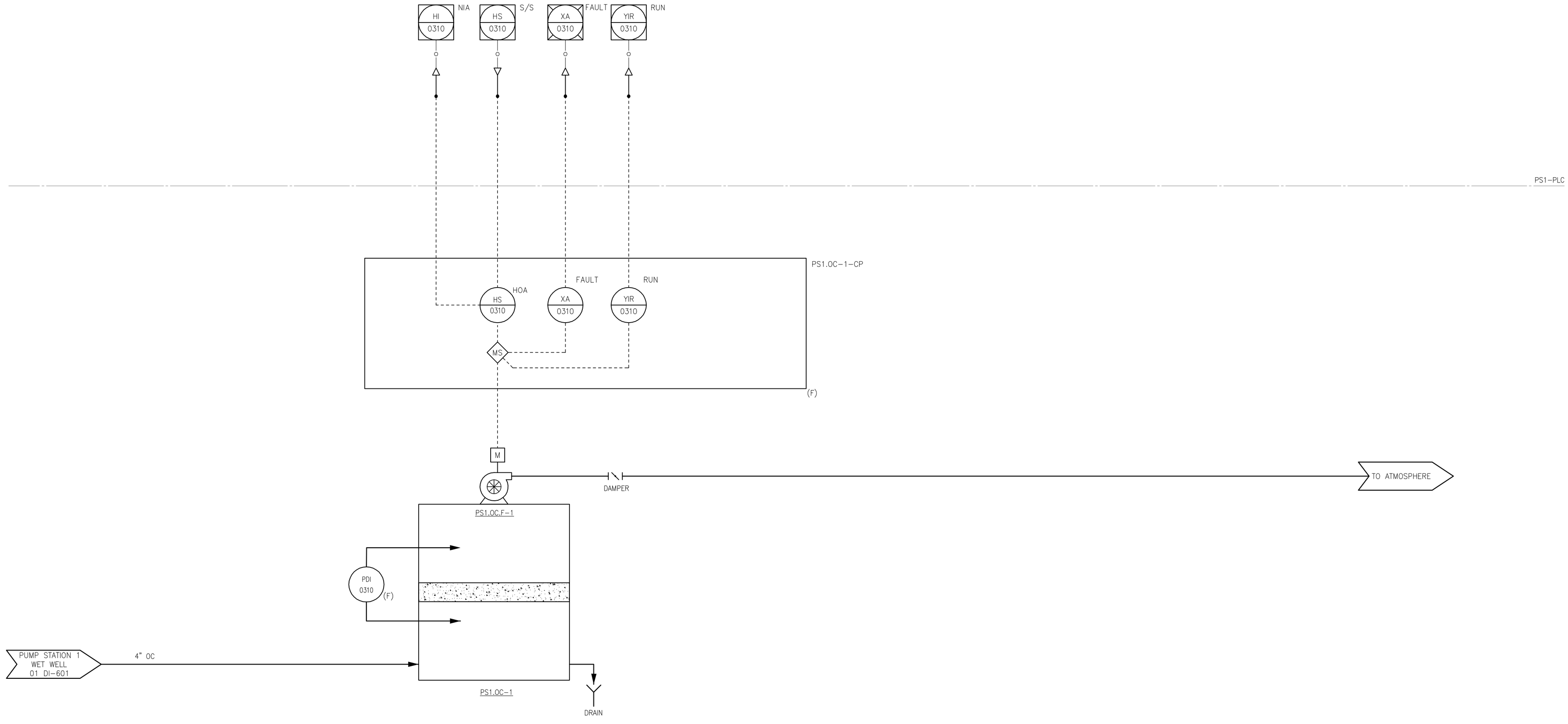
**INSTRUMENTATION**

**SHEET TITLE**

# PUMP STATION NO. 3 P&ID

**SHEET NUMBER**

# 03 DI-601

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# PUMP STATION 3 ODOR CONTROL P&ID

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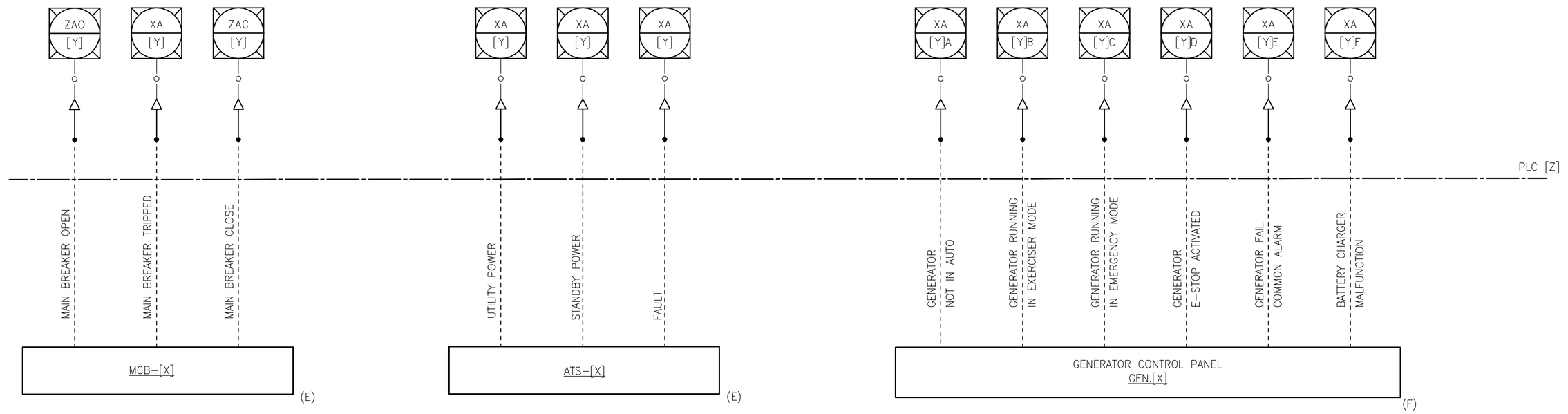
# 03 DI-603




| EQUIP TAG [X] | LOOP NO. [Y] | LOCATION | PLC [Z] |
|---|---|---|---|
| MCB.01-1 | 0111 | PUMP STATION 1 | WW.PS-1-PLC |
| MCB.02-1 | 0211 | PUMP STATION 2 | WW.PS-2-PLC |
| MCB.03-1 | 0311 | PUMP STATION 3 | WW.PS-3-PLC |

| EQUIP TAG | LOOP NO. [Y] | LOCATION | PLC [Z] |
|---|---|---|---|
| ATS.01-1 | 0121 | PUMP STATION 1 | WW.PS-1-PLC |
| ATS.02-1 | 0212 | PUMP STATION 2 | WW.PS-2-PLC |
| ATS.03-1 | 0312 | PUMP STATION 3 | WW.PS-3-PLC |

| EQUIP TAG [X] | LOOP NO. [Y] | LOCATION | PLC [Z] |
|---|---|---|---|
| GEN.01-1 | 0131 | PUMP STATION 1 | WW.PS-1-PLC |
| GEN.02-1 | 0213 | PUMP STATION 2 | WW.PS-2-PLC |
| GEN.03-1 | 0313 | PUMP STATION 3 | WW.PS-3-PLC |

AECOM

**PROJECT**

DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2019-02
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA

19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
SARAH PAPPUN
INSTRUMENTATION
No.52296
REGISTERED
PROFESSIONAL ENGINEER

Jan 24 2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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**PROJECT NUMBER**

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| Designed By: | ---- |
| Drawn By: | ---- |
| Dept Check: | ---- |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

INSTRUMENTATION

**SHEET TITLE**

# MISCELLANEOUS SIGNALS

**SHEET NUMBER**

# 99 DI-601

Last saved by: TREMBLAYS (2019-06-06) Last Plotted: 2020-01-27
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March 10, 2020

**ADDENDUM NO. 5**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 5 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 14 pages and 32 pages of attachments for a total of 46 pages.

**ATTACHMENTS**

1. SECTION 00310, BID BOND (EJCDC)
2. Orleans_MA-2019-01-Bid Form_Add_5-03-10-20
3. Orleans_MA-2019-01-SubBid Form_Add_5-03-10-20
4. SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS
5. DRAWING 00 C-104, SITE LAYOUT PLAN – WWTF
6. DRAWING 99 DI-602, MISC SIGNALS II AND TABLE OF RESPONSIBILITY

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. ADDENDUM No. 4
   - A. Changes Made to the Contract Drawings
     - 1) Item 19., delete reference to DRAWING 00 DI-606, EFFLUENT PUMPS P&ID and replace with DRAWING 10 DI-606, EFFLUENT PUMPS P&ID.
2. GENERAL
   - A. Sub-Bid Opening - March 18, 2020 at 2:00 pm.
   - B. General Bid Opening - March 25, 2020 at 2:00 pm.
3. TABLE OF CONTENTS
   - A. Page TOC-2, DIVISION 0 – BIDDING AND CONTRACT REQUIREMENTS, add SECTION 00310, BID BOND (EJCDC), as attached.

4. SECTION 00310, BID BOND

   A. Add new SECTION 00310, BID BOND (EJCDC) as an alternative Bid Bond Form, as attached.

5. SECTION 00410, FORM OF GENERAL BID

   A. Delete "Orleans_MA-2019-01-Bid Form_Add_4-02-28-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_5-03-10-20" in both hard copy and Microsoft Excel format.

6. SECTION 00420, FORM OF SUBBID

   A. Delete "Orleans_MA-2019-01-SubBid Form_Add_4-02-28-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-SubBid Form_Add_5-03-10-20" in both hard copy and Microsoft Excel format.

7. SECTION 01025, MEASUREMENT AND PAYMENT

   A. Page 01025-8, BID ITEM A4 – SBR TRANSFER PUMP NO. 4, add the following to the end of Paragraph A.:

      All equipment, piping, valves, electrical work and instrumentation and the like for SBR Transfer Pump No. 4 shall be furnished in accordance with drawings and specifications for SBR Transfer Pumps No. 1, 2 and 3. The work is shown on the following drawings:

      1. Drawing 00 D-006 - Process Flow Diagram I
      2. Drawing 10 D-102 - Facility Lower Plan II
      3. Drawing 10 E-006 - WWTF – Electrical Single Line Diagram II – MCC.10-1
      4. Drawing 10 E-102 - WWTF – Lower Level – Power Plan II
      5. Drawing 10 DI-603 - SBR Transfer Pumps P&ID

   B. Page 01025-8, BID ITEM A5 – SBR BLOWER NO. 4, add the following to the end of Paragraph A.:

      All equipment, piping, valves, electrical work and instrumentation and the like for SBR Blower No. 4, shall be furnished in accordance with drawings and specifications for SBR Blowers No. 1, 2 and 3. The work is shown on the following drawings:

      1. Drawing 00 D-006 - Process Flow Diagram I
      2. Drawing 10 D-103 - Facility Lower Plan III
      3. Drawing 10 E-005 - WWTF – Electrical Single Line Diagram I – SWBD.10-1
      4. Drawing 10 E-102 - WWTF – Lower Level – Power Plan II
      5. Drawing 10 DI-610 - SBR Blowers P&ID

   C. Page 01025-8, BID ITEM A6 – SBR AERATION DIFFUSER GRIDS, add the following to the end of Paragraph A.:

      All equipment, piping, valves and the like for thirds SBR Aeration Diffuser Grid in each SBR Tank, shall be furnished in accordance with drawings and specifications for the first two SBR Aeration Diffuser Grids furnished in each SBR Tank. The work is shown on the following drawings

      1. Drawing 15 D-101 - SBR Lower Plan I *
      2. Drawing 15 D-102 - SBR Lower Plan II *
      3. Drawing 15 D-103 -SBR Upper Plan I *
      4. Drawing 15 D-104 -SBR Upper Plan II *
      5. Drawing 15 E-101 - SBRS – Power Plan

      *Two Base Bid Diffusers Shown and the Third Diffuser Shown Horizontally

8. SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS

   A. Delete the section in its entirety and replace with the new section as attached.

9. SECTION 02435, CRUSHED STONE

A. Page 02435-2, ARTICLE 1.04 – SUBMITTALS, delete Paragraph B in its entirety and replace with the following new paragraph:

B. Submittals required under this section include, but are not limited to the following:

1. Gradation test results from the Contractor's Independent Testing Laboratory, must be submitted at least two (2) weeks prior to hauling material, for the Engineer's acceptance.

2. If crushed stone is utilized, a 10-pound sample shall be submitted, if requested by the Engineer.

3. If Processed Glass Aggregate (PGA) is utilized, a 10-pound sample shall be submitted. In addition, provide a certified test report that indicates that the PGA is free of debris and other materials that is associated with the glass recycling process.

B. Page 02435-2, ARTICLE 2.01 - MATERIAL, Paragraph B, add the following to the end of subparagraph 2.:

Other glass products (i.e. fluorescent lights, video screens, automobile glass, lead crystal, etc.) shall not be incorporated into PGA.

10. SECTION 02520, WICK CONSTRUCTION AND TESTING

A. Page 02520-2, ARTICLE 1.01 - SCOPE, add the following as new Paragraph E.:

E. Specialty Contractors provided for consideration:

Hib Foundation
139 Billerica Road
Chelmsford, MA 01824
Phone: 978-456-2387
http://www.nefco.com/

Maher Services, Inc.
71 Concord Street
North Reading, MA 01864
Phone: 978-664-9355
https://maherserv.com/

F.G. Sullivan Drilling, Co.
394 Parker Road
Lancaster, MA 01523
978-365-2932
https://fgsullivandrill.com/

New England Foundation Co., Inc.
One Westinghouse Plaza, Bldg. D
Boston, MA 02136
617-361-9750
http://www.nefco.com/

Atlas Drilling
85 Constitution Lane, Suite 100F
Danvers, MA 01923
978-304-0812
https://atlasdrillingllc.com/

Helical Geotechnical Design/Build
639 Granite Street, Suite 101
Braintree, MA 02184
781-848-2110
https://helicaldrilling.com

B. Page 02520-6, ARTICLE 1.07 – WARRANTY, delete Paragraph C. in its entirety and replace with the following new paragraph:

C. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during the warranty period should the need arise.

11. SECTION 06225, EXTERIOR FINISH CARPENTRY

A. Page 06225-3, ARTICLE 2.01 – EXTERIOR TRIM, add the following new paragraphs:

B. Trim

1. Size of Vertical Trims: 1-1/2-inch thick, 3-1/2-inch wide, smooth sanded edge.
2. Size of Fascia Boards: 3/4-inch thick, 9-1/2-inch wide Fascia boards, and 3/4-inch thick, 2-1/2-inch wide Fascia boards.
3. Size of Frieze Boards: 3/4-inch thick, 5-1/2-inch wide Frieze boards.
4. Texture: Smooth.
5. Color: As selected by Architect from manufacturer's full range of industry colors.

C. Fiber Cement Soffit

1. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
2. Nominal Thickness: Not less than 5/16-inch.
3. Pattern: 12-inch wide sheets.
4. Texture: Smooth.
5. Ventilation: Provide perforated continuous soffit vents- see accessories.
6. Color: As selected by Architect from manufacturer's full range of industry colors.

D. Beam and Post Wraps

1. Size: 3/4-inch thick, largest panel available to avoid joints.
2. Texture: Smooth.
3. Color: As selected by Architect from manufacturer's full range of industry colors.

12. SECTION 04200, UNIT MASONRY AND ACCESSORIES

A. Page 04200-2, ARTICLE 1.01, SCOPE, Paragraph B., delete subparagraph 19., in its entirety and replace with the following new subparagraph:

19. Air/Vapor Barrier Membrane (furnished by the Contractor and installed by the filed sub-contractor which is located behind the masonry veneer).

B. Page 04200-10, ARTICLE 2.07, CAVITY WALL INSULATION, delete the article in its entirety and replace with the following new article:

2.07 - CAVITY WALL INSULATION – Not Used

C. Page 04200-15, ARTICLE 3.16 – CAVITY WALL INSULATION, delete the article in its entirety and replace with the following new article:

3.16 - CAVITY WALL INSULATION – Not Used

13. SECTION 05500, MISCELLANEOUS METAL

    A. Page 05500-12, add the following new ARTICLE 2.17 – Z-GIRT SYSTEM:

    2.17 – Z-GIRT SYSTEM

    A. Basis of Design: ThermaFast Z-Track

    B. Materials Properties

    i. Design loads: Wind pressure and self-weight of cladding as indicated on the project's Architectural/Structural Drawings and as required by the International Building Code.

    ii. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi (450MPa) minimum tensile strength, with ASTM A653/A653M G90 (Z275) hot dipped galvanized coating.

    iii. Thickness: 54 mil minimum (16 gauge, 0.0566-inch design thickness)

    iv. Thermal Tape: Thickness 1/16-inch, Density 15 lbs/ft3 (ASTM D-1667)

    v. Thermal Conductivity k-factor: 0.3 (ASTM C-518)

14. SECTION 07461, SIDING

    A. Page 07461-4, ARTICLE 2.02 - SIDING, Paragraph A., delete the words "and Soffit panels".

    B. Page 07461-4, ARTICLE 2.02 - SIDING, delete Paragraph C. in its entirety and replace with the following new paragraph:

    C. Corner Boards (Interior and Exterior)

    1. Size of Vertical Trims: 5/4-inch thick, 11-1/4-inch wide, smooth sanded edge.

    2. Texture: Smooth.

    3. Color: As selected by Architect from manufacturer's full range of industry colors.

    C. Page 07461-4, ARTICLE 2.02- SIDING, delete Paragraph D. in its entirety.

    D. Page 07461-4, ARTICLE 2.02 - SIDING, delete Paragraph E. in its entirety.

15. SECTION 07600, WALL FLASHING AND SHEET METALWORK

    A. Page 07600-1, PART 1 – GENERAL, add the following new article:

    1.00 - SUBBID REQUIREMENTS

    A. The Work of 3.SECTION 07600, WALL FLASHING AND SHEET METALWORK is a part of DIVISION 7, THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07610, METAL ROOFING.

    B. The Work of 3.SECTION 07600, WALL FLASHING AND SHEET METALWORK requires the Subcontractor to perform all Work specified under this section.

16. SECTION 07610, METAL ROOFING

    A. Page 07610-1, ARTICLE 1.00 – SUB-BID REQUIREMENTS, delete Paragraph B. in its entirety and replace with the following new paragraph:

    B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

    1. SECTION 07610, METAL ROOFING

    2. SECTION 07710, ROOF SPECIALTIES

    3. SECTION 07600, WALL FLASHING AND SHEET METALWORK

B. Page 07610-1, ARTICLE 1.00 – SUB-BID REQUIREMENTS, delete Paragraph F. in its entirety and replace with the following new paragraph:

F. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 07610, METAL ROOFING,
SECTION 07710, ROOF SPECIALTIES and
SECTION 07600, WALL FLASHING AND SHEET METALWORK

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

C. Page 07610-7, ARTICLE 2.04- FINISHES, Paragraph A., delete subparagraph 2.b. In its entirety and replace with the following new subparagraph:

b. Topcoat shall yield a 0.7 mil minimum thick coating. Topcoat shall be fully cured and of consistent color throughout Project.

D. Page 07610-7, ARTICLE 2.04- FINISHES, Paragraph A., delete subparagraph 4. In its entirety and replace with the following new subparagraph:

4. Back Coat: Corrosion resistant primer plus wash coat, 0.2 mil minimum total dry thickness.

17. SECTION 08500, FIXED WINDOWS

A. Page 08500-3, ARTICLE 1.04 – SUBMITTALS, Paragraph B., add the following to the end of subparagraph 3.:

Manufacturer to provide a recommendation of the thermal-break system as part of the submittal.

B. Page 08500-10, ARTICLE 2.01 – MANUFACTURERS, add the following new paragraphs:

E. Basis of Design: (1) Kawneer: NX-3800 Window Series and (2) Fire Rated Window: Fyre-Tec – Series H950 Heavy Fixed Lite.

F. Source Limitations

1. Windows shall be from a single source and from a single manufacturer.

2. A single manufacturer providing windows under this section and SECTION 08550, WINDOWS is acceptable assuming that the manufacturer meets all the performance criteria specified in both sections and as shown on the drawings.

C. Page 08500-10, ARTICLE 2.02 – MATERIALS, add the following new paragraph:

L. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.

D. Page 08500-11, ARTICLE 2.03 – WINDOW OPERATION, Paragraph A., delete the words “Projected Double Hung Windows…” and replace with the words “Double Hung Windows…”.

E. Page 08500-13, ARTICLE 2.06 – ALUMINUM FINISHES, Paragraph B., delete subparagraph 1. in its entirety and replace with the following new subparagraph:

1. Color: As selected by Engineer from manufacturer's full range.

18. SECTION 08550, WINDOWS

A. Page 08550-3, ARTICLE 1.00 – SUBBID REQUIREMENTS, Paragraph A., delete the sentence "See SECTION 08500 – FIXED WINDOWS." In its entirety and replace with the following new sentence "See SECTION 08500 – WINDOWS."

B. Page 08550-2, ARTICLE 1.04 – SUBMITTALS, Paragraph B., add the following to the end of the subparagraph 1.:

Manufacturer to provide a recommendation of the thermal-break system as part of the submittal.

C. Page 08550-7, ARTICLE 2.02 – MANUFACTURERS, Paragraph A., add the following new subparagraph:

4. Basis of Design: Crystal Window and Door Systems, Ltd., Series 5500 Heavy Commercial / Architectural Aluminum Thermal-Break Tilt Windows

D. Page 08550-7, ARTICLE 2.02 – MANUFACTURERS, delete Paragraph B. in its entirety and replace with the following new paragraph:

B. Source Limitations

a. Windows shall be from a single source and from a single manufacturer.

b. A single manufacturer providing windows under this section and SECTION 08500, FIXED WINDOWS is acceptable assuming that the manufacturer meets all the performance criteria specified in both sections and as shown on the drawings.

E. Page 08550-7, ARTICLE 2.03 – ALUMINUM WINDOWS, Paragraph C., delete subparagraph 4. in its entirety and replace with the following new subparagraph:

4. Low-E Coating:

a. Glass: 1-in. thick clear, insulating-glass units, with low-E coating pyrolytic on third surface for tinted windows.

b. Tint: Solar gray with visible light transmittance of 18%.

F. Page 08550-8, ARTICLE 2.04 – ACCESSORIES, Paragraph C., add the following new subparagraph:

3. Location: Window W4

19. SECTION 09800, PROTECTIVE COATING

A. Page 09800-2, ARTICLE 1.01 – SCOPE, add the following new paragraph:

C. Non-wood Products specified in SECTION 06225, EXTERIOR FINISH CARPENTRY and SECTION 07461, SIDING do not require Protective Coatings.

B. Page 09800-4, ARTICLE 2.02 – CONCRETE CONTAINMENT PROTECTIVE COATING (PC-1), delete Paragraph A., in its entirety and replace with the following new paragraph:

A. Locations:

1. Chemical Storage Room 1

2. Chemical Storage Room 2

C. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), delete Paragraph A., in its entirety and replace with the following new paragraph:

A. Locations:

1. Pre-Equalization Tanks

2. Waste Sludge Storage Tanks

3. Thickened Sludge Storage Tank

4. Pre-Equalization Tank

D. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), Paragraph C., delete subparagraph 1.b. in its entirety and replace with the following new subparagraph:

a. Finish: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 125.0 mils DFT.

E. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), Paragraph D., delete subparagraph 1.b. in its entirety and replace with the following new subparagraph:

b. Topcoat: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 80-100 mils DFT.

20. SECTION 10475, EMERGENCY AND MISCELLANEOUS EQUIPMENT

A. Page 10475-3 ARTICLE 2.04 - MISCELLANEOUS EQUIPMENT – OTHER INDUSTRIAL SUPPLY CATALOGS, delete Item 33 in its entirety and replace with the following new item:

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 33 | Not Used | --- | --- |

21. SECTION 10525, FIRST AID AND FIRE FIGHTING EQUIPMENT

A. Page 10525-3, ARTICLE 2.01 – EQUIPMENT, Paragraph A., delete subparagraph 4. in its entirety and replace with the following new subparagraph:

4. Locate first-aid cabinets in each of the following buildings and rooms, location determined by Engineer.

| Location | Room Number | Quantity |
|---|---|---|
| WWTF - Break Room | 103 | 1 |
| WWTF - Control Room | 116 | 1 |
| WWTF - Basement Pump Room | 126 | 1 |
| Equipment Storage Facility | 201 | 1 |
| Equipment Storage Facility – Work Room | 202 | 1 |

22. SECTION 10600, IDENTIFICATION SYSTEMS

A. Page 10600-4, ARTICLE 2.02 – INTERIOR SIGNAGE, delete the article in its entirety and replace with the following new article:

2.02 – INTERIOR SIGNAGE

A. Refer to SECTION 10440 - SIGNS

B. Page 10600-7, SIGN SCHEDULE, delete Item 4. in its entirety and replace with the following new item:

| Location and Quantity of Signs | Sign Type | Overall Size (in.) | Lettering Text | Letter Size (in.) | Colo of Wording | Color of Backing | Additional Graphics |
|---|---|---|---|---|---|---|---|
| 4. Not Used | --- | --- | --- | --- | --- | --- | --- |

C. Page 10600-7, SIGN SCHEDULE, delete Item 10. in its entirety and replace with the following new item:

| Location and Quantity of Signs | Sign Type | Overall Size (in.) | Lettering Text | Letter Size (in.) | Colo of Wording | Color of Backing | Additional Graphics |
|---|---|---|---|---|---|---|---|
| 10. Area/room identification signs | Refer to SECTION 10440 - SIGNS | | | | | | |

23. SECTION 11333, SEPTAGE RECEIVING STATION

    A. Page 11333-17, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

24. SECTION 11365, ROTARY DRUM THICKENERS

    A. Page 11365-14, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

25. SECTION 11398, DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

    A. Page 11398-6, ARTICLE 2.03 - ENGINE GENERATOR ENCLOSURE, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. Provide fixed means as necessary for personnel and equipment access to generator doors including stairs, platforms or catwalks. Stairs, platforms or catwalks shall be provided in accordance with SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS

    B. Page 11398-6, ARTICLE 2.03 - ENGINE GENERATOR ENCLOSURE, Paragraph I., delete subparagraph 3.c. in its entirety and replace with the following new subparagraph:

        c. Provide aluminum stairs, railings and platforms for enclosure access as required. Stairs, railings and platforms shall be provided in accordance with SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS

26. SECTION 11399, EFFLUENT DISK FILTERS

    A. Page 11399-17, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

27. SECTION 11600, SEQUENCING BATCH REACTORS

    A. Page 11600-23, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

28. SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL

    A. Page 13330-5, ARTICLE 1.08 – WARRANTY, delete the article in its entirety and replace with the following new article:

        1.08 - WARRANTY

            A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. Equipment Manufacturer

1. The Equipment Manufacturer shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. In addition, the Equipment Manufacturer shall warrant that the system will function in accordance with the manufacturer's published technical description guides and as specified herein. The Warranty, obtained by the Equipment Manufacturer, shall be secured by a Performance Bond issued jointly to the Equipment Manufacturer and the Owner. The Equipment Manufacturer agrees to furnish a Warranty in the sum of 100 percent of the equipment price and duly executed by the said Equipment Manufacturer as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract.

3. The Equipment Manufacturer shall be responsible for execution of warranties during the warranty period should the need arise.

C. Contactor

1. The Contractor shall provide a warranty that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply. The Warranty, obtained by the Contractor, shall be secured by a Performance Bond issued jointly to the Contractor and the Owner. The Contractor agrees to furnish a Warranty in the sum of the full amount of the equipment price and duly executed by the said Contactor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract.

3. The Contractor shall be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor's and Equipment Manufacturer's responsibility to resolve any and all warranty claims.

E. The Warranties shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bonds will be summarily rejected and returned to the Contractor without further review and consideration.

29. SECTION 13345, DATA NETWORK

A. Page 13345-2, ARTICLE 1.01 – SCOPE, Paragraph A., delete the words "Provide, terminate, test and put in operation…" and replace with the words "Provide, terminate, test and put in operation…".

B. Page 13345-2, ARTICLE 1.01 – SCOPE, Paragraph B., delete the paragraph in its entirety and replace with the following new paragraph:

B. Fiber optic cables shall be provided for use with the WWTF SCADA control system, including the fiber required for the Pump Station and Collection System.

C. Page 13345-6, ARTICLE 2.02 – FIBER OPTIC CABLE, add the following new paragraph:

3. Provide a minimum of 4-foot coil of spare fiber in each handhole throughout the cable length. Quantity and locations of handholes as shown on Electrical drawings.

D. Page 13345-11, ARTICLE 2.13 – RADIO, add the following new paragraphs:

C. Pump Station No. 1 (Namskaket Pump Station)

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR or approved equal.

a. Antenna must be installed at 12-foot elevation. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

D. Effluent Disposal Site

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR or approved equal.

a. Antenna must be installed at 87-foot elevation on nearby water tank. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

E. Page 13345-12, ARTICLE 2.14 – SPARE PARTS, Paragraph B., delete the paragraph in its entirety and replace with the following new paragraph:

B. Furnish one Ethernet switch and one firewall of each type provided.

F. Page 13345-12, ARTICLE 3.01 – GENERAL, Paragraph A., delete the paragraph in its entirety and replace with the following new paragraph:

A. Provide all material, equipment, and labor to install the fiber optic cables and network devices including but not limited to terminating and testing as indicated, and as specified.

G. Page 13345-12, ARTICLE 3.02 – INSTALLATION, delete the article in its entirety and replace with the following new article:

3.02 - INSTALLATION

A. Fiber optic cable installation shall be by the Electrical Contractor.

30. SECTION 15857, ODOR CONTROL SYSTEMS – CARBON

A. Page 15857-2, ARTICLE 1.01 – SCOPE, Paragraph C., delete subparagraph 2. In its entirety.

31. SECTION 16120, ELECTRIC WIRES AND CABLES

A. Page 16120-7, add the following as new ARTICLE 3.05 - INSTALLATION OF FIBER OPTIC CABLE

3.05 - INSTALLATION OF FIBER OPTIC CABLE

A. Install fiber optic cable as indicated on the Contract drawings. Provide all material, equipment, and labor to install the fiber optic cables.

B. Install fiber optic cable in accordance with fiber optic cable manufacturer requirements.

C. Fiber optic cable is supplied under DIVISION 13, SPECIAL CONSTRUCTION in specification SECTION 13345, DATA NETWORK in accordance with Table of Responsibility for Electrical, General and System Integrator on Contract Drawing 00 E-602.

D. Install cable directly from shipping reels. Ensure that cable is not:

1. Dented, nicked, or kinked.

2. Subjected to pull stress greater, or bend radius less, than manufacturer’s specification.

3. Subjected to treatment which may damage fiber strands during installation.

E. Conduit: Install fiber optic cable directly in conduit.

F. Identification: Identify each cable on both ends, all pull points it goes through and in all hand holes/ man holes.

G. Sequencing: Provide cables in accordance with sequencing requirements.

H. Handholes:

1. Provide supports for cables at maximum 300-millimeter centers along sides of manholes.
2. Provide a minimum 4-foot coil of spare fiber in each manhole throughout the cable length.
3. Install fiber optic cables in underground ducts. Rod and swab out ducts prior to installing cables.
4. Install fiber optic cables in the conduit systems provided inside buildings and structures.

B. Page 16120-7, ARTICLE 3.05 – FIELD CABLE TESTS, revised the article number to 3.06.

C. Page 16120-7, ARTICLE 3.06 – CONTRACT CLOSEOUT, revised the article number to 3.07.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 00 C-104, SITE LAYOUT PLAN – WWTF

A. Delete the drawing in its entirety and replace with the new drawing as attached.

B. Delete Note 5 in its entirety and replace with the following new note:

5. Ground Improvement Shall Be Performed For SBR Foundation Soils (SBR No. 1 and SBR No. 2) In Accordance With Specification SECTION 02351, VIBRO-COMPACTION AND VIBRO-REPLACEMENT.

2. DRAWING 10 A-401, ENLARGED PLANS, ELEVATIONS, SCHED. – CONTROL ROOM

A. Control Room Accessory Schedule, add the following to new Item 25:

| Item Number | Generic Name | Room | Count | Width | Height |
|---|---|---|---|---|---|
| 25 | Chair | Crtl Rm | 2 | 2’ – 3’1/2” | 3’ – 11” |

| Depth | Family | Model | Manufacturer | Comments |
|---|---|---|---|---|
| 3’ – 5” | Executive High-Back Chair | HIEH2 | The Hon Company | --- |

3. DRAWING 10 A-404, ENLARGED PLANS, ELEVATIONS, SCHED. – OFFICE/COPIER ROOM

A. Office/Copier Room Accessory Schedule, add the following to Item 11:

| Model | Manufacturer | Comments |
|---|---|---|
| WC7855 | Xerox | Copy, Email, Print, Scan and Fax |

4. DRAWING 10 DI-603, SBR TRANSFER PUMPS P&ID

A. Add the following new Note:

Note:

9. The PIs for (SBR.TP-1 thru 3) shall be provided by the Contractor as specified in SECTION 11308, RECESSED IMPELLER PUMPS AND APPURTENANCES.

5. DRAWING 10 DI-606, EFFLUENT PUMPS P&ID
   A. Add the following new Note:

      Note:

      1. The PIs for (EFF.P-1 thru 3) shall be provided by the Contractor as specified in SECTION 11316, PROCESS PUMPS AND APPURTENANCES.

   B. Delete the three High-Pressure Switches and associated components in their entirety.
6. DRAWING 10 DI-610, SBR BLOWERS P&ID
   A. Delete the words “SBR-PLC” and replace with words “SBR-1-CP”.
   B. Add the following new Note:

      Note:

      1. SBR-1-CP shall be provided by the vendor.
7. DRAWING 10 DI-613, SLUDGE TRANSFER PUMPS P&ID
   A. Add the following new Note:

      Note:

      1. The PIs for (SL.TP-1 thru 3) shall be provided by the Contractor as specified in SECTION 11308, RECESSED IMPELLER PUMPS AND APPURTENANCES.
8. DRAWING 10 DI-615, THICKENED SLUDGE STORAGE TANK AND PUMPS P&ID
   A. Add the following new Note:

      Note:

      1. The PIs for (TSL.P-1 thru 3) shall be provided by the Contractor as specified in SECTION 11309, CHOPPER PUMPS AND APPURTENANCES.
9. DRAWING 15 DI-601, SBRs P&ID
   A. Add the following new Note 3:

      3. The control panel shown is SBR-1-CP and shall be provided by the vendor.
10. DRAWING 99 DI-602, MISC SIGNALS II AND TABLE OF RESPONSIBILITY
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 5**

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

**SECTION 00310**

**BID BOND**

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name— Include Location)*:

BOND
Bond Number:
Date:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

| **BIDDER** | **SURETY** |
|---|---|
| _____ (Seal) | _____ (Seal) |
| Bidder's Name and Corporate Seal | Surety's Name and Corporate Seal |
| By: _____ | By: _____ |
| Signature | Signature (Attach Power of Attorney) |
| _____ | _____ |
| Print Name | Print Name |
| _____ | _____ |
| Title | Title |
| Attest: _____ | Attest: _____ |
| Signature | Signature |
| Title | Title |

*Note: Addresses are to be used for giving any required notice.*
*Provide execution by any additional parties, such as joint venturers, if necessary.*

Note: The Bidder may submit their standard Bid Bond as long as it fully complies with the requirements of DOCUMENT C-430.

EJCDC ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

   3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

   3.2 All Bids are rejected by Owner, or

   3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

**END OF DOCUMENT**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | | |
| | $ | - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of | | | | |
| | $ | - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of | | | | |
| | $ | - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of | | | | |
| | $ | - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of | | | | |
| | One Hundred Twenty Five Thousand Dollars and No Cents | | | | |
| | $ | 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | | |
| | $ | 30,000.00 | Allowance | 1 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as speficied, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as speficied, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as speficied, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishng Section 11365 - Rotary Drum Thickeners, as speficied, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD** - The OWNER's present funding constraint limits award of this contract to $22,350,000. The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraint will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding the total of $22,350,000. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in May 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive**

**$** -

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | |
| | | **$** | | - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | |
| | | **$** | | - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | |
| | | **$** | | - |

| | |
|---|---|
| Company's Name | Date |
| Company's Address | **Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.** |

Date:

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

**PART I - BASE BID**

1. The work of the Subbidder for all Work of the Project other than that covered by other items, as specified, the lump sum of

$ - l.s.

2. The Work of the Subbider including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of

$ - l.s.

**TOTAL OF PART I - BASE BID**

$ -

**PART II - ALTERNATIVES**

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

_____ may be used by any General Bidder except:

_____

_____ may only be used by the following General Bidders:

_____

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

_____

Class of Work:

_____

Bid Price:

_____

2 Name:

Class of Work:

Bid Price:

3. Name:

Class of Work:

Bid Price:

4. Name:

Class of Work:

Bid Price:

5. Name:

Class of Work:

Bid Price:

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name _____

2. Ever failed to complete any work awarded? _____

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

b) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

c) Project

Engineer or Architect

General Contractor

Amount of Contract

d) Project

Engineer or Architect

General Contractor

Amount of Contract

e) Project

Engineer or Architect

General Contractor

Amount of Contract

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

**SECTION 01650**

**FACILITY START-UP AND TESTING REQUIREMENTS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Contractor shall be responsible for furnishing of all labor, equipment, appliances and materials and performing all operations in connection with the facility testing and inspection and startup and performance testing prior to final acceptance of all process systems, including the coordination of all performance tests and the furnishing of operating instructions for all equipment.

B. Start-up and Testing Requirements for individual equipment systems shall be as indicated for all equipment as specified in individual sections in DIVISION 11 - EQUIPMENT, DIVISION 15 - MECHANICAL and DIVISION 16 - ELECTRICAL.

C. HVAC systems shall be tested and balanced in accordance with DIVISION 15, MECHANICAL. Fire Protection Systems shall be commissioned in accordance with DIVISION 10, SPECIALTIES and DIVISION 15, MECHANICAL.

D. Electrical and Fire Alarm tests shall be performed as specified in DIVISION 16 - ELECTRICAL.

E. The Instrumentation and Control System tests shall be performed as specified in DIVISION 13 - SPECIAL CONSTRUCTION

F. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 1, GENERAL REQUIREMENTS, Specification Sections, apply to this section

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

10. “Shop Testing” shall mean testing that is done by the manufacturer either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment meets the requirements of the pertinent technical specification(s). All costs associated with Shop Testing shall be at additional cost to the Owner.

11. “Physical Checkout, Inspection and Certification” shall mean the process of physically inspecting products by the Contractor and manufacturer/supplier after they have been installed in the work, and then certifying that the products have been properly and completely installed and are ready for field and/or start-up. All costs associated with Physical Checkout, Inspection and Certification shall be at additional cost to the Owner.

12. “Field Testing” or “Functional Testing” shall mean testing that is performed by the Contractor and manufacturer/supplier on process equipment that has been installed in the work and after the Physical Checkout, Inspection and Certification, for the purpose of proving that the tested products meet the requirements of the pertinent technical specifications. All costs associated with Field Testing or Functional Testing shall be at additional cost to the Owner.

13. “System Testing” shall mean testing performed on a "system" comprised of two or more pieces of equipment, after the equipment has been installed in the work, and after Physical Checkout, Inspection and Certification and Field Testing has been completed, for the purpose of providing that the system meets requirements as specified and as indicated. All costs associated with System Testing shall be at additional cost to the Owner.

14. "Clear Water Testing" shall mean a test conducted on all items and systems performed with portable water after Physical Checkout, Inspection and Certification, Field Testing and System Testing have been satisfactorily conducted by the Contractor and manufactures/suppliers and the they are satisfied that the equipment is operating as specified. All costs associated with Clear Water Testing shall be at additional cost to the Owner except as specified herein.

15. "Start-up" shall mean the initial operation of the completed facility and processes by the Owner, utilizing wastewater and related substances (sludge, wastewater, scum), or other media which the facility has been designed to process.

16. "Performance Testing" shall mean testing performed by the Contractor and manufacturers/supplies to verify performance of the individual components under actual operating conditions. The tests shall indicate compliance with the performance requirements in the individual specification sections. All costs associated with Performance Testing shall be at additional cost to the Owner.

17. "Final Acceptance" shall mean passing of the Performance Testing of individual components under actual operating conditions.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data and certificates in accordance with SECTION 01300, SUBMITTALS and as specified herein.

2. Detailed specific start-up plans for each mechanical or process system.

**1.05 - SHOP TESTING**

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty days written notice indicating the time and place of testing. Submit the following for approval thirty days prior to this notice.

1. Description of the Test - Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing Devices That Will be Used in the Tests - Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience shall be submitted. As a minimum, personnel shall have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.

4. Schedule for Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Submit all forms used to record and report on shop test data, for approval, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall conform to the Engineer's format for heading and check off sections. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have me the required criteria, and that the equipment will operate as indicated and as specified.

B. Shop test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the shop test procedure and proposed test date. The Contractor will be notified, in writing by the Engineer, if a formal resubmission is required with the transmittal of the review comments.

C. Submit the following within one week after completion of the tests for approval:

1. Completed test forms, for each device tested, on forms as approved prior to the test.
2. Completed certification, the content of which was approved prior to the tests.
3. A written summary of testing, reporting on the results and summarizing the entire procedure.
4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

**1.06 - PHYSICAL CHECKOUT, INSPECTION AND CERTIFICATION**

A. When required by the technical specifications, perform field or functional testing on installed equipment. If none are required by the technical specifications, complete field / functional testing as detailed below. Field / functional testing shall be in addition to and not in lieu of, any shop testing either required or otherwise performed. Perform testing as a part of the overall testing process defined herein. However, the following specific instructions shall also apply. Provide thirty days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces.

Submit with this notice the following for approval by the Engineer:

1. Description of the Tests - Outline how the test will conform to the requirements in the technical specifications.
2. Testing Devices That Will Be Used in the Tests - Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.
3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience. As a minimum, personnel must have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.
4. Schedule of Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.
5. Test Forms - Review and comment on all forms provided by the Engineer for recording reporting on the field test data, prior to the test.
6. Material and Equipment Required for the Test - This material and equipment shall be supplied by the Contractor or his/her subcontractors at no additional cost to the Owner.
7. Water and Power Requirements - Water and power requirements shall be identified in the plan by the Contractor and will be supplied by the Contractor for field testing purposes only. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water.
8. Disposal of Waste – The Contractor is responsible for the legal disposal of all wastes generated from the testing.

B. Field test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Engineer if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Engineer for approval.

1. Completed test forms for each device tested on forms provided prior to the tests.
2. Completed certification documentation, the content of which was approved prior to the tests.
3. A written summary of testing, reporting on the results and summarizing the entire procedure.
4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

D. Minimum Field Test Requirements

1. Calibrate equipment as required. For pumps, use water as a calibration liquid.
2. Test equipment and systems through a normal start, normal stop, and all emergency shutdown sequences.
3. Complete a four-hour running test. For variable speed units, the test shall include running for three complete cycles of one-hour duration at the maximum and minimum speeds for one half of each of those cycles. Operate each system through its normal automatic sequence of operation. During the four-hour test, observe and record all level indications, flow indicators, and pressure indicators.
4. If the equipment utilizes a local programmable logic controller (PLC), verify that the PLC is capable of operating and controlling the system as specified in the individual specification sections. Also verify all communications with distributed control system (DCS) are as specified.
5. For equipment not supplied with a PLC, verify that the instrumentation and control system is capable of operating and controlling the system.
6. Check safety devices, and interlocks for satisfactory operation. Check instrumentation and control systems for conformance with the Specifications.
7. Check for system leaks and proper valve operation.
8. Demonstrate to the Owner's Representative that all temporary jumpers and/or bypass have been removed and that all of the components are operating under their own controls as designated.
9. Coordinate start-up activities with the Owner's representative and with the Engineer prior to commencing system start-up.

E. Motor Testing

1. Visually inspect the motor for any physical damage.
2. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.
3. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and the results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

F. Engine Generator Test

1. Visual and Mechanical Inspection.
    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect correct anchorage and grouting.
2. Electrical and Mechanical Tests.
    a. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE Standard 43. Calculate polarization index.
    b. Test protective relay per applicable NETA standards.
    c. Perform phase-rotation test to determine compatibility with load requirements.
    d. Functionally test engine shutdown for low oil pressure, over temperature overspeed, and other features as applicable.
    e. Conduct performance test in accordance with ANSI/NFPA Standard 110, (Installation Acceptance).
    f. Verify correct function of governor and regulator.
    g. Test circuit breakers per applicable NETA standards.

G. Upon completion of installation of all permanent equipment and related shop and field testing, the manufacturer's technical service representative shall inspect and, as necessary, adjust and/or calibrate the equipment. The inspection shall consider the completeness and integrity of the installation, the alignment and clearances of the equipment parts with respect to each other, and the sufficiency of any required sealing, lubricants or packing.

H. The technical service representative shall submit the results of the inspection including certification that the equipment was properly installed and is operating as specified and as installed. The report should verify that the equipment is ready for sustained operation and free from defects that would render the guarantee null and void.

**1.07 - FIELD TESTING OR FUNCTIONAL TESTING**

A. Field Testing or Functional Testing shall be made at on each piece of process equipment.

B. Field Testing or Functional Testing shall be conducted by the Contractor and manufacturer/supplier utilizing portable water to demonstrate to the satisfaction of the Engineer that the equipment is ready for System Testing.

C. Fourteen days' notice of scheduled start-up of individual equipment items or mechanical systems, the Contractor shall prepare a schedule of activities and provide the schedule to the Engineer for review and approval. The following representatives, as appropriate, shall be present simultaneously for the Field Testing or Functional Testing

1. General Contractor;
2. Electrical Subcontractor;
3. Equipment Manufacturer's Technical Service Representative;
4. Instrumentation and Control Equipment Representative;
5. System Integrator; and
6. Owner, OPM and Engineer.

D. The following must be completed prior to start-up and testing:

1. Controls and alarm systems shall be tested to show it is capable of transmitting and annunciating all specified control points to the facility-wide SCADA system;
2. All safety equipment shall be installed and operating properly;
3. Training of Contractor Operator personnel by manufacturer's technical service representatives has been completed; and
4. All spare parts, tools, lubricants shall be delivered to the Owner.
5. Installation drawings delivered to the Owner.

E. The Contractor shall, upon orders by the Engineer, startup, adjust and place in satisfactory operation all equipment constructed under this contract. At the discretion of the Engineer, individual startups may be required for various phases of the work or individual systems. The Engineer may order the start-ups prior to the completion of non-essential items of work.

F. As soon as practical after the initial start-up, the Contractor shall arrange for the manufacturer's representatives to perform all field tests and complete all additional training.

**1.08 - SYSTEM TESTING**

A. System Testing shall be made after all equipment that comprises of a complete system has been installed and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and manufacturer/supplier and the Contractor is satisfied that the equipment is operating as specified. System are identified as follows:

1. Liquid Stream (Influent Screen, Pre-Equalization Tanks, Mixing Blowers, SBR Transfer Pumps, SBRs and SBR Blowers) as shown on Drawing 00 D-006 - Process Flow Diagram I and Drawing 00 D-007 - Process Flow Diagram II;

2. Effluent Stream (Disk Filters, Post Equalization Tank, Post Equalization Tank Mixers, Effluent Pumps, UV System and Effluent Disposal) as shown on Drawing 00 D-007 - Process Flow Diagram II;

3. Plant Water (Plant Water System, Bladder Tank, Foam Spray Pump and Plant Water Storage Tank) as shown on Drawing 00 D-007 - Process Flow Diagram II;

4. Septage Receiving (Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-008 - Process Flow Diagram III;

5. Sludge Processing (Sludge Transfer Pumps, Rotary Drum Thickeners, Polymer Feed System, Thickened Sludge Storage Tank, Mixing Bowers and Thickened Sludge Pumps) as shown on Drawing 00 D-008 - Process Flow Diagram III; and

6. Odor Control (Odor Control System and Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-009 – Odor Control Air Flow Diagram.

B. The successful performance of all systems shall be demonstrated to the satisfaction of the Engineer by completing the System Testing utilizing portable water. Unless especially required in technical specifications, the System Testing will consist of operating each system for an uninterrupted four hours or as otherwise specified.

C. Failure of equipment to operate as specified will require the System Test to be reperformed for the full period. At no time during the System Testing shall any equipment or system be operated under a more severe condition than the maximum design condition for which the equipment is rated.

**1.09 - CLEAR WATER TESTING**

A. Clear Water Testing (4-hour) shall be conducted on all items and systems shall be made after all equipment has been installed for a given unit process and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and the Contractor is satisfied that the equipment is operating as specified.

B. Clear Water Testing shall not be conducted until completion of the “Certification of Proper Equipment Installation” by the Equipment Manufacturer and “Verification of Manufacturer’s Training” (Refer to SECTION 01030, SPECIAL REQUIREMENTS on each piece of process equipment.

C. The Contractor shall continue to conduct the Clear Water Test until the test has successfully run for 4 continuous hours.

D. The Contractor is responsible for all repairs and/or replacement of equipment and/or components of the equipment that does not function in accordance with the Contract Documents, approved shop drawings and manufacturer’s operational requirements.

E. The Contractor is responsible for all costs associated with conducting the 4-hour Clear Water Test including but, not limited to, labor, equipment, tools and supplies except as follows:

1. The Contractor is responsible for making all arrangements and gathering necessary permissions from the Owner’s water district for use of water.

2. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and shall be borne by the Contractor.

3. The water is obtained from the Owner ate not cost but, the water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

F. The Clear Water Test shall be performed with the OWNER, OPM, ENGINEER, Contract Operator and MassDEP in attendance. The Clear Water Test shall be scheduled at least twenty-one (21) days in advance so that OWNER, OPM, ENGINEER, Contract Operator and MassDEP personnel can be present.

**1.10 - SUBSTANTIAL COMPLETION**

A. Issuance of Substantial Completion shall occur following the successful completion of Clear Water Testing.

**1.11 – START UP**

A. Contract Operations

1. The Town of Orleans, Massachusetts will seek proposals from qualified firms capable of providing full-service operation and maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.

2. Operation and Maintenance services will be provided in a safe, secure, effective and efficient manner and will be in full compliance with GWDP Permit requirements of the MassDEP, applicable laws of the Commonwealth of Massachusetts and regulations of the Massachusetts Department of Environmental Protection.

3. Procurement of the Contract Operator is anticipated to be completed July 2021. Personnel from the Contractor Operator will be on-site during the last 6 to 8 months of construction to observe and/or be involved with the following:

   a. Construction Activities;

   b. Physical Checkout, Inspection and Certification;

   c. Field Testing or Functional Testing;

   d. Training;

   e. System Testing; and

   f. Clear Water Testing.

B. Operation and Maintenance

1. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the OWNER will notify Property Owners that they have up to one year to connect into the wastewater system.

2. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the Contract Operator will be responsible for Start-up and Operation and Maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.

3. Operation and Maintenance shall include, but not be limited to, the following

   a. Staffing – Number and Qualifications Required by MassDEP.

   b. Maintenance - Building and Grounds, Equipment, etc.;

   c. Maintain the Inventory of Spare Parts, Tools and Supplies, and the like;

   d. Process Control – SCADA System, Sampling and Analysis, etc.;

   e. Septage Receiving and Processing;

   f. Sludge Processing and Legal Disposal;

   g. Consumables – Power, Chemicals and the like; and

   h. Training of their Personnel –Additional Training (i.e. Safety Program, Standard Operating Procedures, etc.) Not Including Training Specified and Conducted by the Contractor and Manufacturers/Suppliers.

**1.12 - PERFORMANCE TESTING**

A. Performance Testing by the Contractor shall occur within the one-year warranty period but shall not occur until an average of 50,000 gpd of raw wastewater is being received at the facility. The Performance Testing will occur as soon as an average of 50,000 gpd of raw wastewater being received at the facility.

B. Since the facility may be underloaded during start-up, the following is required:

1. The Contractor shall coordinate the stat-up activities with the SBR manufacturer, Aqua Aerobics.

2. The system will be started-up by placing one SBR reactor in service.

3. Aqua Aerobics has run a preliminary design scenario for the reactor at its lowest loading to determine the quantity of seed required to be obtained by the Contractor. Refer to the attachment to this section.

    a. The design shows how much flow from the Pre-Equalization Tanks(s) is required for the SBR biology to be self-sustaining.

    b. This is an estimate based on a blend of raw wastewater entering the facility and flow from the Septage Receiving Station.

C. Performance Tests and Performance Criteria: Specific performance testing criteria are listed for specific equipment and systems in the Division 11 through Division 16 specifications. Compliance with these performance test requirements shall be demonstrated during the full system testing or otherwise demonstrated prior to substantial completion.

D. In the event of a failure to demonstrate satisfactory facility performance on the first or any subsequent attempt, it shall be the responsibility of the Contractor to make all the necessary and required changes, replacements, and tests to make the units meet the specified operating and efficiency requirements.

E. If equipment is unable to operate, initial calibration and/or additional adjustments are required, or representatives are absent, the start-up or tests shall be canceled at that time and full rescheduling will be required. Damages shall be assessed to the Contractor for time and expenses wasted on scheduling, coordinating and attending the failed performance test by the Owner, OPM, Engineer and Manufacturer Representatives.

F. Once the complete facility system has successfully passed the Performance Testing, the Contractor can submit a request for payment for money withheld.

**1.11 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING**

A. The Contractor shall not operate any of the existing facilities at any time. This shall include the starting and stopping of equipment or opening and closing of valves. Whenever the Contractor believe their work will affect or be impacted by the existing facilities operation, they shall so notify the Engineer in writing three (3) working days prior to the intended start of the work. This notification shall clearly detail the work to be completed, the method by which the existing facilities operation may be impacted, and the assistance requested of the Owner.

B. Contractor's Responsibilities: The Contractor shall be responsible for furnishing and installing all of the several kinds and types of equipment required in the treatment facilities, and for testing each individual piece of equipment, all combinations of equipment as they may operate one in conjunction with another, and the complete system, such that each component and the total unit may operate in an acceptable fashion to the Engineer, the Owner, and to any other municipal, State or Federal authorities within whose jurisdiction the operation of the facility may be a concern, at no additional costs to the Owner:

1. Develop specific start-up plans and schedule.

2. Provide specific start-up material and operating supplies until substantial completion. Supplies include lubricants, chemicals, gases, specialized fluids, electric power, water and all other required appurtenances.

3. Provide all specified third-party testing and laboratory costs at no additional costs to the Owner.

4. Provide manufacturer's representative to provide guidance during performance testing.

5. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the start-up and performance testing.

6. Provide the necessary craft or labor assistance, in the event of an emergency equipment failure requiring immediate attention, (emergency is defined as a failure of function which precludes the further operation of a critical segment of; or the whole of the work) with a response time of not less than four hours from the time of notification. The time of notification is defined as the time of contact between the Engineer's representative and the Contractor's representative.

7. Correct all failures or equipment problems identified during start-up when notified by the Engineer. Resolve and correct all equipment or system failures during the performance testing.

8. Provide manufacturer's representatives and operating supplies for retesting of systems that fail to pass the initial performance tests due to deficiencies in products or workmanship at no additional cost to the Owner.

9. Provide training as specified.

10. Prior to starting the start-up and testing, the Contractor shall provide and field calibrate certified flow meters (by using volumetric calibration), flow recorders, all electrical meters, and electrical recorders. The Contractor shall provide a test procedure, wiring diagram of field test recorders and instrumentation, and a field calibration report on the installed meter.

11. Review procedures for performance testing.

12. Attend meetings related to the review of start-up plan(s).

13. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract Documents.

C. The Owner's Responsibilities

1. Assist in the start-up testing activities. The Owner will endeavor to be cooperative with the Contractor when required. However, it is emphasized that the existing facilities operations and treatment take precedence and only requests that do not adversely affect the flow or treatment will be considered. Additionally, any assistance given to the Contractor must be completed when the Owner's schedule and manpower permit. There may be instances when the Owner cannot provide assistance at the time of the Contractor's request and this shall not be the basis for a claim by the Contractor.

2. Provide staff to operate and maintain equipment, systems, and facilities requiring start-up.

**1.12 - TREATMENT EQUIPMENT USAGE**

A. Any partial or full usage of the proposed equipment by the Owner, and/or his employees or agents, prior to acceptance shall be the responsibility of the Contractor.

**1.13 - OPERATIONAL EXPENSES**

A. During the construction stage and start-up period, before Substantial Completion, the Contractor shall bear all expenditures and operational expenses of all systems included in the project including, but not limited to, labor, equipment, tools, electrical power, chemicals, maintenance, and fuel.

B. The Contractor shall be responsible for the proper handling, sampling, and lab testing and analysis from the testing and start-up of facility processes.

C. During Performance Testing, the Contractor shall bear the costs for Contractor and manufacturer/suppliers, including but not limited to labor, equipment and tools.

**1.14 - GUARANTEE**

A. The Contractor shall guarantee the materials and equipment furnished and the performance thereof to be in accordance with the requirements of the Contract Documents.

B. The Contractor agrees upon written notice to make promptly and without charge, all necessary changes, corrections, and replacements (including installation of replacement parts) required to make good all defects developing in the material or equipment, under ordinary use and proper care, within a period of twelve months after substantial completion of the Project.

**PART 2 - PRODUCTS**

**2.01 - TEST EQUIPMENT**

A. The Contractor shall provide all test equipment, including kWh demand meters and recorders, instruments, analyzers, handling equipment, etc., required to sample and test the various systems. All test equipment must have been tested and calibrated within six months of their use on this contract.

**PART 3 - EXECUTION – Not Used**

**END OF TEXT**

See Attachment

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# AquaSBR - Sequencing Batch Reactor - Design Summary

**Design#: 158326**

**Project:** ORLEANS MA

**Option:** Sample Start up Conditions for SBR

*Designed by Tamera Knapp on Thursday, November 7, 2019*

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

## DESIGN INFLUENT CONDITIONS

**Avg. Design Flow** = 0.05 MGD = 189 m3/day

**Max Design Flow** = 0.05 MGD = 189 m3/day

## DESIGN PARAMETERS

| | Influent | mg/l | Effluent Required | <= mg/l | Effluent Anticipated | <= mg/l |
|---|---|---|---|---|---|---|
| **Bio/Chem Oxygen Demand:** | BOD5 | 200 | BOD5 | 15 | BOD5 | 15 |
| **Total Suspended Solids:** | TSS | 200 | TSS | 15 | TSS | 15 |
| **Total Kjeldahl Nitrogen:** | TKN | 40 | -- | -- | -- | -- |
| **Total Nitrogen:** | -- | -- | TN | 7 | TN | 7 |
| **Phosphorus:** | Total P | 4 | -- | -- | -- | -- |

## SITE CONDITIONS

| | Maximum | Minimum | Design | Elevation (MSL) |
|---|---|---|---|---|
| **Ambient Air Temperatures:** | 77 F 25.0 C | 30 F -1.1 C | 77 F 25.0 C | 60 ft |
| **Influent Waste Temperatures:** | 68 F 20.0 C | 50 F 10.0 C | 68 F 20.0 C | 18.3 m |

## SBR BASIN DESIGN VALUES

**No./Basin Geometry:** = 1 Rectangular Basin(s)

**Freeboard:** = 2.0 ft = (0.6 m)

**Length of Basin:** = 65.0 ft = (19.8 m)

**Width of Basin:** = 45.0 ft = (13.7 m)

| | Water Depth | | Basin Vol./Basin | | |
|---|---|---|---|---|---|
| **Min** | = 14.5 ft | = (4.4 m) | **Min** | = 0.318 MG | = (1,203.4 m³) |
| **Avg** | = 15.7 ft | = (4.8 m) | **Avg** | = 0.343 MG | = (1,298.0 m³) |
| **Max** | = 15.7 ft | = (4.8 m) | **Max** | = 0.343 MG | = (1,298.0 m³) |

| | | |
|---|---|---|
| **Number of Cycles:** | = 2 per Day/Basin (advances cycles beyond MDF) | |
| **Cycle Duration:** | = 12.0 Hours/Cycle | |
| **Food/Mass (F/M) ratio:** | = 0.026 lbs. BOD5/lb. MLSS-Day | |
| **MLSS Concentration:** | = 1200 mg/l @ Min. Water Depth | |
| **Hydraulic Retention Time:** | = 6.858 Days @ Avg. Water Depth | |
| **Solids Retention Time:** | = 43.6 Days | |
| **Est. Net Sludge Yield:** | = 0.799 lbs. WAS/lb. BOD5 | |
| **Est. Dry Solids Produced:** | = 66.6 lbs. WAS/Day | = (30.2 kg/Day) |
| **Est. Solids Flow Rate:** | = 100 GPM (1997 GAL/Day) | = (7.6 m³/Day) |
| **Decant Flow Rate @ MDF:** | = 333.0 GPM (as avg. from high to low water level) | = (21.0 l/sec) |
| **LWL to CenterLine Discharge:** | = 3.0 ft | = (0.9 m) |
| **Lbs. O2/lb. BOD5** | = 1.25 | |
| **Lbs. O2/lb. TKN** | = 4.60 | |
| **Actual Oxygen Required:** | = 181 lbs./Day | = (82.1 kg/Day) |
| **Air Flowrate/Basin:** | = 154 SCFM | = (4.4 Sm3/min) |
| **Max. Discharge Pressure:** | = 8.4 PSIG | = (58 KPA) |
| **Avg. Power Required:** | = 181.2 KW-Hrs/Day | |

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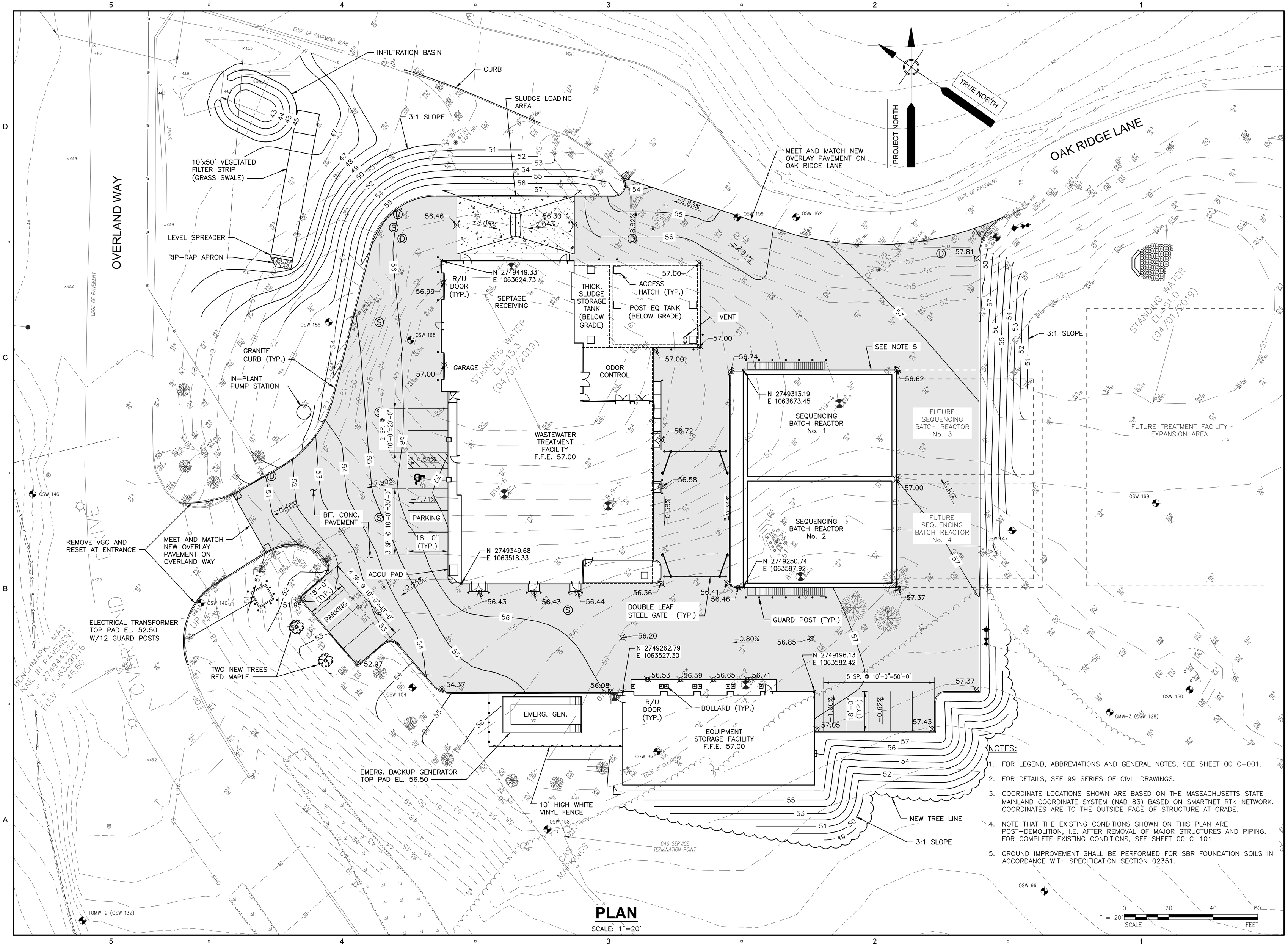



## PLAN

SCALE: 1"=20'

0 20 40 60
1" = 20' SCALE FEET

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE 99 SERIES OF CIVIL DRAWINGS.
3. COORDINATE LOCATIONS SHOWN ARE BASED ON THE MASSACHUSETTS STATE MAINLAND COORDINATE SYSTEM (NAD 83) BASED ON SMARTNET RTK NETWORK. COORDINATES ARE TO THE OUTSIDE FACE OF STRUCTURE AT GRADE.
4. NOTE THAT THE EXISTING CONDITIONS SHOWN ON THIS PLAN ARE POST-DEMOLITION, I.E. AFTER REMOVAL OF MAJOR STRUCTURES AND PIPING. FOR COMPLETE EXISTING CONDITIONS, SEE SHEET 00 C-101.
5. GROUND IMPROVEMENT SHALL BE PERFORMED FOR SBR FOUNDATION SOILS IN ACCORDANCE WITH SPECIFICATION SECTION 02351.

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
THOMAS E. PARECE
CIVIL
No. 34463
REGISTERED PROFESSIONAL ENGINEER

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | T. LAFFER |
| Drawn By: | S. NAPOLITANO |
| Dept Check: | C. BENZIGER |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

CIVIL

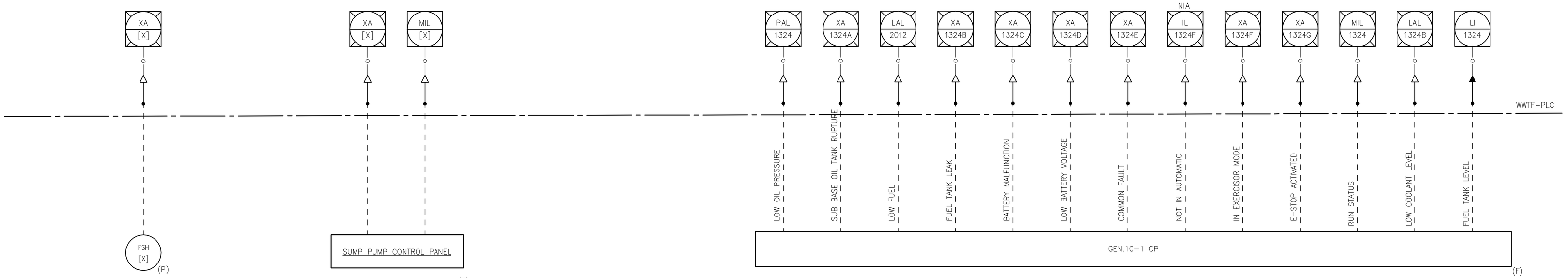
**SHEET TITLE**

# SITE LAYOUT PLAN - WWTF

**SHEET NUMBER**

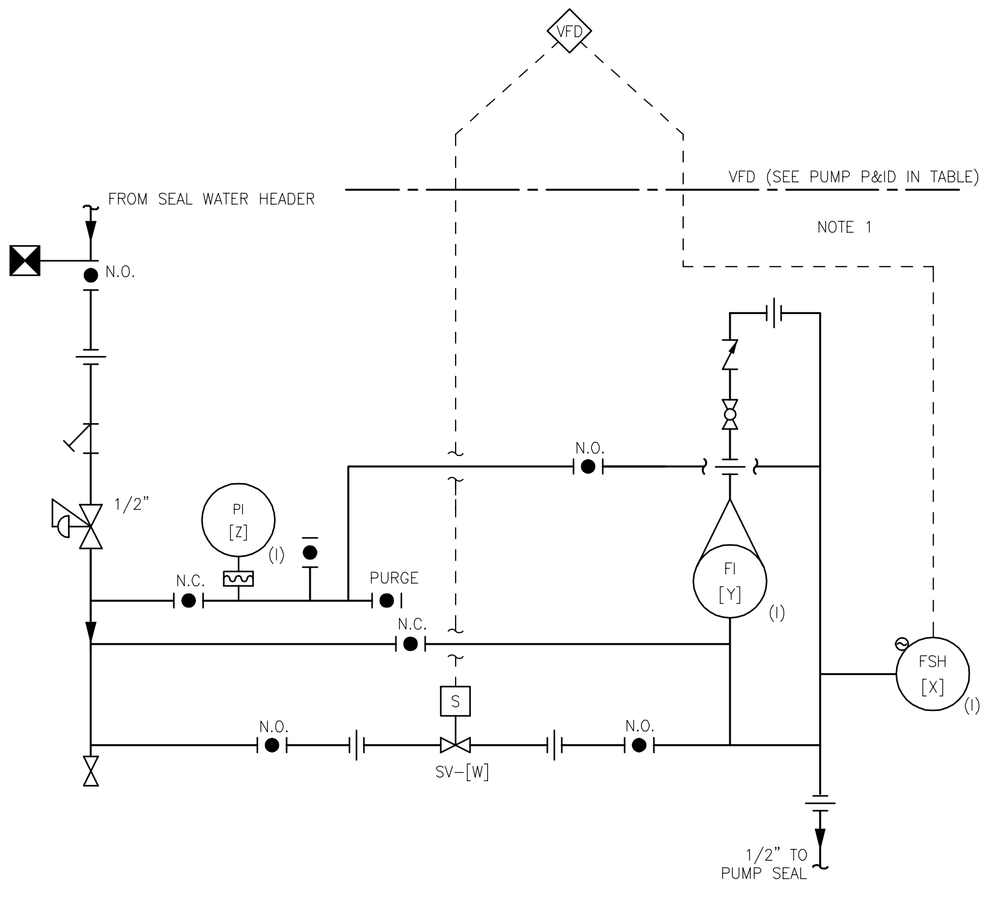
# 00 C-104

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\C00 C-104 WITH NEWER SURVEY 2-28-20 CHK 1.DWG
LAST UPDATE: Wednesday, March 04, 2020 12:51:49 PM
PLOT DATE: Thursday, March 05, 2020 9:41:08 AM




| TAG [X] | FIXTURE | LOCATION |
|---|---|---|
| FSH 1321A | EWS-1 | TRUCK BAY/SEPTAGE RECEIVING |
| FSH 1321B | EWS-2 | SODIUM HYPOCHLORITE/PACL ROOM |
| FSH 1321C | EWS-3 | LABORATORY |
| FSH 1321D | EWS-4 | POLYMER ROOM |
| FSH 1321E | EWS-5 | SODA ASH ROOM |
| FSH 1321F | EWS-6 | DISK FILTER ROOM |

| TAG | LOOP [X] | LOCATION |
|---|---|---|
| 10-SP-1/1A | 1322A | |
| 10-SP-2/2A | 1322B | |
| 10-SP-3 | 1322C | |




SEAL WATER PANEL

| TABLE OF SEAL WATER INSTRUMENTS | | | | | | |
|---|---|---|---|---|---|---|
| PUMP | SHEET | SOLENOID [W] | FLOW SWITCH [X] | ROTAMETER [Y] | PRESSURE GAUGE [Z] | LOCATION |
| SBR.TP-1 | 10 DI-603 | SV-1011 | FSH 1011 | FI 1011 | PI 1011C | MCC.10-1 |
| SBR.TP-2 | | SV-1012 | FSH 1012 | FI 1012 | PI 1012C | |
| SBR.TP-3 | | SV-1013 | FSH 1013 | FI 1013 | PI 1013C | |
| TSL.P-1 | 10 DI-615 | SV-1171 | FSH 1171 | FI 1171 | PI 1171C | |
| TSL.P-2 | | SV-1172 | FSH 1172 | FI 1172 | PI 1171C | |

| TABLE OF RESPONSIBILITY - ELECTRICAL, GENERAL, AND SYSTEM INTEGRATOR | | | | |
|---|---|---|---|---|
| | ELEMENT | GENERAL CONTRACTOR | SYSTEM INTEGRATOR | ELECTRICAL CONTRACTOR |
| 1 | FURNISH, TEST AND CALIBRATE INSTRUMENTS | | X | |
| 2 | INSTALL INSTRUMENTS | X | | |
| 3 | INSTALL FIELD LOCATED DEVICES ASSOCIATED WITH INSTRUMENTS INCLUDING TRANSMITTERS, INDICATORS, CONTROL PANELS, AND ANCIALLARY COMPONENTS THAT ARE NOT LOCATED WITHIN PROCESS PIPING AND TANKS. LOCATIONS SHALL BE AS INDICATED ON THE ELECTRICAL DRAWINGS. | X | | |
| 4 | FURNISH NETWORK EQUIPMENT, SCADA THIN CLIENT WORKSTATIONS/ENCLOSURES | | X | |
| 4 | FURNISH AND INSTALL INTERCONNECTING WIRE, CABLE, CONDUIT, AND CONNECTIONS FOR INSTRUMENTS | | | X |
| 5 | FURNISH AND INSTALL ETHERNET CABLES | | | X |
| 6 | PROVIDE FIBER OPTIC CABLE, PATCH PANELS AND ASSOCIATED HARDWARE | | X | |
| 7 | INSTALL FIBER OPTIC CABLE | | | X |
| 8 | TERMINATE AND TEST FIBER OPTIC CABLE | | X | |
| 9 | FURNISH AND INSTALL GAS MONITORING CONTROL PANELS, HORN STROBES AND ALARM DEVICES | | | X |
| 10 | FURNISH GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | X | | |
| 11 | INSTALL GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | | | X |

NOTES:

1. SEE 99 D-504 FOR ADDITIONAL SEAL WATER DETAILS.

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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PHONE: (508) 833-6950
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
SARAH PAPAZIAN
INSTRUMENTATION
No.52296
REGISTERED
PROFESSIONAL ENGINEER

Jan 24 2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 3/9/20 | ADDENDUM NO. 5 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | S. PAPAZIAN |
| Drawn By: | S. PAPAZIAN |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

INSTRUMENTATION

**SHEET TITLE**

MISC SIGNALS II AND TABLE OF RESPONSIBILITY

**SHEET NUMBER**

99 DI-602

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTP\SHEETS\DI\99 DI-602.DWG
LAST UPDATE: Friday, March 06, 2020 2:13:37 PM
PLOT DATE: Friday, March 06, 2020 2:13:54 PM

March 12, 2020

**ADDENDUM NO. 6**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 6 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 10 pages and 30 pages of attachments for a total of 40 pages.

**ATTACHMENTS**

1. SECTION 00410, FORM FOR GENERAL BID

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. GENERAL

   A. Sub-Bid Opening – April 1, 2020 at 11:00 am.

   B. General Bid Opening – April 15, 2020 at 2:00 pm.

   C. Sub-Bid Opening Results – An addendum will be issued providing the results of the Sub-Bid Opening. The addendum will instruct the General Contractor Bidders to carry a specific dollar amount for that subtrade on the Bid Form. Following the opening of the General Bids, new sub-bids will be solicited from three or more qualified subcontractors via a written quotation process. The Owner will open these sub-bids publicly and read them aloud at the time and place specified in the solicitation. The Owner will select the lowest responsible and eligible sub-bidder to which the winning General Contractor has no objection. An adjustment to the General Contract price will be made via a Change Order to reflect the difference between the amount the General Contractor Bidders carried and the actual subcontract cost. The General Contractor is not entitled to overhead and profit on the incremental difference between the amount carried and the amount of the new sub-bid.

   D. The Bid and Subbid Forms in Excel Format can be downloaded from the Tighe & Bond website. You must click on “pre-qualified” to access the Forms.

2. SECTION 00100, ADVERTISEMENT FOR BIDS

   A. Page 00100-1, Paragraph 2, delete the words "…not more than 372 working days." and replace with the words "…not more than 411 working days."

   B. Page 00100-1, Paragraph 3.a, first subparagraph, delete the words "…until 2:00 p.m. prevailing time, on March 25, 2020 at which time and place…" and replace with the words "…until 2:00 p.m. prevailing time, on April 15, 2020 at which time and place…".

   C. Page 00100-1, Paragraph 3.b, first subparagraph, delete the words "…until 2:00 p.m. prevailing time, on March 18, 2020 at which time and place…" and replace with the words "…until 11:00 a.m. prevailing time, on April 1, 2020 at which time and place…".

3. SECTION 00200, INSTRUCTIONS TO BIDDERS

   A. Page 00200-6, ARTICLE 1.09 - ADDENDA AND INTERPRETATIONS, Paragraph B., delete the words "…be received at least ten working days prior…" and replace with the words "…be received at least seven working days prior…".

4. SECTION 00410, FORM OF GENERAL BID

   A. Delete SECTION 00410, FORM FOR GENERAL BID in its entirety and replace with the following new section as attached.

5. SECTION 00520, AGREEMENT

   A. Page 00520-2, Paragraph 5, delete the words "…within 654vcalendar days, using not more than 372 working days split into four phases." and replace with the words "…within 654 calendar days, using not more than 411 working days."

6. SECTION 00520, ATTACHMENT A - ADDITIONAL FORMS TO BE SUBMITTED WITH THE BID, PART A - INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS

   A. Page 00520A-3, add the following to the end of Item 2):

      The minimum limit of liability of $5,000,000.00 is a standalone certificate that cannot be satisfied by using another certificate to satisfy this requirement.

   B. Page 00520A-3, delete Item 4) in its entirety and replace with the following new item:

      4) X - Builder's Risk - Amount of the General Contractor's Contract

   C. Page 00520A-3, delete Item 5) in its entirety and replace with the following new item:

      5) ___ - Professional Liability/ Errors and Omissions - Not Required.

7. SECTION 01025, MEASUREMENT AND PAYMENT

   A. Page 01025-8, BID ITEM A6 – SBR AERATION DIFFUSER GRIDS, add the following to the end of Paragraph A.

      The SBR Drawings show the locations of the three aeration grids in each basin. Two aeration girds in each basin are to be furnished under the Base Bid and associated allowance for SECTION 11600, SEQUENCING BATCH REACTORS. The third aeration grid in each basin are to be furnished under this bid item.

8. SECTION 07610, METAL ROOFING

   A. Page 07610-3, ARTICLE 1.05 – QUALITY ASSURANCE, add the following new paragraph:

      E. Workmanship and methods for sheet metal work shall conform to the applicable requirements of the National Roofing Contractors Association, New England Approved Roofers Association Manual and the Sheet Metal and Air Conditioning Contractors National Association.

B. Page 07610-4, ARTICLE 2.01 – MANUFACTURER, Paragraph A., delete the paragraph in its entirety and replace with the following new paragraph:

A. Acceptable Manufacturers

1. Classic Metal Roof Systems

2. Approved Equal

C. Page 07610-5, ARTICLE 2.02 – MATERIALS, Paragraph A., delete the words "…minimum thickness of 0.032, 3105-H14 aluminum …" and replace with the words "…minimum thickness of 0.024, 3105-H14 aluminum …".

D. Page 07610-5, ARTICLE 2.03 – ACCESSORIES, Paragraph C., delete the words "…minimum thickness of 0.032 aluminum and coated…" and replace with the words "…minimum thickness of 0.024 aluminum and coated…".

E. Page 07610-5, ARTICLE 2.03 – ACCESSORIES, Paragraph D., delete the words "…4-inch x 6-inch, 0.032 aluminum with …" and replace with the words "…4-inch x 6-inch, 0.024 aluminum with …".

9. SECTION 00800, SUPPLEMENTARY CONDITIONS

A. Page 00800-2, ARTICLE 5 - BONDS AND INSURANCE NOTICE TO CONTRACTOR, SC-5.04, add the following new paragraph:

The General Contractor shall carry the coverage by naming the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured at the limits specified herein. SECTION 05020, INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS are separate from the Owners and Contractors Protective Liability and shall name the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured.

10. SECTION 04200, UNIT MASONRY AND ACCESSORIES

A. Page 04200-2, ARTICLE 1.01 - SCOPE, Paragraph B., delete subparagraph 5. in its entirety and replace with the following new subparagraph:

5. Cavity wall insulation including spray foam insulation in accordance with SECTION 07200, BUILDING INSULATION.

B. Page 04200-2, ARTICLE 1.01, SCOPE, Paragraph B., delete subparagraph 19., in its entirety and replace with the following new subparagraph:

19. Air/Vapor Barrier Membrane (furnished by the Contractor and installed by the filed sub-contractor on the CMU).

11. SECTION 05500, MISCELLANEOUS METAL

A. Page 05500-14, add the following new ARTICLE 3.15 – Z-GIRT SYSTEM:

3.17 – Z-GIRT SYSTEM

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

B. Attach cladding support system to steel stud backup with a minimum of two #10-16 self-drilling screws to each stud. Additional screws may be required for high design wind pressures per manufacturer's recommendations.

C. Attach cladding panels or tiles to cladding support system per cladding panels manufacturer's recommendations.

D. Door Openings: Install framing below sills of openings to match framing required above door heads.

E. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly and support closures and to make partitions continuous from floor to underside of solid structure.

B. Page 05500-14, rename ARTICLE 3.15 – CONTRACT CLOSEOUT to ARTICLE 3.16 – CONTRACT CLOSEOUT.

12. SECTION 08210, FLUSH WOOD DOORS

    A. Page 08210-4, ARTICLE 2.02 - SOLID CORE DOORS, Paragraph B., delete subparagraph 3. In its entirety and replace with the following new subparagraph:

        20. Facing:

            a. Wood Veneer: Closed-grain hardwood.

            b. Veneer Grade: A

            c. Veneer Species: Natural Birch

            d. Veneer Cut: Plain Sliced

            e. Veneer Match: Book Matched (Uniform Pattern)

            f. Assembly of Veneer on Door Face: Running Match (Non-Symmetrical Appearance Veneer Pieces of Unequal Widths)

13. SECTION 08920, TRANSLUCENT WALL PANELS

    A. Page 08920-1, ARTICLE 1.02 – MEASUREMENT AND PAYMENT, add the following new paragraph:

        B. The Work of this section requires the Contractor to perform all Work specified under this section.

    B. Page 08920-2, ARTICLE 1.06 – QUALITY CRITERIA, Paragraph C., delete subparagraph 2.d. in its entirety and replace with the following new subparagraphs:

        d. “U” Factor: Minimum of 0.53.

        e. Wind Load Requirement: Panel system and fasteners to withstand a wind load as shown on Drawing 00 S-002, STRUCTURAL NOTES II.

    C. Page 08920-3, ARTICLE 2.01 - MATERIALS, Paragraph B., delete subparagraph 2 and subparagraph 3. in their entirety and replace with the following new subparagraphs:

        2. Exterior and interior face sheets shall have thickness with a variation in thickness not greater than plus or minus 10 percent capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.

        3. Color: As selected by Architect from manufacturer’s full range of industry colors.

    D. Page 08920-3, ARTICLE 2.01 - MATERIALS, Paragraph E., delete the words “Fin Battens and” in their entirety.

14. SECTION 10475, EMERGENCY AND MISCELLANEOUS EQUIPMENT

    A. Page 10475-9, ARTICLE 2.05 - PROJECTION SCREEN AND PROJECTOR, add the following new paragraph:

        C. Projection Screen and Projector to be located in Room 105 of the WWTF.

    B. Page 10475-9, ARTICLE 2.06 - MARKER BOARD, add the following new paragraph:

        E. Marker Boards to be located in the field by the Engineer.

    C. Page 10475-10, ARTICLE 2.07 - BULLETIN BOARD, add the following new paragraph:

        D. Bulletin Boards to be located in the field by the Engineer.

15. SECTION 10525, FIRST AID AND FIRE FIGHTING EQUIPMENT

A. Page 10525-3, ARTICLE 2.01 – EQUIPMENT, Paragraph B., add the following new subparagraph:

4. Locate fire extinguishers in each of the following buildings and rooms at locations determined by Engineer.

| Type | Building | Room Number | Quantity |
|---|---|---|---|
| Type 1 Dry Chemical (Class B and C) | WWTF | 101 | 3 |
| | WWTF | 104 | 1 |
| | WWTF | 108 | 2 |
| | WWTF | 117 | 1 |
| | WWTF | 118 | 1 |
| | WWTF | 119 | 1 |
| | WWTF | 135 | 1 |
| Type 2 Multi-Purpose (Class A, B and C) | WWTF | 102 | 1 |
| | WWTF | 109 | 1 |
| | WWTF | 115 | 1 |
| | WWTF | 126 | 2 |
| | Equipment Storage Facility | 201 | 3 |
| | Equipment Storage Facility | 202 | 1 |
| Type 3 Carbon Dioxide (Class B and C) | --- | --- | --- |
| Type 4 Clean Streaming Agent | --- | --- | --- |

16. SECTION 10999, BUILDING SPECIALTIES

A. Page 10999-3, ARTICLE 2.04 - HORIZONTAL BLINDS, Paragraph B., add the following new subparagraph:

6. Horizontal blinds shall be located on all exterior windows.

B. Page 10999-5, ARTICLE 2.05 - FALL PROTECTION DEVICES, Paragraph B., delete the article in its entirety and replace with the following new article:

2.05 - FALL PROTECTION DEVICES – Not Used

C. Page 10999-8, ARTICLE 2.09 - SELF-CLOSING SAFETY GATES, add the following new paragraph:

C. Locations

1. DRAWING 10 A-406 – ENLARGED STAIR 1 PLANS, at the Top of Stair 1 at Grade Level.

2. DRAWING 10 A-407 – ENLARGED STAIR 2 PLANS, at the Top of Stair 2 at Grade Level.

17. SECTION 11350, ULTRAVIOLET DISINFECTION EQUIPMENT

A. Page 11350-5, ARTICLE 2.01 – SYSTEM DESCRIPTION, Paragraph D., add the following new subparagraphs:

3. The UV system is fed from Panel Board DP.10-5 as shown on Drawing 10 E-608. DP.10-5 ratings are as shown on Drawing 10 E-602.

4. The design layout does not include motor operated valves associated with the UV System. Flow into each UV Reactor is controlled by manual butterfly valves.

B. Page 11350-5, ARTICLE 2.01 – SYSTEM DESCRIPTION, Paragraph F., delete the paragraph in its entirety and replace with the following new paragraph:

F. The UV system shall consist of two UV Reactors (one operating and one stand-by) proving full redundancy. The UV System shall be comprised of the following components:

1. UV reactors: (2) two
2. Number of lamps per reactor: As required to meet the design conditions specified herein and with a system dimension that fits within the foot print shown on the drawings
3. Control Panel: (1) one per reactor
4. PLC: (1) one per reactor.
5. UV Intensity Sensor: (1) one per reactor
6. Wiping System per reactor: Automatic Mechanical

C. Page 11350-6, Article 2.03 - UV DISINFECTION EQUIPMENT CONSTRUCTION, Paragraph B., delete subparagraph 3. in its entirety and replace with the following new subparagraph:

3. UV reactor shall be supplied with ANSI 150 lb. flanged inlet/outlet connections with maximum diameter of 16 inches and provided with the necessary reducers for connections to the 8-inch upstream and downstream piping.

D. Page 11350-5, 2.03 - UV DISINFECTION EQUIPMENT CONSTRUCTION, Paragraph B.16., add the following to the end of the subparagraph:

Pipe supports to be provided by the Contractor with coordination with the manufacturer in order to allow for proper operation and maintenance on the UV System.

E. Page 11350-6, ARTICLE 2.03 - UV DISINFECTION EQUIPMENT CONSTRUCTION, Paragraph I, delete subparagraph 9.a. in its entirety and replace with the following new subparagraph:

a. Communication between the UV reactors and the plant control center shall be through the following protocol:

(1) Ethernet. If the vendor's typical communication protocol is not Ethernet, the UV vendor is responsible for all communication configuration to provide Ethernet out of the control panel.

F. Page 11350-10, Article 3.03 – FIELD AND FUNCTIONAL TESTING, add the following new paragraph:

B. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.
2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection - 1 person-day.
3. Functional Testing: Calibrate, check alignment and perform a functional test with portable water - 1 person-day.
4. Field Performance Testing: 1 person-day.
5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions - 1 person-day.
6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.
7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

18. SECTION 12484, ENTRANCE FLOOR MATS AND FRAMES

    A. Page 12484-4, ARTICLE 2.01 - ENTRANCE FLOOR MATS AND FRAMES, GENERAL, delete the article in its entirety and replace with the following new article:

       2.01- ENTRANCE FLOOR MATS AND FRAMES, GENERAL – Not Used

19. SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL

    A. Page 13300-5, ARTICLE 1.08 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

       A. Equipment Manufacturer – Not Used

    B. Attachment A – Instruments Product Sheets, Page 13330-A5, Dissolved Oxygen Specification, delete Item 10 in its entirety and replace with the following new item:

       10. Mounting: SUSPENSION ASSEMBLY HOLDER

    C. Attachment A – Instruments Product Sheets, Page 13330-A15, Continuous On-Line Multi-Parameter Analyzer Specification, delete Item d. in its entirety.

20. SECTION 13330, PROCESS INSTRUMENTS

    A. Page 13330-6, ARTICLE 3.05 - MANUFACTURER'S FIELD SERVICES, delete the article in its entirety and replace with the following new article:

       3.05 - MANUFACTURER'S FIELD SERVICES

          A. Manufacturer's Field Services shall be provided for installation, startup and training for the equipment as follows:

             1. 3 working days (via 2 separate trips to project site).

    B. Page 13330-6, ARTICLE 3.06 - MANUFACTURER'S TRAINING, delete the article in its entirety and replace with the following new article:

       3.06 – NOT USED

21. SECTION 15400, PLUMBING SYSTEMS

    A. Page 15400-2, ARTICLE 1.00 - SUB-BID REQUIREMENTS, Paragraph D., add the following drawings:

       10 S-103 10 S-301 10 S-302 10 S-107 99 S-502

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 00 C-104, SITE LAYOUT PLAN - WWTF

    A. Add the following new Note 6.:

       6. If Alterative No. A-1 – Equipment Storage Facility is not accepted, all grading, pavement, curbing, site utilities, emergency generator, fencing and the like shall be constructed as shown. All underground utilities shall be terminated 10-feet from the face of the Equipment Storage Facility.

2. DRAWING 10 A-601, ROOM FINISH SCHEDULE

    A. Delete Room No. 109 and Room Number 126 in their entirety and replace with the following new information:

| Room Number | Room Name | Floor | | Wall | |
|---|---|---|---|---|---|
| | | Material | Finish | Material | Finish |
| 109 | Mech. Rm | SC | --- | PT | TBD |
| 126 | Basement Pump Room | SC | --- | --- | --- |

| Ceiling | | Base | | |
|---|---|---|---|---|
| **Material** | **Finish** | **Material** | **Finish** | **Notes** |
| MRB | TBD | RB | TBD | |
| --- | --- | --- | --- | |

3. DRAWING 10 A-503, DETAILS – MISC. I

   A. Detail 1, Alum Hatch HL-93, add the following new note:

      Note:

      1. HL-93 Hatch required due to the weight of the vehicle(s) that are anticipated to utilize the Garage (Room 102).

4. DRAWING 10 A-505, EXTERIOR SECTION DETAILS

   A. Typical Chimney Detail, add the following notes:

      Notes:

      1. Precast Trim shall be 2-inches thick.
      2. Prefabricated Chimney Caps shall be furnished under SECTION 05500, MISCELLANEOUS METAL.

5. DRAWING 10 A-601, ROOM FINISH SCHEDULE

   A. Room Finish Schedule, modify the Room Finish Schedule as follows

| Room Number | Room Name | Floor | | Wall | |
|---|---|---|---|---|---|
| | | **Material** | **Finish** | **Material** | **Finish** |
| 101 | Truck Bay | EFC | TBD | PC | TBD |
| 102 | Garage | EFC | TBD | PC | TBD |
| 117 | Polymer Rm | EFC | TBD | PC | TBD |
| 118 | Headworks | EFC | TBD | PC | TBD |
| 119 | Disk Filter Rm | EFC | TBD | PC | TBD |
| 128 | SBR – 1 | --- | --- | --- | --- |
| 129 | SBR – 2 | --- | --- | --- | --- |
| 135 | Soda Ash Rm | EFC | TBD | PC | TBD |

| Room Number | Ceiling | | Base | | |
|---|---|---|---|---|---|
| | **Material** | **Finish** | **Material** | **Finish** | **Notes** |
| 101 | FRP | TBD | --- | --- | --- |
| 102 | FRP | TBD | --- | --- | --- |
| 117 | FRP | TBD | --- | --- | --- |
| 118 | FRP | TBD | --- | --- | --- |
| 119 | FRP | TBD | --- | --- | --- |
| 128 | --- | --- | --- | --- | --- |
| 129 | --- | --- | --- | --- | --- |
| 135 | FRP | TBD | --- | --- | --- |

6. DRAWING 10 A-603, WINDOWS AND LOUVER SCHEDULES

   A. HVAC Louver Schedule, add L10 as follows:

| | | | Group | | | |
|---|---|---|---|---|---|---|
| **Type** | **Width** | **Height** | **Head** | **Jamb** | **Sill** | **Count** |
| L10 | 4’ – 0” | 2’ – 0” | LH-1 | LJ-1 | LS-1 | 4 |

7. DRAWING 20 A-601, EQUIPMENT STORAGE FACILITY – DOOR SCHEDULE AND DETAILS

   A. Door Schedule, modify the door specifications as follows:

| Door | Size | | Door | | | Frame | | |
|---|---|---|---|---|---|---|---|---|
| **Number** | **Width** | **Height** | **Type** | **Material** | **Finish** | **Type** | **Material** | **Finish** |
| 002 | 3” – 0” | 7” – 0” | F | Alum | PT | 1 | Alum | PT |
| 010 | 3” – 0” | 7” – 0” | F | Alum | PT | 1 | Alum | PT |
| 011 | 6” – 4” | 7” – 0” | FF | HM | PT | 1 | HM | PT |

| Door | Detail | | | | HDW | |
|---|---|---|---|---|---|---|
| **Number** | **Head** | **Jamb** | **Sill** | **Fire Rating** | **Group** | **Notes** |
| 002 | DH-2 | DJ-2A/B | DS-2 | --- | 30 | --- |
| 010 | DH-2 | DJ-SA/B / DJ-3A/B | DS-2 | --- | 30 | --- |
| 011 | DH-1 | DJ-1 | DS-1 | 60 MIN. | 80 | --- |

   B. Door Schedule, add the following note:

      Note: Finish of all Doors and Frames shall be “PT”.

8. DRAWING 20 A-602, EQUIPMENT STORAGE FACILITY – DOOR DETAILS CONT.

   A. Details, delete the words “Insulated Hollow Metal Door” in all locations and replace with the words “Door (See Schedule)”.

9. DRAWING 10 S-103, GRADE LEVEL PLAN I

   A. Grade Level Plan I, add the following new note:

      3. Modular Type System Trench Drains furnished under SECTION 15400, PLUMBING SYSTEMS.

10. DRAWING 10 S-107, SLUDGE LOADING PAD

   A. Grade Level Plan, add the following new note:

      3. Modular Type System Trench Drain furnished under SECTION 15400, PLUMBING SYSTEMS.

11. DRAWING 00 D-006, PROCESS FLOW DIAGRAM I

   A. SBR Transfer Pump suction Header, add an 8” Plug Valve between SBR TP-1 and SBR TP-2.

   B. SBR Transfer Pump suction Header, add an 8” Plug Valve between SBR TP-2 and SBR TP-3.

12. DRAWING 10 D-102, FACILITY LOWER PLAN II and DRAWING 10 D-103, FACILITY LOWER PLAN III

    A. SBR Transfer Pump Suction Header, add an 8" Plug Valve between SBR TP-1 and SBR TP-2.

    B. SBR Transfer Pump Suction Header, add an 8" Plug Valve between SBR TP-2 and SBR TP-3.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 6**

**SECTION 00410**

**FORM OF GENERAL BID**

1. Proposal of _____ (hereinafter called "Bidder")*

   (_) a corporation, organized and existing under the laws of the State of _____

   (_) a partnership

   (_) a joint venture

   (_) a limited liability company

   (_) an individual doing business as _____

   *Check corporation, partnership, joint venture, LLC or individual as applicable.

2. To the Town of Orleans, MA (hereinafter called "Owner") regarding: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486.

   The Bidder, in compliance with your invitation for bids for Downtown Area WWTF and Effluent Disposal having examined the plans and specifications with related documents and the site of the proposed work, attended the mandatory pre-bid conference, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to construct the project in accordance with the contract documents, within the time set forth below, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this bid is a part.

   The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written “Notice to Proceed” given by the Owner to the Contractor and to fully complete the project within 654 calendar days, using not more than 411 working days.

   The Bidder further agrees to pay as liquidated damages the sum of $6,700 for each consecutive calendar day and/or working day thereafter during which the work as not been fully completed, as provided in the “Liquidated Damages” provisions of SECTION 00800 - SUPPLEMENTARY CONDITIONS.

3. Bidder acknowledges receipt of the following addenda:

| No. | Dated | No. | Dated |
|---|---|---|---|
| 1 | | 6 | |
| 2 | | 7 | |
| 3 | | 8 | |
| 4 | | 9 | |
| 5 | | 10 | |

4. Bidder agrees to perform all the work, including 10all incidental labor, materials and equipment necessary for the satisfactory completion of the work and in full compliance with the contents and intent of the Specifications and/or Drawings of the work.

5. Bid Proposal

   A. The BID PROPOSAL unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, engineering costs, etc., to cover the finished work of the several kinds called for. The Bidder understands that all bids for this project are subject to the applicable bidding laws of the Commonwealth of Massachusetts, including General Laws Chapter 149, Section 44D and Section 44E, as amended.

   B. Bidder shall complete and submit the Proposal Form. The bidder is not allowed to submit a proposal that has been printed out and prices typewritten or written by hand. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   C. Use of the Microsoft Excel Proposal Form

      1. Upon Opening the Microsoft Excel Proposal Form:

         a) A yellow bar will appear on the top of the screen labeled as "*Security Warning*"

         b) You must select the "*Enable Content*" button in order to properly access the file.

            1) This will enable macros in the excel file, as you must enable macros to properly view the file.

            2) If you do not enable macros, the excel document will be invalid.

         c) Manually enter the Bidder's Name in the blue box.

         d) Manually enter the Date in the blue box.

         e) Manually enter the unit cost in the blue boxes for each bid item. Allowances have already been prepopulated.

         f) The document will automatically update the cost estimates (Unit Price in Words; Extended Totals and Bid Total based on the user's unit cost input into the blue boxes for each bid item.

      2. In Order to Save the Proposal Form Document.

         a) The document must be saved as a file with macros enabled.

         b) Please save as the file type "Excel Macro-Enabled Workbook (*.xlsm)".

         c) If the file is saved incorrectly as a different file type, the document will be invalid.

      This process must be repeated for every time the document is opened and saved.

   D. Bidder shall print out in Landscape Format and submit the completed Microsoft Excel Proposal Form. In addition, Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format on a Thumb Drive.

   E. In the event of a discrepancy between the price in words and the price in figures, the words shall govern. In the event of a discrepancy between the total of the items and the total stated, the total of the items shall govern.

   F. In the event of a discrepancy between the printed out completed Microsoft Excel Proposal Form and the completed Microsoft Excel Proposal Form in ".xlsm" format, the printed out completed Microsoft Excel Proposal Form shall govern.

   G. Interlineation, alteration or erasure may void the bid.

   H. Bid security is attached in the sum of five percent (5%) of the total bid in accordance with the conditions of SECTION 00200 - INSTRUCTIONS TO BIDDERS. The bid security may become the property of the Owner in the event the contract and bond are not executed within the time set forth above.

   I. The undersigned states that no officer, agent or employees of the Owner directly or indirectly has a financial interest in this Bid.

6. The time period for holding bids, where Federal approval is not required is 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids and where Federal approval is required, the time period for holding bids is 30 days, Saturdays, Sundays and holidays excluded after Federal approval.

7. State Taxes - Pursuant to M.G.L.c.62C, s49A I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all State Taxes required under law.
8. Award
   A. The contract will be awarded to the lowest responsible and eligible bidder.
   B. Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding as deemed to be in the best interest of the Owner.
   C. The Owner reserves the right to reject any bid in the event that any bid item or items are obviously unbalanced or appear to the Owner to be so unbalanced as to affect or to be liable to affect adversely any interest of the Owner.
   D. The Owner reserves the right to reject any or all bids if it deems it to be in its best interest to do so. The Owner reserves the right to award the Contract based on sufficiency of appropriated funds to complete the work.
   E. In the event the lowest bids from responsive and responsible bidders are tied, the following methods of breaking the tie shall be employed unless otherwise provided for in these bid documents: The bidder's names shall be entered on a slip of paper and placed in a hat. The award shall then be made to the bidder whose slip is drawn from the hat. The drawing of the slip from the hat shall be performed in the presence of the tied bidders unless they waive their right to be present in writing.
9. Within 10 days of receipt of the written notice of acceptance of this bid, the Bidder will execute the formal agreement attached in SECTION - AGREEMENT and provide the requisite payment and performance bonds and certificates of insurance.
10. The selected Contractor shall furnish a performance bond and a payment bond each in an amount at least equal to one hundred percent (100%) of the contract prices in accordance with SECTION 00610 - PERFORMANCE BOND, SECTION 00615 - PAYMENT BOND, and as stipulated in paragraph 5.01 of SECTION 00700 - GENERAL CONDITIONS of these specifications.
11. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.
12. The Undersigned, as Bidder, declares as follows:
   A. The only parties interested in this BID as Principals are named herein;
   B. The Bidder has carefully examined the site of the proposed Work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed Work, the difficulties attendant upon its execution and the accuracy of all estimated quantities stated in this BID, and has carefully read and examined the Drawings, the annexed proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;
   C. This BID is made without collusion with any other person, firm, or corporation;
   D. No officer, agent, or employee of the Owner is directly or indirectly interested in this BID; and
   E. Understands that information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered will be the same as those shown on the Drawings or in any of the other Contract Documents and agrees that the Bidder shall not use or be entitled to use any such information made available to him through the Contract Documents or otherwise or obtained by him in his own examination of the site, as a basis of or ground for any claim against the Owner or the Engineer arising from or by reason of any variance which may exist between the aforesaid information made available to or acquired by him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and has made due allowance therefore in this BID.
13. Equal Employment Opportunity/Affirmative Action Provisions - C.30 s39 (c)
   A. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.

B. The undersigned bidder hereby certifies he/she will comply with the specific affirmative action steps contained in the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these contract provisions. The contractor receiving the award of the contract shall incorporate the EEO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

14. Non-Debarment - C.30 s39 (a)

A. The undersigned certifies under penalties of perjury that this bid is in all respects bonafide, fair and made without collusion or fraud with any other person. As use in this paragraph the "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

B. The undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

15. Suspension and Debarment

A. The EPA prohibits the use of suspended or debarred contractors and suppliers in SRF financed contracts. All SRF financed contracts and subcontracts must include the following language requiring compliance with 2 CFR 180 and 2 CFR 1532.

B. Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled responsibilities of Participants Regarding transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

16. Diesel Retrofit Program - The undersigned bidder hereby certifies he/she will comply with the Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply (see Appendix B).

17. The undersigned offers the following information as evidence of its qualifications to perform the work as bid upon according to all the requirements of the plans and specifications.

A. Have been in business under present name for _____years.

B. The Bidder shall state below what work of a similar character to that included in the proposed contract it has done within the last 1o years, and give references that will enable the Owner to judge its experience, skill and business standing (add supplementary page(s) if necessary).

**Project No. 1**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 2**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 3**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 4**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 5**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

C. The names and addresses of all persons interested in the bid (if made by a partnership or corporation) as Principals, are as follows (add supplementary page(s) if necessary):

| Name | Address |
|---|---|
| | |
| | |
| | |
| | |

18. Pursuant to M.G.L. CH. 62C, Sec 49A, the undersigned Bidder certifies under the penalties of perjury that it is in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

19. The undersigned Bidder hereby certifies that (1) it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; and (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

20. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity which sells materials, equipment or supplies used in or for, or engages in the performance of, the same or similar construction, reconstruction, installation, demolition, maintenance or repair work or any part thereof.

21. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, Section 25C (10) of Chapter 152 (workers' compensation) or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder.

Respectfully submitted:

Date: _____ By: _____

(Signature)

_____

(Name – Typed or Printed)

_____

(Title)

_____

(Business Name)

_____

(Federal ID Number)

_____

(Business Address)

_____

(City and State)

_____

(Telephone Number)

(SEAL - if bid is by a corporation)

22. The following documents are attached to and made a condition of the bid, and shall be submitted with the bid:

    A. Microsoft Excel Proposal Form (hard copy in Landscape Format and ".xlsm" format copy on Thumb Drive);

    B. Bid Security (5%);

    C. Completed and signed Bid Proposal and Project Reference List;

    D. Insurance Requirements for Inclusion in All Specifications and Contracts;

    E. Statement of State Tax Compliance;

    F. Certificate of Non-Collusion;

    G. Acknowledgement of Principal, if a Corporation;

    H. Acknowledgement of Principal, if a Partnership;

    I. Certification of OSHA 10-Hour Training.

    J. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply.

    K. MassDEP Appendix B - Diesel Retrofit Program

    L. MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

M. Division of Capital Asset Management and Maintenance

1) Certificate of Eligibility

2) Update Statement (Form CQ3)

3) Contractor Qualification Statement (CQS)

N. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program

O. Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

**END OF TEXT**

SEE ATTACHED PROPOSAL FORM

SEE ATTACHED APPENDIX

MassDEP Appendix B Diesel Retrofit Program

MassDEP Appendix E Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

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# APPENDIX B

## APPENDIX B
## DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

**Diesel Construction Equipment Standard**

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

**Exemptions**

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

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**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

**Contractor Certification**

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

**Recordkeeping**

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

**Project Regulatory Agreement**

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

**APPENDIX B** (cont.)
**DIESEL RETROFIT PROGRAM**

## STATEMENT OF INTENT TO COMPLY

***This form must be signed and submitted by the bidder as part of the bid.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Bidder** _____

**The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:**

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____
**(Signature of Bidder's Authorized Representative)** **(Date)**

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**APPENDIX B** (cont.)

**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

***Each Contractor and its Subcontractor(s) must sign and submit this form to DEP DMS project engineer, 5th Floor, MassDEP, One Winter Street, Boston, MA 02108 and the Municipality within 10 days after the Contractor is notified that it is awarded the Contract.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Contractor** _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

**APPENDIX B** (cont.)

**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

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# APPENDIX E

## APPENDIX E
## CONSTRUCTION BID SPECIFICATIONS
## SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES
## MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
### DIVISION OF MUNICIPAL SERVICES

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM BACKGROUND

In May 2008 a United States Environmental Protection Agency (EPA) rule became effective that changed the Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) Program to a Disadvantaged Business Enterprise (DBE) Program.

For firms to qualify under the old MBE/WBE program they needed to be socially disadvantaged and had to be certified by the Supplier Diversity Office (SDO). Under the new DBE rule, the firms must be both **socially** and **economically** disadvantaged, **citizens of the United States**, and certified as a DBE. Women and certain minorities are presumed to be socially disadvantaged. The economic disadvantage is measured by the owner's initial and continuing personal net worth of less than $1,320,000.

Because the Clean Water Act requires the use of MBEs and WBEs, these firms will still be utilized in the State Revolving Fund (SRF) Loan Program, but they must also be certified as DBEs.

SDO will continue to be the certifying agency for the SRF program. SDO certifies firms under the federal Department of Transportation program, which is acceptable for use in the SRF program. An additional form has been added to the DBE package to verify that DBEs are owned or controlled by United States citizens.

BID SPECIFICATIONS

**I.** In this contract, the percentage of business activity to be performed by disadvantaged business enterprise(s) (DBE) shall not be less than the following percentages of the total contract price or the percentage submitted by the contractor in the Schedule of Participation, whichever is greater:

Disadvantaged MBE (D/MBE) 4.2% Disadvantaged WBE (D/WBE) 4.5%

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## II. DEFINITIONS

For the purpose of these provisions, the following terms are defined as follows:

A. Awarding Authority – Entity that awards a prime contract under a State Revolving Fund loan.

B. Bidder - Any individual, partnership, joint venture, corporation, or firm submitting a price, directly or through an authorized representative, for the purpose of performing construction or construction related activities under a Contract.

C. Certified DBE – A DBE certified by the United States Small Business Administration, under its 8(a) Business Development Program (13 CFR part 124, subpart A) or its Small Disadvantaged Business Program (13 CFR part 124, subpart B); The United States Department of Transportation (DOT), under its regulations for Participation by DBSs in DOT programs (49 CFR parts 23 and 26); or SDO in accordance with 40 CFR part 33; provided that the certification meets the U.S. citizenship requirement under 40 CFR §33.202 or §33.203.

D. Compliance Unit - A subdivision of MassDEP's Affirmative Action Office designated to ensure compliance under these provisions.

E. Contractor - Any business that contracts or subcontracts for construction, demolition, renovation, survey, or maintenance work in the various classifications customarily used in work and that is acting in this capacity under the subject contract.

F. Construction Related Services - Those services performed at the work site ancillary to, and/or in support of, the construction work, such as hauling, trucking, equipment operation, surveying or other technical services, etc. For the purposes hereof, supply and delivery of materials (e.g. pre-cast concrete elements) to the site by a supplier who has manufactured those goods, or substantially altered them before re-sales shall be considered as "construction related services

G. Construction Work - The activities at the work site, or labor and use of materials in the performance of constructing, reconstructing, erecting, demolishing, altering, installing, disassembling, excavating, etc, all or part of the work required by the Contract Documents.

H. Disadvantaged Business Enterprise (DBE) - An entity owned or controlled by a socially and economically disadvantaged individual as described by Public Law 102-389 (42 U.S.C. 4370d) or an entity owned and controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note); a Small Business Enterprise (SBE); a Small Business in a Rural Area (SBRA); or a Labor Surplus Area Firm (LAF), a Historically Underutilized Business (HUB) Zone Small Business Concern, or a concern under a successor program.

I. Equipment Rental Firm - A firm that owns equipment and assumes actual and contractual responsibility for renting said equipment to perform a useful function of the work of the contract consistent with normal industry practice

J. Good Faith Efforts – The race and/or gender neutral measures described in 40 CFR 33, subpart C.

K. HUBZone - A historically underutilized business zone, which is an area located within one or more qualified census tracts, qualified metropolitan counties, or lands within the external boundaries of an Indian reservation.

L. HUBZone small business concern - A small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

M. Joint Venture - An agreement between SDO certified DBE and a non-DBE or non-DBE controlled enterprise.

1. A pairing of companies will be considered a DBE joint venture if the SDO certified DBE which is part of the relationship has more than 51% of the profits that are derived from that project.

2. A joint venture between a certified DBE subcontractor and a non DBE subcontractor, in which the DBE for that proportion of the joint venture's contract equal to the DBE participation in the joint venture.

3. Whenever a general bid is filed by a joint venture with a certified DBE participant in the joint venture that does not exercise more than 51% control over management and profits, that joint venture shall be entitled to credit as a DBE for that portion of the joint venture's contract equal to the DBE participation in the joint venture. Minority As deemed by SDO.

N. Labor surplus area firm (LSAF) - A concern that together with its first-tier subcontractors will perform substantially in labor surplus areas (as identified by the Department of Labor in accordance with 20 CFR part 654). Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.

O. Letter of Intent – Certified document signed by the principal(s) of the DBE with respect to the work to be performed under contract.

P. Local Government Unit (LGU) – A city, town, or municipal district which applies for a loan under the Clean Water Trust Program.

Q. Material Supplier – A vendor certified by SDO as a DBE in sales to supply industry from an established place of business or source of supply, and that vendor.

1. Manufactures goods from raw materials, or substantially utilizes them in the work, or substantially alters them before resale, entitling the general contractor to DBE credit for 100% of the purchase order.

2. Provides and maintains a storage facility for materials utilized in the work, entitling the general contractor to DBE credit for 10% of the purchase order

R. Minority and Women Business Enterprise (M/WBE) – Any business concern certified by the SDO as a bona-fide M/WBE. A bona-fide M/WBE is a business whose minority group/women ownership interests are real, which have at least 51% ownership and control over management and operation.

S. Percent of Total Price – Is the percentage to be paid to the DBE, work they perform, as compared to the total bid price

T. Recipient - An agency, person or political subdivision which has been awarded or received financial assistance by the Trust or MassDEP.

U. Small business, small business concern or small business enterprise (SBE) - A concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR part 121.

V. Small business in a rural area (SBRA) - A small business operating in an area identified as a rural county with a code 6-9 in the Rural-Urban continuum Classification Code developed by the United States Department of Agriculture in 1980.

W. SDO – The Supplier Diversity Office.

X. Subcontractor – A company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Y. Total Contract Price – The total amount of compensation to be paid for all materials, work or services rendered in the performance of the contract

Z. Trust – The Massachusetts Clean Water Trust established by M.G.L. c.29.

## III. REQUIREMENTS FOR CONTRACT AWARD

DBE packages must be submitted by the two lowest bidders on the project. Following bid opening, the LGU shall notify the two lowest bidders to submit DBE packages to the LGU or the LGUs consultant, as directed. By the close of business on the third business day after notification, the two lowest bidders, including a bidder who is a MBE, WBE or DBE, shall submit the following information:

A. A Schedule of Participation (Form EEO-DEP-190). The Schedule of Participation shall list those certified DBEs the bidder intends to use in fulfilling the contract obligations, the nature of the work to be performed by each certified DBE subcontractor and the total price they are to be paid.

   1. A listing of bona-fide services such as a professional, technical, consultant or managerial services, assistance in the procurement of essential personnel, facilities, equipment, materials, or supplies required for performance of the contract, and reasonable fees or commissions charged.

   2. A listing of haulers, truckers, or delivery services, not the contractors, including reasonable fees for delivery of said materials or supplies to be included on the project.

B. A Letter of Intent (Form EEO-DEP-191) for each DBE the bidder intends to use on the project. The Letter of Intent shall include, among other things, a reasonable description of the work the certified DBE is proposing to perform and the prices the certified DBE proposes to charge for the work. A Letter of Intent shall be jointly signed by the certified DBE and the General Contractor who proposes to use them in the performance of the Contract.

C. Each DBE must also sign and return the DBE Certification of United States Citizenship form to verify that the firm is owned or controlled by a United States citizen.

D. The SDO "DBE Certification" as prepared by each certified DBE.

E. A completed Request for Waiver form and backup documentation should the goals not be achieved (See IV below).

## IV. REQUIREMENTS FOR MODIFICATION OR WAIVERS.

The bidder shall make every possible effort to meet the minimum requirements of certified DBE participation. If the percentage of DBE participation submitted by the bidder on its Schedule of Participation (EEO-DEP-190) does not meet the minimum requirements, the bid may be rejected by the Awarding Authority and found not to be eligible for award of the contract.

In the event that the bidder is unable to meet the minimum requirements of DBE participation, the bidder shall submit with his/her submittal required in Section III. Requirement of Contract Award a Request for Waiver form (EEO-DEP-490). The Awarding Authority shall review the waiver request to determine if the request should proceed. If approved by the Awarding Authority, the Awarding Authority shall submit the waiver request and supporting documentation, with a recommendation to MassDEP within five days of receipt of the Request for Waiver. MassDEP in conjunction with the project manager, Compliance Unit, will determine whether the waiver will be granted.

The waiver request shall include detailed information as specified below to establish that the bidder has made a good faith effort to comply with the minimum requirements of DBE participation specified in Part I. In addition, the bidder must show that such efforts were undertaken well in advance of the time set for opening of bids to allow adequate response. A waiver request shall include the following:

A. A detailed record of the effort made to contact and negotiate with the certified DBE, including, but not limited to:

   1. names, addresses and telephone numbers of all such companies contacted;

   2. copies of written notices(s) which were sent to certified DBE potential subcontractors, prior to bid opening;

   3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

   4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price;

   5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/ women-focused media detailing the opportunities for participation.

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after MassDEP receives all required information and documentation, it shall make a decision in writing, whether the waiver is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing. If the waiver request is denied, the bid shall be rejected by the Awarding Authority, or the contract will be determined ineligible for SRF funding.

   If a Request for Waiver is denied by MassDEP and the bid is rejected by the Awarding Authority, the Awarding Authority may then move to the second bidder on the project. At the Awarding Authority's discretion, it may collect a DBE package from the third bidder on the project.

## V. DISADVANTAGED BUSINESS ENTERPRISES PARTICIPATION

A. Reporting Requirements

1. The Contractor's utilization of certified DBEs will be documented based upon submittal of the LGU's monthly Payment Requisitions as reported on Form-2000. The Form-2000 form will show all certified DBEs performing work on the project regardless of any billing activity for that month. For auditing and accounting purposes, the Contractor periodically may be required to submit copies of canceled checks verifying that payments have been made to the certified DBE as listed on the schedule. The Contractor may also be required to submit current schedules on utilization of all DBEs to indicate when their services will commence and be billed for.

2. During the life of the Contract, the Contractor's fulfillment of the percentage requirements in Part I shall be determined with reference to the Contract price as follows:

   A. If the price in the Contract executed exceeds the base bid price (e.g., because an alternate was selected or because unit prices were used in awarding the Contract), the Contractor shall submit for approval by MassDEP a revised Schedule of Participation by certified DBEs satisfying the percentage requirements and such other information concerning additional DBE participation as may be requested by MassDEP.

   B. If the Contract price increases after execution due to change orders or other adjustments, MassDEP may require the Contractor to subcontract additional work or to purchase additional goods and services from certified DBEs up to the percentages stated in Part I.

## VI. COMPLIANCE

A. If the Schedule or any of the Letters of Intent are materially incomplete or not submitted in a timely manner, the LGU may rescind its vote of award; treat the bid informal as to substance and reject the bid. If the bid is incomplete in any other respect than the Schedule the LGU with the approval of MassDEP may waive the informalities upon satisfactory completion of the required information by the Contractor and the certified DBE as applicable.

B. If the LGU finds that the percentage of certified DBE participation submitted by the contractor on its Schedule does not meet the percentage requirement in Part I, it shall rescind its vote of award and find such contractor not to be eligible for award of the contract.

C. The Contractor shall not perform with its own organization, or subcontract to any other primary or subcontractor any work designated for the named certified DBEs on the schedule submitted by the Contractor under Part III without the approval of MassDEP.

D. A Contractor's compliance with the percentage requirement in Part I shall continue to be determined by reference to the required percentage of the total contract price as stated in Section I even though the total of actual contract payments may be greater or less than the bid price.

E. If the Contractor for reasons beyond its control cannot comply with Part III in accordance with the Schedule submitted under Part III, Section B, the contractor must submit to MassDEP as soon as they are aware of the deficiency, the reason for its inability to comply. Proposed revisions to the Schedule stating how the contractor intends to meet its obligations under these conditions must be submitted within ten (10) working days of notification.

F. If the Contractor is becomes aware by any means that that DBE is no longer certified, the Contractor shall immediately notify MassDEP. The Contractor shall use good faith efforts to retain a substitute certified DBE.

G. If a certified DBE listed by the bidder in its Schedule of M/WBE contractors fails to obtain a performance or payment bond requested by the bidder, said failure shall not entitle the bidder to avoid the requirements of Part III (A). After a bidder has been awarded the contract, he shall not change the certified DBE listed in its Schedule at the time of the award or make any other such substitutions without the written approval of MassDEP.

## VII. SANCTIONS

A. If the Contractor does not comply with the terms of these Special Provisions, the Awarding Authority may (1) suspend any payment for the work that should have been performed by a certified DBE pursuant to the schedule, or (2) require specific performance of the Contractor's obligation by requiring the Contractor to subcontract with a DBE for any contract or specialty item at the contract price established for that item in the proposal submitted by the Contractor.

B. To the extent that the Contractor has not complied with the terms of these Special Provisions, the Awarding Authority may retain in connection with Estimates and Payments an amount determined by multiplying the bid price of this contract by the percentage in Section I, less the amount paid to DBE's for work performed under the contract and any payments already suspended under VII A.

C. The Awarding Authority may suspend, terminate or cancel this contract, in whole or in part, or may call upon the Contractor's surety to perform all terms and conditions in the contract, unless the contractor is able to demonstrate his compliance with the terms

of these Special Provisions, and further deny to the Contractor, the right to participate in any future contracts awarded by the Awarding Authority for a period of up to three years.

D. In any proceeding involving the imposition of sanctions by the Awarding Authority, no sanctions shall be imposed if the Awarding Authority finds that the contractor has taken every possible measure to comply with these Special Provisions or that some other justifiable reason exists for waiving these Special Provisions in whole or in part.

E. The contract shall provide such information as is necessary in the judgment of the Awarding Authority to ascertain its compliance with the terms of these Special Provisions.

F. A contractor shall have the right to request suspension of any sanctions imposed under this section upon demonstrating that he is in compliance with these Special Provisions.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## SCHEDULE OF PARTICIPATION FOR SRF CONSTRUCTION

**Project Title:** _____ **Project Location:** _____

**Disadvantaged Minority Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/MBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/MBE Commitment:** | **$** |
| **Percentage D/MBE Participation** = (Total D/MBE Commitment) / (Bid Price) = | | **%** |

**Disadvantaged Women Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/WBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/WBE Commitment:** | **$** |
| **Percentage D/WBE Participation** = (Total D/WBE Commitment) / ( Bid Price) = | | **%** |

The Bidder agrees to furnish implementation reports as required by MassDEP to indicate the D/MBEs and D/WBE(s) which it has used or intends to use. Breach of this commitment constitutes a breach of the contract.

Name of Bidder: _____

Date: _____ By: _____
Signature

NOTE: Participation of a DBE may be counted in only their certified category; the same dollar participation cannot be used in computing the percentage of D/MBE participation and again of D/WBE participation.

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## LETTER OF INTENT FOR SRF CONSTRUCTION

This form is to be completed by the D/MBE and D/WBE and must be submitted by the Bidder no later than close of business on the third business day after notification by the LGU. A separate form must be completed for each D/MBE and D/WBE involved in the project.

Project Title: _____ Project Location: _____

**TO:** _____
(Name of Bidder)

**FROM:** _____
(Please Indicate Status [ ] D/MBE or [ ] D/WBE)

° I/we intend to perform work in connection with the above project as (check one):

[ ] An individual
[ ] A corporation
[ ] Other (explain): _____
[ ] A partnership
[ ] A joint venture with: _____

° It is understood that if you are awarded the contract, you intend to enter into an agreement to perform the activity described below for the prices indicated.

**DBE PARTICIPATION**

| Description of Activity | Date of Project Commencement | $ Amount | % Bid Price |
|---|---|---|---|
| | | $ | % |

° The undersigned certify that they will enter into a formal agreement upon execution of the contract for the above referenced project.

| **BIDDER** | **DBE** |
|---|---|
| (Authorized Original Signature) Date | (Authorized Original Signature) Date |
| ADDRESS: | ADDRESS: |
| TELEPHONE #: | TELEPHONE #: |
| FEIN: | FEIN: |
| EMAIL ADDRESS: | EMAIL ADDRESS: |

**ORIGINALS:**
- **Compliance Mgr. City/Town Project Location**
- **DEP Program Manager for DEP's AAO Director**

*** Attach a copy of current (within 2 years) DBE Certification**

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## DBE CERTIFICATION OF UNITED STATES CITIZENSHIP

For the SRF program, under the EPA Disadvantage Business Enterprise (DBE) Rule, a DBE must be owned or controlled by a socially and economically disadvantaged person that is also a **citizen of the United States** (*See* 40 CFR 33.202). "Ownership" is defined at 13 CFR 124.105 and "control" is defined at 13 CFR 124.106.

DBEs are certified for the SRF program through the Supplier Diversity Office using the federal Department of Transportation (DOT) DBE rules. EPA allows the use of DBEs certified under the DOT rules as long as they are also United States citizens. To ensure compliance with the EPA rule, MassDEP must verify United States citizenship through the completion of the following form for each DBE used on the project.

SRF Project Number _____

Contract Number _____

Contract Title _____

DBE Subcontractor _____

The undersigned, on behalf of the above named DBE subcontractor, hereby certifies that the DBE firm is either owned or controlled by a person or persons that are citizens of the United States.

_____
Printed Name and Title of DBE Signatory

_____
DBE Signature

_____
Date



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**DISADVANTAGED BUSINESS ENTERPRISE**
**PROGRAM DBE SUBCONTRACTOR PARTICIPATION**
**FORM**

The United States Environmental Protection Agency (EPA) requires that this form be provided to all subcontractors on the project. At the option of the subcontractor, this form may be filled out and submitted directly to the EPA DBE Coordinator.

| | |
|---|---|
| NAME OF SUBCONTRACTOR | PROJECT NAME |
| ADDRESS | CONTRACT NO. |
| TELEPHONE NO. | E-MAIL ADDRESS |
| PRIME CONTRACTOR NAME: | |

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

_____

_____

_____

_____

_____

| CONTRACT ITEM NO. | ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR | AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR |
|---|---|---|
| | | |

_____ _____
Subcontractor Signature Title/Date

Equivalent to EPA form 6100-2

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**REQUEST FOR WAIVER FOR SRF CONSTRUCTION**

Upon exhausting all known sources and making every possible effort to meet the minimum requirements for DBE participation, the Bidder may seek relief either partially or entirely from these requirements by submitting a completed waiver package by the close of business on the third business day after notification by the LGU. Failure to comply with this process shall be cause to reject the bid thereby rendering the Bidder not eligible for award of the contract.

General Information

Project Title: _____ Project Location: _____

Bid Opening (time/date) _____

Bidder: _____

Mailing Address: _____

Contact Person: _____ Telephone No. (  ) _____ Ext. _____

Minimum Requirements

The bidder must demonstrate that good faith efforts were undertaken to comply with the percentage goals as specified. The firm seeking relief must show that such efforts were taken appropriately in advance of the time set for opening bid proposals to allow adequate time for response(s) by submitting the following:

A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:

1. names, addresses, telephone numbers and contact dates of all such companies contacted;

2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;

3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/women-focused media detailing the opportunities for participation;

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B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after submission of all required information and documentation, MassDEP shall make a determination, in writing, whether the waiver request is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing.

CERTIFICATION

The undersigned herewith certifies that the above information and appropriate attachments are true and accurate to the best of my knowledge and that I have been authorized to act on behalf of the bidder in this matter.

_____ _____

(authorized original signature) DATE

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DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## STATE REVOLVING FUND LOAN PROGRAM – SCHEDULE OF SUBCONTRACTOR PARTICIPATION

Local Governmental Unit _____

Project Name _____

SRF Identification Number _____

General Contractor _____

Contract Value _____

The United States Environmental Protection Agency (EPA) requires that all SRF borrowers develop and maintain a list of all MBE/WBE and non MBE/WBE subcontractors on the project.

This form must be completed and returned to MassDEP within 90 days of award of the contract.

| Subcontractor | Point of Contact | Mailing Address | Telephone Number | E-Mail Address | MBE | WBE | DBE | Subcontract Value |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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March 24, 2020

**ADDENDUM NO. 7**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 7 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 14 pages and 123 pages of attachments for a total of 137 pages.

**ATTACHMENTS**

1. Orleans_MA-2019-01-Bid Form_Add_7-03-24-20
2. Orleans_MA-2019-01-Sub-id Form_Add_7-03-24-20
3. SECTION 16050, ELECTRICAL WORK - GENERAL
4. SECTION 16110, ELECTRICAL RACEWAY SYSTEMS
5. SECTION 16721, FIRE ALARM SYSTEM
6. SECTION 16724, SECURITY ALARM SYSTEM
7. SECTION 16761, VIDEO SURVEILLANCE SYSTEM
8. SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT
9. DRAWING 00 E-001, ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES
10. DRAWING 00 E-601, ELECTRICAL SCHEDULES I
11. DRAWING 00 E-602, ELECTRICAL SCHEDULES II
12. DRAWING 10 E-001, WWTF – ELECTRICAL SITE PLAN - POWER
13. DRAWING 10E-002, WWTF – ELECTRICAL SITE PLAN - SYSTEMS
14. DRAWING 10 E-003, WWTF – ELECTRICAL SITE PLAN – FIBER NETWORK I
15. DRAWING 10 E-004, WWTF – ELECTRICAL SITE PLAN – FIBER NETWORK II
16. DRAWING 10 E-005, WWTF – ELECTRICAL SINGLE LINE DIAGRAM I – SWBD.10-1
17. DRAWING 10 E-006, WWTF – ELECTRICAL SINGLE LINE DIAGRAM II – MCC.10-1
18. DRAWING 10 E-007, ELECTRICAL SINGLE LINE DIAGRAM II – MCC.10-2

19. DRAWING 10 E-102, WWTF – LOWER LEVEL - POWER PLAN II
20. DRAWING 10 E-103, WWTF – LOWER LEVEL - SYSTEMS PLAN I
21. DRAWING 10 E-104, WWTF – LOWER LEVEL - SYSTEMS PLAN II
22. DRAWING 10 E-201, WWTF – GRADE LEVEL - POWER PLAN I
23. DRAWING 10 E-202, WWTF – GRADE LEVEL – POWER PLAN II
24. DRAWING 10 E-301, WWTF – LOWER LEVEL - SECURITY PLAN I
25. DRAWING 10 E-302, WWTF - GRADE LEVEL - SECURITY PLAN I
26. DRAWING 10 E-604, WWTF – ELECTRICAL RISER DIAGRAMS I
27. DRAWING 10 E-607, WWTF – ELECTRICAL RISER DIAGRAMS IV
28. DRAWING 10 E-608, WWTF – ELECTRICAL RISER DIAGRAMS V
29. DRAWING 10 E-610, WWTF – ELECTRICAL RISER DIAGRAMS VII
30. DRAWING 10 E-613, ELECTRICAL WIRING SCHEMATICS I
31. DRAWING 10 E-614, ELECTRICAL WIRING SCHEMATICS II
32. DRAWING 10 E-617, ELECTRICAL WIRING SCHEMATICS V
33. DRAWING 20 E-602, EQUIPMENT STORAGE FACILITY – WIRING SCHEMATICS
34. DRAWING 99 E-503, ELECTRICAL DETAILS III
35. DRAWING 00 FA-001, FIRE ALARM LEGEND, ABBREVIATIONS AND GENERAL NOTES

**CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS**

1. GENERAL

   A. Sub-Bid Opening – April 22, 2020 at 11:00 a.m.

   B. General Bid Opening – April 29, 2020 at 2:00 pm.

   C. The Bid and Sub-bid Forms in Excel Format may be downloaded from the Tighe & Bond website. You must click on the "pre-qualified" button to access the Forms. Once obtained, in most cases a yellow bar will appear on the top of the screen labeled as "Security Warning". If this occurs, you must select the "Enable Content" button in order to properly utilize the file.

   D. No Pre-Filed Submission of a Sub-bid Form is required on this Project.

2. ADDENDUM NO. 6

   A. Subbid Results, delete the second sentence in its entirety and replace with the following new sentence:

      The addendum will instruct the General Contractor Bidders to carry a specific dollar amount on the Bid Form for subtrades in which the Owner: (a) rejects all sub-bids in a filed sub-bid category; (b) does not receive any subbids in a filed sub-bid category; and/or (c) only receives sub-bids restricted to the use of one or more general bidders, in a particular category.

3. SECTION 00100, ADVERTISEMENT FOR BIDS

   A. Page 00100-1, Paragraph 3.a, first subparagraph, delete the words "…until 2:00 p.m. prevailing time, on April 15, 2020 at which time and place…" and replace with the words "…until 2:00 p.m. prevailing time, on April 29, 2020 at which time and place…".

   B. Page 00100-1, Paragraph 3.b, first subparagraph, delete the words "…until 11:00 a.m. prevailing time, on April 1, 2020 at which time and place…" and replace with the words "…until 11:00 a.m. prevailing time, on April 22, 2020 at which time and place…".

4. SECTION 00410, FORM OF GENERAL BID

   A. Page 00410-1, Paragraph 5., delete subparagraph B. in its entirety and replace with the following new subparagraph:

      B. Bidder shall complete, printout in Landscape Format, and submit the Proposal Form with a combination of typed and handwritten entries. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   B. Page 00410-2, Paragraph 5., delete subparagraph D. in its entirety and replace with the following new subparagraph:

      D. Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com). The bidder is not allowed to submit a Microsoft Excel Proposal Form that has been prices typewritten or written by hand.

   C. Page 00410-6, Item 22., delete Paragraph J. in its entirety and replace with the following new paragraph:

      J. Not Used.

   D. Page 00410-6, Item 22., delete Paragraph K. in its entirety and replace with the following new paragraph:

      K. Not Used

   E. Page 00410-6, Item 22., delete Paragraph O. in its entirety and replace with the following new paragraph:

      O. Not Used

   F. Delete "Orleans_MA-2019-01-Bid Form_Add_6-03-12-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_7-03-24-20" in both hard copy and Microsoft Excel format.

5. SECTION 00420, FORM OF SUBBID

   A. Delete "Orleans_MA-2019-01-SubBid Form_Add_5-02-10-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-SubBid Form_Add_7-03-24-20" in both hard copy and Microsoft Excel format.

6. SECTION 00520, AGREEMENT, ATTACHMENT A - ADDITIONAL FORMS TO BE SUBMITTED WITH THE BID, PART A - INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS

   A. Page 00520A-3, delete Item 2) in its entirety and replace with the following new item:

      2) X - "Broad Form" Comprehensive General Liability including, but not limited to, Bodily Injury, Personal Injury and Property Damage Liability, Full Contractual Liability and liability arising from Explosion, Collapse and Underground Damage and all other applicable insurance necessary to carry out the contractual obligation to proceed under the contract. Provide a minimum limit of liability of $5,000,000.00 utilizing: (a) a standalone certificate or (b) a minimum $2,000,000.00 General Liability Policy combined with Umbrella Policy.

   B. Page 00520A-3, delete Item 4) in its entirety and replace with the following new item:

      4) X - Builder's Risk - Amount of the General Contractor's Contract including a flood sublimit of $1,000,000.

   C. Page 00520A-3, delete Item 5) in its entirety and replace with the following new item:

      5) ___ - Professional Liability/ Errors and Omissions - Not Required.

7. SECTION 01020, ALLOWANCES

   A. Page 01020-2, ARTICLE 1.05 - ALLOWANCES FOR PRODUCTS, Paragraph C., Scheduled Allowances, add the following new allowance:

**SCHEDULED ALLOWANCES**

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 9 | Compressed Air System | $30,000 | A-1 |

8. SECTION 01025, MEASUREMENT AND PAYMENT

   A. Page 01025-7, PART IV – ALTERNATIVES, ITEM A-2 – - FIBER OPTIC CONDUITS AND HANDHOLES, add the following to the end of Paragraph A.:

      The General Contractor on Contract 2019-02, Downtown Area Collection System and Pumping Stations will provide the Fiber Optic Conducts and Handholes between the Limit-of-Work shown of DRAWING 00 C-106, YARD PIPING PLAN II & PROFILE – WWTF to Pumping Station No. 1 to the Limit-of-Work shown on DRAWING 00C-203, YARD PIPING PLAN – EFFLUENT DISPOSAL.

      The General Contractor and Electrical Contractor on Contract 2019-01, Downtown Area WWTF and Effluent Disposal will provide the Fiber Optic Conducts and Handholes within the WWTF Site and within the Effluent Disposal Site. The Electrical Contractor on Contract 2019-01, Downtown Area WWTF and Effluent Disposal will provide the Fiber Optic Cables in the Fiber Optic Conduits and Handholes provided under both Contracts as shown of DRAWING 10 E-003, WWTF – ELECTRICAL SITE PLAN – FIBER NETWORK I and DRAWING 10 E-004, WWTF – ELECTRICAL SITE PLAN – FIBER NETWORK II.

   B. Page 01025-8, PART IV – ALTERNATIVES, ITEM A-3 – TRACER WIRE, add the following to the end of Paragraph A.:

      The Work of this section shall be provided by the General Contractor.

   C. Page 01025-8, PART IV – ALTERNATIVES, ITEM A-4 – SBR TRANSFER PUMP NO. 4, add the following to the end of Paragraph A.:

      All piping, valves and fittings and the like shown in “gray” or “dashed” on the Drawing 10 D-102 - Facility Lower Plan II shall be included as part of the scope of work of Bid Item A-4.

   D. Page 01025-8, PART IV – ALTERNATIVES, ITEM A-5 – SBR BLOWER NO. 4, add the following to the end of Paragraph A.:

      All piping, valves and fittings and the like shown in “gray” or “dashed” on the Drawing 10 D-103 - Facility Lower Plan III shall be included as part of the scope of work of Bid Item A-5.

   E. Page 01025-8, PART IV – ALTERNATIVES, ITEM A-6 – SBR AERATION DIFFUSER GRIDS, add the following to the end of Paragraph A.:

      The Base Bid includes two SBR Diffuser Grids. Bid Item A-6 includes of one additional diffuser grid per SBR tank (2 total). All piping, valves and fittings and the like shown in “bold” on the drawings shall be provided as part of the Base Bid. The Work of Bid Item A-6 does not require electrical work.

9. SECTION 01400, QUALITY ASSURANCE

   A. Page 01400-3, ARTICLE 1.08 – QUALITY CONTROL AND CONTROL OF WORK, add the following new paragraph to the end of the article:

      K. The Contractor’s Project Superintendent, meeting the same QC Manager qualifications, may also act as the QC Manager.

10. SECTION 01600, CONTROL OF MATERIALS

   A. Page 01600- 5, ARTICLE 1.10 – WARRANTY, add the following new paragraph:

      D. Unless otherwise specified in the individual equipment sections that equipment warranties are limited to 12 months from the date of Substantial Completion.

11. SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS

   A. Delete the section in its entirety and replace with the new section as attached.

12. SECTION 01680, PHYSICAL CHECKOUT; SHOP, FIELD AND FUNCTIONAL TESTING

   A. Page 01680-1, ARTICLE 1.01 – SCOPE, add the following new paragraph:

      D. This section shall apply to all components of the facility except as otherwise specified in other sections.

13. SECTION 02444, CHAIN LINK FENCE AND GATES

A. Page 02444-4, ARTICLE 2.01 – MATERIALS, Paragraph H., delete subparagraph 6.k. in its entirety and replace with the following new subparagraph:

k. Gate Access System Controls:

1) Provide gate access system with pushbutton to be located at WWTF Control Room to remotely open/close gate system. Provide gate control panel with hardwired contacts for use with remote pushbutton.

2) Provide (2) keypads for local open/close control of gate. Provide (1) keypad for mounting at passenger car height, and (1) keypad for mounting at truck height. Keypads shall be hardwired to gate control panel for local open/close control of gate. Keypads shall be programmable.

3) Provide intercom system for 2-way remote communication including (1) intercom to be located at WWTF Control Room, (1) intercom for mounting at passenger car height, and (1) intercom for mounting at truck height.

4) The gate shall fail-safe open upon loss of power. In addition, gate shall have a manual by-pass of the gate controller.

B. Page 02444-4, ARTICLE 2.01 – MATERIALS, Paragraph H., delete subparagraph 6.m. in its entirety and replace with the following new subparagraph:

m. Ten (10) openers shall be provided to be used by the Owner during construction. Openers shall be compact, one-button decodable transmitter remote control.

C. Page 02444-3, ARTICLE 2.01 – MATERIALS, Paragraph H., delete subparagraph 6.n. in its entirety and replace with the following new subparagraph:

n. The gate controls shall be reprogrammed following completion of the Project. Twenty (20) openers shall be provided to the Owner. Openers shall be compact, one-button decodable transmitter remote control.

14. SECTION 02520, WICK CONSTRUCTION AND TESTING

A. Page 02520-2, ARTICLE 1.01 - SCOPE, Paragraph E., delete Hub Foundation information and replace with the following new information:

Hub Foundation Co., Inc.
139 Billerica Road
Chelmsford, MA 01824
Phone: 978-456-2387
http://hubfoundation.com/

B. Page 02520-2, ARTICLE 1.01 - SCOPE, add the following as new Paragraph F.:

F. Specialty Contractor utilized for the installation of the existing Wick is:

Desmond Well Drilling, Inc.
5 Rayber Road
Orleans, MA 02653
Phone: 508-240-1000
https://desmondwelldrilling.com/

15. SECTION 02725, MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES

A. Page 02725-4, SECTION 2.06 – MANHOLE FRAMES AND COVERS, delete Item B. and replace with the following new item:

B. Bolted and gasketed manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

16. SECTION 02890, TRACER WIRE

    A. Page 02890, ARTICLE 1.01 – SCOPE, add the following new paragraph:

        C. The Work of this section shall be provided by the General Contractor.

17. SECTION 03300, CAST-IN-PLACE CONCRETE

    A. Page 03300-22, ARTICLE 3.10 – CONCRETE FINISHES, Table 03300-4, Finish Designation, add the following new sentence to the Area Applied:

        Minimum liquid level elevation of the SBR's is 69.00.

18. SECTION 03345, CONCRETE FLOOR TREATMENT

    A. Page 03345-1, ARTICLE 1.01 - SCOPE, add the following new paragraph:

        C. The Work of this section shall be provided by the General Contractor.

19. SECTION 04200, UNIT MASONRY AND ACCESSORIES

    A. Page 04200-2, ARTICLE 1.01, SCOPE, Paragraph B., delete subparagraph 5., in its entirety and replace with the following new subparagraph:

        5. Cavity wall insulation including spray foam insulation shall be provided by the filed sub-bid subcontractor in accordance with SECTION 07200, BUILDING INSULATION.

    B. Page 04200-2, ARTICLE 1.01, SCOPE, Paragraph B., delete subparagraph 19., in its entirety and replace with the following new subparagraph:

        19. Air/Vapor Barrier Membrane. The Air/Vapor Barrier Membrane shall be provided by the filed sub-bid subcontractor. The entire cavity (stone veneer and siding) shall receive the air/vapor barrier against the CMU.

20. SECTION 05500, MISCELLANEOUS METAL

    D. Page 05500-2, ARTICLE 1.00, SUBBID REQUIREMENTS, Paragraph D., add the following Reference Drawing, 99 C-605 with regards to the hatches and 0.33-inch thick steel plates.

    E. Page 05500-11, ARTICLE 2.12 - FALL PREVENTION SYSTEM FOR LADDERS, delete the article in its entirety and replace with the following new article:

        ARTICLE 2.12 - FALL PREVENTION SYSTEM FOR LADDERS – Not Used

    F. Page 05500-12, delete ARTICLE 2.17 – Z-GIRT SYSTEM, in its entirety.

21. SECTION 06200, CARPENTRY

    A. Page 06200-5, add the following new ARTICLE 2.06 – Z-GIRT SYSTEM:

        2.06 – Z-GIRT SYSTEM

            A. Basis of Design: ThermaFast Z-Track

            B. Materials Properties

                i. Design loads: Wind pressure and self-weight of cladding as indicated on the project's Architectural/Structural Drawings and as required by the International Building Code.

                ii. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi (450MPa) minimum tensile strength, with ASTM A653/A653M G90 (Z275) hot dipped galvanized coating.

                iii. Thickness: 54 mil minimum (16 gauge, 0.0566-inch design thickness)

                iv. Thermal Tape: Thickness 1/16-inch, Density 15 lbs/ft3 (ASTM D-1667)

                v. Thermal Conductivity k-factor: 0.3 (ASTM C-518)

22. SECTION 09500, ACOUSTICAL CEILINGS

    A. Page 09500-4, ARTICLE 2.02 - SUSPENSION SYSTEM, delete Paragraph A. in its entirety and replace with the following new paragraphs:

        A. Suspension systems for acoustical units shall be a steel lay-in exposed system and shall conform to the requirements of ASTM Specification C635 heavy duty type. Suspension system shall be completely compatible with the acoustical units and lighting fixtures.

        B. Edge or wall molding shall be steel with colored factory applied vinyl paint finish, with a 3/4 inch reveal as detailed on the drawings, color to be selected by the Engineer. Wall moldings shall have a flange of not less than 15/16 inch and shall be provided with inside and outside corner caps.

        C. Wire shall be zinc-coated, 12 gage steel wire unless otherwise recommended by suspension system manufacturer.

        D. Hangers shall be the sizes and types recommended by the suspension system manufacturer.

23. SECTION 09800, PROTECTIVE COATING

    A. Page 09800-4, ARTICLE 2.03 – STEEL TANKS (PC-2), delete the article in its entirety and replace with the following new article:

        2.03 – STEEL TANKS (PC-3) - Not Used

    B. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), delete Paragraph A., in its entirety and replace with the following new paragraph:

        A. Locations:

            1. Pre-Equalization Tanks

            2. Waste Sludge Storage Tanks

            3. Thickened Sludge Storage Tank

            4. Post-Equalization Tank

    C. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), Paragraph C., delete subparagraph 1.b. in its entirety and replace with the following new subparagraph:

        b. Finish: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 100.0 mils DFT applied in two coats.

    D. Page 09800-5, ARTICLE 2.04 – CONCRETE TANKS (PC-3), Paragraph D., delete subparagraph 1.b. in its entirety and replace with the following new subparagraph:

        b. Topcoat: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 100 mils DFT applied in two coats.

24. SECTION 10506, METAL LOCKERS

    A. Page 10506-3, ARTICLE 2.20 – LOCKER DATA, delete Paragraph A in int entirety and replace with the following new article:

        A. Locations, sizes and quantities as follows.

        1. Location and Quantities: As shown on the drawings.

        2. Size and Type: Men’s and Women’s Room are 15” W x 15” D x 6’ H single tier lockers.

25. SECTION 11140, COMPRESSED AIR SYSTEMS

    A. Page 11140-2, ARTICLE 1.01- SCOPE, Paragraph A., add the following new sentence to the end of the paragraph:

        The Compressed Air System shall be provided as part of the Equipment Storage Facility. The location of the air compressor, hose reels and the like will be determined in the field. All piping shall be surfaced mounted within the Equipment Storage Facility.

B. Page 11140-2, ARTICLE 1.02- MEASUREMENT AND PAYMENT, add the following new paragraph:

B. An allowance is specified in SECTION 01020, ALLOWANCES which is required to be utilized by the Contractor during the preparation of their bid for PART IV – ALTERNATIVES, Item A-1 - Addition of the Equipment Storage Facility. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Compressed Air System. Paid invoices from the equipment suppliers and detailed labor, materials and supplies worksheets shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

26. SECTION 11333, SEPTAGE RECEIVING STATION

A. Page 11333-17, ARTICLE 3.04 – WARRANTY, Paragraph B., add the following new sentence to the end of the paragraph:

The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

27. SECTION 11365, ROTARY DRUM THICKENERS

A. Page 11365-2, ARTICLE 1.10 - SCOPE, Paragraph C., add the following new sentence to the end of the paragraph:

The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

28. SECTION 11399, EFFLUENT DISK FILTERS

A. Page 11399-17, ARTICLE 3.04 – WARRANTY, Paragraph C., add the following new sentence to the end of the paragraph:

The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

29. SECTION 11600, SEQUENCING BATCH REACTORS

A. Page 11600-23, ARTICLE 3.04 – WARRANTY, delete Paragraph B. in its entirety and replace with the following new paragraph:

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

30. SECTION 11324, CHEMICAL PERISTALTIC METERING PUPS AND APPURTENANCES

A. Page 11324-5, ARTICLE 2.01 – SYSTEM DESCRIPTION, Paragraph B.1., add the following to the end of the subparagraph:

The Owner will provide the totes, filled with the proper chemicals, for facility start-up and operation.

B. Page 11324-5, ARTICLE 2.01 – SYSTEM DESCRIPTION, Paragraph C.1., add the following to the end of the subparagraph:

The Owner will provide the totes, filled with the proper chemicals, for facility start-up and operation.

31. SECTION 11326, MECHANICALLY CLEANED FINE SCREENS AND APPURTENANCES

    A. Page 11326-7, ARTICLE 2.04 - FINE SCREEN CONSTRUCTION, Paragraph A.1., delete the words "Provide spiral constructed of high-strength carbon steel." and replace with the following new words "Provide spiral constructed of high-strength AISI Type 316L stainless steel."

    B. Page 11326-7, ARTICLE 2.04 - FINE SCREEN CONSTRUCTION, Paragraph B., delete the words "…of perforated 14 gage Type 316L stainless..." and replace with the following new words "…of perforated 14 gage (minimum) Type 316L stainless 316L stainless…."

32. SECTION 11398, DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

    A. Page 11398-1, ARTICLE 1.01 – SCOPE, add the following new paragraph:

        K. The Work of this section shall include the Physical Checkout, Inspection and Certification as specified in SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

33. SECTION 12484, ENTRANCE FLOOR MATS AND FRAMES

    A. Delete the Section in its entirety.

34. SECTION 15900, HVAC CONTROL SYSTEMS

    A. Page 15900-2, ARTICLE 1.01 – SCOPE, delete subparagraph G.1 and replace with the following new subparagraph:

        1. All HVAC control system equipment, devices, hardware and software shall be manufactured by either Alerton Controls, Allen-Bradley, Siemens, or Schneider Electric. Unless otherwise indicated, HVAC control system products shall be by only one of these manufacturers and there shall be no mixing of products by different manufacturers, except as permitted by the selected manufacturer amongst the three named hereinabove.

    B. Page 15900-25, ARTICLE 2.16 – CONTROL WIRING, delete subparagraph B.1.c. in its entirety.

35. SECTION 16050, ELECTRICAL WORK - GENERAL

    A. Delete SECTION 16050, ELECTRICAL WORK - GENERAL in its entirety and replace with the attached new section.

36. SECTION 16110, ELECTRICAL RACEWAY SYSTEMS

    A. Delete SECTION 16050, ELECTRICAL WORK - GENERAL in its entirety and replace with the attached new section.

37. SECTION 16721, FIRE ALARM SYSTEM

    A. Add new SECTION 16721, FIRE ALARM SYSTEM as attached.

38. SECTION 16724, SECURITY ALARM SYSTEM

    A. Add new SECTION 16724, SECURITY ALARM SYSTEM as attached.

39. SECTION 16761, VIDEO SURVEILLANCE SYSTEM

    A. Add new SECTION 16761, VIDEO SURVEILLANCE SYSTEM as attached.

40. SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

    A. Delete SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT in its entirety and replace with the attached new section.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWINGS 99 C-504 – DETAILS IV, add the following new note:

    2. The Double Leaf Steel Gate shall be provided under SECTION 00500 MISCELLANEOUS METAL.

2. DRAWING 10 A-103, ROOF PLAN, add the following new note:

   Note: Truss Manufacturer to provide gable end trusses at all gable roofs flush with exterior face of CMU. Exterior wall construction at the gables above the masonry construction is similar.

3. DRAWING 10 A-505 – EXTERIOR SECTIONS DETAILS

   A. Typical Chimney Detail, add the following new note:

      3. The metal chimney cap is not a prefabricated item and therefore is required to be fabricated. The following are design criteria for the fabrication:

         a. Size: Match the exterior dimension shown for each respective chimney.

         b. Height of opening are determined by HVAC drawings and louver openings.

         c. Material: Painted Aluminum (see requirements in SECTION 05500 – MISCELLANEOUS METAL).

         d. The cap slope for the top should be a 3:12 pitch so as to shed water and snow.

4. DRAWING 10 A-601, ROOM FINISH SCHEDULE

   A. Delete Room No. 104 and Room No. VEST-1 in its entirety and replace with the following new information:

| Room Number | Room Name | Floor | | Wall | |
|---|---|---|---|---|---|
| | | Material | Finish | Material | Finish |
| 104 | Sodium Hypochlorite / PACL Room | EFC | --- | PT | --- |
| VEST-1 | Vestibule | VF | TBD | PT | TBD |

| Ceiling | | Base | | |
|---|---|---|---|---|
| Material | Finish | Material | Finish | Notes |
| FRP | --- | --- | --- | |
| ACT | TBD | PVC | TBD | Surface Entry Mat |

5. DRAWING 00 D-003, PROCESS PIPING SCHEDULE

   A. Add the following new Pipe to the schedule:

| Legend | Service | System Design Conditions | | | |
|---|---|---|---|---|---|
| | | Temp. (Deg. F) | | Pressure (PSI) | |
| | | Oper. | Max. | Work. | Max |
| INF | Raw Wastewater | 40 | 80 | --- | --- |

| Piping | | | | |
|---|---|---|---|---|
| Material | Diameter Range | Sch./Class | Lining/Coating | Joint Type |
| Ductile Iron | All | See Specs. | Cement | Flanges/Restrained Mechanical Joint |

| Insultation | | Valving | | |
|---|---|---|---|---|
| Type | Thickness (In.) | Block | Check | Throttling |
| --- | --- | --- | --- | --- |

| Test Requirements | | | | Specs. Section Number | Remarks |
|---|---|---|---|---|---|
| Pressure (PSI) | Medium | Test Duration (Min.) | Leakage Allowance (See Notes) | | |
| 150 | Water | 60 | Zero | 02615 | --- |

6. DRAWING 00 D-006, PROCESS FLOW DIAGRAM I, add the following new note:

   Note: SA is the location of where Soda Ash (SA) will be manually added, as required, by the operating staff.

7. DRAWING 10 D-101, FACILITY LOWER PLAN I, add the following new note:

   Note: The 1" Polymer lines shall be run in the Basement Pump Room (Room 126) up to the Polymer Room (Room 117) through the pipe chase located at Column Line 5 and about 9' south of Colum Line D. The Polymer piping shall not run through the Pre-Equalization Tank No. 1.

8. DRAWING 10 D-304, SECTIONS IV, Section 4, SBI, delete the words "8" x 9" RED" and replace with the words "8" 90 Deg. S.R. ELL. FLG. x FLR.".

9. DRAWING 10 D-304, SECTIONS IV, add the following new note:

   Note: Refer to plan Drawing 10 D-105 for Section No. 4 and Section No. 5. Section No. 4 shows the 10" OC piping penetrating the floor as intended. Section No. 5 is cut behind Section No. 4, showing the 10" OC pickup, in the foreground, terminating above the finished floor of the Headworks Room.

10. DRAWING 10 D-307, SECTIONS VII, Section 7, TSL, delete the words "8" x 9" RED" and replace with the words "8" 90 Deg. L.R. ELL. FLG. x FLR."

11. DRAWING 15 D-104, SBR UPPER PLAN II, add the following new note:

    Note: Revise the 6-inch SBI piping configuration to be at EL. 75.00

12. DRAWING 00 E-001, ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

13. DRAWING 00 E-601, ELECTRICAL SCHEDULES I

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

14. DRAWING 00 E-602, ELECTRICAL SCHEDULE II

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

15. DRAWING 10 E-001, WWTF – ELECTRICAL SITE PLAN – POWER

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

16. DRAWING 10 E-002, WWTF - ELECTRICAL SITE PLAN - SYSTEMS

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

17. DRAWING 10 E-003, WWTF ELECTRICAL SITE PLAN – FIBER NETWORK I

    A. Delete the drawing in its entirety and replace with the new drawing as attached.

18. DRAWING 10 E-004, WWTF ELECTRICAL SITE PLAN – FIBER NETWORK II
    A. Delete the drawing in its entirety and replace with the new drawing as attached.
19. DRAWING 10 E-005, WWTF – ELECTRICAL SINGLE LINE DIAGRAM I – SWBD.10-1
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

B. DRAWING 10 E-006, WWTF – ELECTRICAL SINGLE LINE DIAGRAM II – MCC.10-1
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

C. DRAWING 10 E-007, ELECTRICAL SINGLE LINE DIAGRAM II – MCC.10-2
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

D. DRAWING 10 E-102, WWTF – LOWER LEVEL - POWER PLAN II
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

E. DRAWING 10 E-103, WWTF – LOWER LEVEL -SYSTEMS PLAN I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

F. DRAWING 10 E-104, WWTF – LOWER LEVEL -SYSTEMS PLAN II
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

G. DRAWING 10 E-201, WWTF – GRADE LEVEL -POWER PLAN I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

H. DRAWING 10 E-202, WWTF – GRADE LEVEL – POWER PLAN II
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

I. DRAWING 10 E-301, WWTF – LOWER LEVEL - SECURITY PLAN I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

J. DRAWING 10 E-302, WWTF – GRADE LEVEL – SECURITY PLAN I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

K. DRAWING 10 E-604, WWTF – ELECTRICAL RISER DIAGRAMS I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

L. DRAWING 10 E-607, WWTF – ELECTRICAL RISER DIAGRAMS IV
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

M. DRAWING 10 E-608, WWTF – ELECTRICAL RISER DIAGRAMS V
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

N. DRAWING 10 E-610, WWTF – ELECTRICAL RISER DIAGRAMS VII
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

O. DRAWING 10 E-613, ELECTRICAL WIRING SCHEMATICS I
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

P. DRAWING 10 E-614, ELECTRICAL WIRING SCHEMATICS II
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

Q. DRAWING 10 E-617, ELECTRICAL WIRING SCHEMATICS V
    A. Delete the drawing in its entirety and replace with the new drawing as attached.

R. DRAWING 20 E-602, EQUIPMENT STORAGE FACILITY – WIRING SCHEMATICS

   A. Delete the drawing in its entirety and replace with the new drawing as attached.

S. DRAWING 99 E-503, ELECTRICAL DETAILS III

   A. Delete the drawing in its entirety and replace with the new drawing as attached.

T. DRAWING 00 FA-001, FIRE ALARM LEGEND, ABBREVIATIONS AND GENERAL NOTES

   A. Delete the drawing in its entirety and replace with the new drawing as attached.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 7**

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Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

Company's Name

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Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of<br>$ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of<br>$ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of<br>One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as speficied, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as speficied, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as speficied, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishng Section 11365 - Rotary Drum Thickeners, as speficied, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD** - The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraints will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding its fudning constraints. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in June 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive**

**$** -

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | |
| | | **$** | | - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | |
| | | **$** | | - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | |
| | | **$** | | - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A1. | For Addition of the Equipment Storage Facility, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-1** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories, and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09900, Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

Date:

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

**PART I - BASE BID**

1. The work of the Subbidder for all Work for the WWTF other than that covered by other items, as specified, the lump sum of

$ - l.s.

2. The Work of the Subbider including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of

$ - l.s.

**TOTAL OF PART I - BASE BID**

$ -

**PART II - ALTERNATIVES**

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

$ - l.s.

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

$ - l.s.

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

$ - l.s.

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

$ - l.s.

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

$ - l.s.

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

$ - l.s.

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

_____ may be used by any General Bidder except:

_____

_____ may only be used by the following General Bidders:

_____

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

_____

Class of Work:

_____

Bid Price:

_____

2 Name:

Class of Work:

Bid Price:

3. Name:

Class of Work:

Bid Price:

4. Name:

Class of Work:

Bid Price:

5. Name:

Class of Work:

Bid Price:

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name _____

2. Ever failed to complete any work awarded? _____

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

b) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

c) Project

Engineer or Architect

General Contractor

Amount of Contract

d) Project

Engineer or Architect

General Contractor

Amount of Contract

e) Project

Engineer or Architect

General Contractor

Amount of Contract

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

**SECTION 01650**

**FACILITY START-UP AND TESTING REQUIREMENTS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Contractor shall be responsible for furnishing of all labor, equipment, appliances and materials and performing all operations in connection with the facility testing and inspection and startup and performance testing prior to final acceptance of all process systems, including the coordination of all performance tests and the furnishing of operating instructions for all equipment.

B. Start-up and Testing Requirements for individual equipment systems shall be as indicated for all equipment as specified in individual sections in DIVISION 11 - EQUIPMENT, DIVISION 15 - MECHANICAL and DIVISION 16 - ELECTRICAL.

C. HVAC systems shall be tested and balanced in accordance with DIVISION 15, MECHANICAL. Fire Protection Systems shall be commissioned in accordance with DIVISION 10, SPECIALTIES and DIVISION 15, MECHANICAL.

D. Electrical and Fire Alarm tests shall be performed as specified in DIVISION 16 - ELECTRICAL.

E. The Instrumentation and Control System tests shall be performed as specified in DIVISION 13 - SPECIAL CONSTRUCTION

F. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 1, GENERAL REQUIREMENTS, Specification Sections, apply to this section

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

10. “Shop Testing” shall mean testing that is done by the manufacturer either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment meets the requirements of the pertinent technical specification(s). All costs associated with Shop Testing shall be at no additional cost to the Owner.

11. “Physical Checkout, Inspection and Certification” shall mean the process of physically inspecting products by the Contractor and manufacturer/supplier after they have been installed in the work, and then certifying that the products have been properly and completely installed and are ready for field and/or start-up. All costs associated with Physical Checkout, Inspection and Certification shall be at n0 additional cost to the Owner.

12. “Field Testing” or “Functional Testing” shall mean testing that is performed by the Contractor and manufacturer/supplier on process equipment that has been installed in the work and after the Physical Checkout, Inspection and Certification, for the purpose of proving that the tested products meet the requirements of the pertinent technical specifications. All costs associated with Field Testing or Functional Testing shall be at no additional cost to the Owner.

13. “System Testing” shall mean testing performed on a "system" comprised of two or more pieces of equipment, after the equipment has been installed in the work, and after Physical Checkout, Inspection and Certification and Field Testing has been completed, for the purpose of providing that the system meets requirements as specified and as indicated. All costs associated with System Testing shall be at n0 additional cost to the Owner.

14. “Clear Water Testing” shall mean a test conducted on all items and systems performed with portable water after Physical Checkout, Inspection and Certification, Field Testing and System Testing have been satisfactorily conducted by the Contractor and manufactures/suppliers and the they are satisfied that the equipment is operating as specified. All costs associated with Clear Water Testing shall be at no additional cost to the Owner except as specified herein.

15. “Start-up” shall mean the initial operation of the completed facility and processes by the Owner, utilizing wastewater and related substances (sludge, wastewater, scum), or other media which the facility has been designed to process.

16. “Performance Testing” shall mean testing performed by the Contractor and manufacturers/supplies to verify performance of the individual components under actual operating conditions. The tests shall indicate compliance with the performance requirements in the individual specification sections. All costs associated with Performance Testing shall be at no additional cost to the Owner.

17. “Final Acceptance” shall mean passing of the Performance Testing of individual components under actual operating conditions.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data and certificates in accordance with SECTION 01300, SUBMITTALS and as specified herein.

2. Detailed specific start-up plans for each mechanical or process system.

**1.05 - SHOP TESTING**

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty days written notice indicating the time and place of testing. Submit the following for approval thirty days prior to this notice.

1. Description of the Test - Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing Devices That Will be Used in the Tests - Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience shall be submitted. As a minimum, personnel shall have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.

4. Schedule for Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Submit all forms used to record and report on shop test data, for approval, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall conform to the Engineer's format for heading and check off sections. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have me the required criteria, and that the equipment will operate as indicated and as specified.

B. Shop test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the shop test procedure and proposed test date. The Contractor will be notified, in writing by the Engineer, if a formal resubmission is required with the transmittal of the review comments.

C. Submit the following within one week after completion of the tests for approval:

1. Completed test forms, for each device tested, on forms as approved prior to the test.

2. Completed certification, the content of which was approved prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

**1.06 - PHYSICAL CHECKOUT, INSPECTION AND CERTIFICATION**

A. When required by the technical specifications, perform field or functional testing on installed equipment. If none are required by the technical specifications, complete field / functional testing as detailed below. Field / functional testing shall be in addition to and not in lieu of, any shop testing either required or otherwise performed. Perform testing as a part of the overall testing process defined herein. However, the following specific instructions shall also apply. Provide thirty days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces.

Submit with this notice the following for approval by the Engineer:

1. Description of the Tests - Outline how the test will conform to the requirements in the technical specifications.

2. Testing Devices That Will Be Used in the Tests - Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience. As a minimum, personnel must have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.

4. Schedule of Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Review and comment on all forms provided by the Engineer for recording reporting on the field test data, prior to the test.

6. Material and Equipment Required for the Test - This material and equipment shall be supplied by the Contractor or his/her subcontractors at no additional cost to the Owner.

7. Water and Power Requirements - Water and power requirements shall be identified in the plan by the Contractor and will be supplied by the Contractor for field testing purposes only. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water.

8. Disposal of Waste – The Contractor is responsible for the legal disposal of all wastes generated from the testing.

B. Field test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Engineer if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Engineer for approval.

1. Completed test forms for each device tested on forms provided prior to the tests.
2. Completed certification documentation, the content of which was approved prior to the tests.
3. A written summary of testing, reporting on the results and summarizing the entire procedure.
4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

D. Minimum Field Test Requirements

1. Calibrate equipment as required. For pumps, use water as a calibration liquid.
2. Test equipment and systems through a normal start, normal stop, and all emergency shutdown sequences.
3. Complete a four-hour running test. For variable speed units, the test shall include running for three complete cycles of one-hour duration at the maximum and minimum speeds for one half of each of those cycles. Operate each system through its normal automatic sequence of operation. During the four-hour test, observe and record all level indications, flow indicators, and pressure indicators.
4. If the equipment utilizes a local programmable logic controller (PLC), verify that the PLC is capable of operating and controlling the system as specified in the individual specification sections. Also verify all communications with distributed control system (DCS) are as specified.
5. For equipment not supplied with a PLC, verify that the instrumentation and control system is capable of operating and controlling the system.
6. Check safety devices, and interlocks for satisfactory operation. Check instrumentation and control systems for conformance with the Specifications.
7. Check for system leaks and proper valve operation.
8. Demonstrate to the Owner's Representative that all temporary jumpers and/or bypass have been removed and that all of the components are operating under their own controls as designated.
9. Coordinate start-up activities with the Owner's representative and with the Engineer prior to commencing system start-up.

E. Motor Testing

1. Visually inspect the motor for any physical damage.
2. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.
3. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and the results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

F. Engine Generator Test

1. Visual and Mechanical Inspection.
    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect correct anchorage and grouting.

2. Electrical and Mechanical Tests.

   a. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE Standard 43. Calculate polarization index.

   b. Test protective relay per applicable NETA standards.

   c. Perform phase-rotation test to determine compatibility with load requirements.

   d. Functionally test engine shutdown for low oil pressure, over temperature overspeed, and other features as applicable.

   e. Conduct performance test in accordance with ANSI/NFPA Standard 110, (Installation Acceptance).

   f. Verify correct function of governor and regulator.

   g. Test circuit breakers per applicable NETA standards.

G. Upon completion of installation of all permanent equipment and related shop and field testing, the manufacturer's technical service representative shall inspect and, as necessary, adjust and/or calibrate the equipment. The inspection shall consider the completeness and integrity of the installation, the alignment and clearances of the equipment parts with respect to each other, and the sufficiency of any required sealing, lubricants or packing.

H. The technical service representative shall submit the results of the inspection including certification that the equipment was properly installed and is operating as specified and as installed. The report should verify that the equipment is ready for sustained operation and free from defects that would render the guarantee null and void.

**1.07 - FIELD TESTING OR FUNCTIONAL TESTING**

A. Field Testing or Functional Testing shall be made at on each piece of process equipment.

B. Field Testing or Functional Testing shall be conducted by the Contractor and manufacturer/supplier utilizing portable water to demonstrate to the satisfaction of the Engineer that the equipment is ready for System Testing.

C. Fourteen days' notice of scheduled start-up of individual equipment items or mechanical systems, the Contractor shall prepare a schedule of activities and provide the schedule to the Engineer for review and approval. The following representatives, as appropriate, shall be present simultaneously for the Field Testing or Functional Testing

   1. General Contractor;

   2. Electrical Subcontractor;

   3. Equipment Manufacturer's Technical Service Representative;

   4. Instrumentation and Control Equipment Representative;

   5. System Integrator; and

   6. Owner, OPM and Engineer.

D. The following must be completed prior to start-up and testing:

   1. Controls and alarm systems shall be tested to show it is capable of transmitting and annunciating all specified control points to the facility-wide SCADA system;

   2. All safety equipment shall be installed and operating properly;

   3. Training of Contractor Operator personnel by manufacturer's technical service representatives has been completed; and

   4. All spare parts, tools, lubricants shall be delivered to the Owner.

   5. Installation drawings delivered to the Owner.

E. The Contractor shall, upon orders by the Engineer, startup, adjust and place in satisfactory operation all equipment constructed under this contract. At the discretion of the Engineer, individual startups may be required for various phases of the work or individual systems. The Engineer may order the start-ups prior to the completion of non-essential items of work.

F. As soon as practical after the initial start-up, the Contractor shall arrange for the manufacturer's representatives to perform all field tests and complete all additional training.

**1.08 - SYSTEM TESTING**

A. System Testing shall be made after all equipment that comprises of a complete system has been installed and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and manufacturer/supplier and the Contractor is satisfied that the equipment is operating as specified. System are identified as follows:

1. Liquid Stream (Influent Screen, Pre-Equalization Tanks, Mixing Blowers, SBR Transfer Pumps, SBRs and SBR Blowers) as shown on Drawing 00 D-006 - Process Flow Diagram I and Drawing 00 D-007 - Process Flow Diagram II;

2. Effluent Stream (Disk Filters, Post Equalization Tank, Post Equalization Tank Mixers, Effluent Pumps, UV System and Effluent Disposal) as shown on Drawing 00 D-007 - Process Flow Diagram II;

3. Plant Water (Plant Water System, Bladder Tank, Foam Spray Pump and Plant Water Storage Tank) as shown on Drawing 00 D-007 - Process Flow Diagram II;

4. Septage Receiving (Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-008 - Process Flow Diagram III;

5. Sludge Processing (Sludge Transfer Pumps, Rotary Drum Thickeners, Polymer Feed System, Thickened Sludge Storage Tank, Mixing Bowers and Thickened Sludge Pumps) as shown on Drawing 00 D-008 - Process Flow Diagram III; and

6. Odor Control (Odor Control System and Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-009 – Odor Control Air Flow Diagram.

B. The successful performance of all systems shall be demonstrated to the satisfaction of the Engineer by completing the System Testing utilizing portable water. Unless especially required in technical specifications, the System Testing will consist of operating each system for an uninterrupted four hours or as otherwise specified.

C. Failure of equipment to operate as specified will require the System Test to be reperformed for the full period. At no time during the System Testing shall any equipment or system be operated under a more severe condition than the maximum design condition for which the equipment is rated.

**1.09 - CLEAR WATER TESTING**

A. Clear Water Testing (4-hour) shall be conducted on all items and systems shall be made after all equipment has been installed for a given unit process and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and the Contractor is satisfied that the equipment is operating as specified.

B. Clear Water Testing shall not be conducted until completion of the “Certification of Proper Equipment Installation” by the Equipment Manufacturer and “Verification of Manufacturer’s Training” (Refer to SECTION 01030, SPECIAL REQUIREMENTS on each piece of process equipment.

C. The Contractor shall continue to conduct the Clear Water Test until the test has successfully run for 4 continuous hours.

D. The Contractor is responsible for all repairs and/or replacement of equipment and/or components of the equipment that does not function in accordance with the Contract Documents, approved shop drawings and manufacturer’s operational requirements.

E. The Contractor is responsible for all costs associated with conducting the 4-hour Clear Water Test including but, not limited to, labor, equipment, tools and supplies except as follows:

1. The Contractor is responsible for making all arrangements and gathering necessary permissions from the Owner's water district for use of water.
2. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and shall be borne by the Contractor.
3. The water is obtained from the Owner ate not cost but, the water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

F. The Clear Water Test shall be performed with the OWNER, OPM, ENGINEER, Contract Operator and MassDEP in attendance. The Clear Water Test shall be scheduled at least twenty-one (21) days in advance so that OWNER, OPM, ENGINEER, Contract Operator and MassDEP personnel can be present.

**1.10 - SUBSTANTIAL COMPLETION**

A. Issuance of Substantial Completion shall occur following the successful completion of Clear Water Testing.

**1.11 – START UP**

A. Contract Operations

1. The Town of Orleans, Massachusetts will seek proposals from qualified firms capable of providing full-service operation and maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.
2. Operation and Maintenance services will be provided in a safe, secure, effective and efficient manner and will be in full compliance with GWDP Permit requirements of the MassDEP, applicable laws of the Commonwealth of Massachusetts and regulations of the Massachusetts Department of Environmental Protection.
3. Procurement of the Contract Operator is anticipated to be completed July 2021. Personnel from the Contractor Operator will be on-site during the last 6 to 8 months of construction to observe and/or be involved with the following:
    a. Construction Activities;
    b. Physical Checkout, Inspection and Certification;
    c. Field Testing or Functional Testing;
    d. Training;
    e. System Testing; and
    f. Clear Water Testing.
4. The Contract Operator is a separate contract directly between the Town and a third-party Service Provider and is not part of the scope of work of this Project.

B. Operation and Maintenance

1. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the OWNER will notify Property Owners that they have up to one year to connect into the wastewater system.
2. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the Contract Operator will be responsible for Start-up and Operation and Maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.

3. Operation and Maintenance shall include, but not be limited to, the following

   a. Staffing – Number and Qualifications Required by MassDEP.

   b. Maintenance - Building and Grounds, Equipment, etc.;

   c. Maintain the Inventory of Spare Parts, Tools and Supplies, and the like;

   d. Process Control – SCADA System, Sampling and Analysis, etc.;

   e. Septage Receiving and Processing;

   f. Sludge Processing and Legal Disposal;

   g. Consumables – Power, Chemicals and the like; and

   h. Training of their Personnel –Additional Training (i.e. Safety Program, Standard Operating Procedures, etc.) Not Including Training Specified and Conducted by the Contractor and Manufacturers/Suppliers.

**1.12 - PERFORMANCE TESTING**

A. Performance Testing by the Contractor shall occur within the one-year warranty period but shall not occur until an average of 50,000 gpd of raw wastewater is being received at the facility. The Performance Testing will occur as soon as an average of 50,000 gpd of raw wastewater being received at the facility.

B. Since the facility may be underloaded during start-up, the following is required:

   1. The Contractor shall coordinate the stat-up activities with the SBR manufacturer, Aqua Aerobics.

   2. The system will be started-up by placing one SBR reactor in service.

   3. Aqua Aerobics has run a preliminary design scenario for the reactor at its lowest loading to determine the quantity of seed required to be obtained by the Contractor. Refer to the attachment to this section.

      a. The design shows how much flow from the Pre-Equalization Tanks(s) is required for the SBR biology to be self-sustaining.

      b. This is an estimate based on a blend of raw wastewater entering the facility and flow from the Septage Receiving Station.

C. Performance Tests and Performance Criteria: Specific performance testing criteria are listed for specific equipment and systems in the Division 11 through Division 16 specifications. Compliance with these performance test requirements shall be demonstrated during the full system testing or otherwise demonstrated prior to substantial completion.

D. In the event of a failure to demonstrate satisfactory facility performance on the first or any subsequent attempt, it shall be the responsibility of the Contractor to make all the necessary and required changes, replacements, and tests to make the units meet the specified operating and efficiency requirements.

E. If equipment is unable to operate, initial calibration and/or additional adjustments are required, or representatives are absent, the start-up or tests shall be canceled at that time and full rescheduling will be required. Damages shall be assessed to the Contractor for time and expenses wasted on scheduling, coordinating and attending the failed performance test by the Owner, OPM, Engineer and Manufacturer Representatives.

F. Once the complete facility system has successfully passed the Performance Testing, the Contractor can submit a request for payment for money withheld (five percent of the equipment purchase price minus value of warranty work) for the following:

   1. SECTION 11333, SEPTAGE RECEIVING STATION

   2. SECTION 11365, ROTARY DRUM THICKENERS

   3. SECTION 11399, EFFLUENT DISK FILTERS

   4. SECTION 11600, SEQUENCING BATCH REACTORS

**1.12 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING**

A. The Contractor shall not operate any of the existing facilities at any time. This shall include the starting and stopping of equipment or opening and closing of valves. Whenever the Contractor believe their work will affect or be impacted by the existing facilities operation, they shall so notify the Engineer in writing three (3) working days prior to the intended start of the work. This notification shall clearly detail the work to be completed, the method by which the existing facilities operation may be impacted, and the assistance requested of the Owner.

B. Contractor's Responsibilities: The Contractor shall be responsible for furnishing and installing all of the several kinds and types of equipment required in the treatment facilities, and for testing each individual piece of equipment, all combinations of equipment as they may operate one in conjunction with another, and the complete system, such that each component and the total unit may operate in an acceptable fashion to the Engineer, the Owner, and to any other municipal, State or Federal authorities within whose jurisdiction the operation of the facility may be a concern, at no additional costs to the Owner:

1. Develop specific start-up plans and schedule.
2. Provide specific start-up material and operating supplies until substantial completion. Supplies include lubricants, chemicals, gases, specialized fluids, electric power, water and all other required appurtenances.
3. Provide all specified third-party testing and laboratory costs at no additional costs to the Owner.
4. Provide manufacturer's representative to provide guidance during performance testing.
5. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the start-up and performance testing.
6. Provide the necessary craft or labor assistance, in the event of an emergency equipment failure requiring immediate attention, (emergency is defined as a failure of function which precludes the further operation of a critical segment of; or the whole of the work) with a response time of not less than four hours from the time of notification. The time of notification is defined as the time of contact between the Engineer's representative and the Contractor's representative.
7. Correct all failures or equipment problems identified during start-up when notified by the Engineer. Resolve and correct all equipment or system failures during the performance testing.
8. Provide manufacturer's representatives and operating supplies for retesting of systems that fail to pass the initial performance tests due to deficiencies in products or workmanship at no additional cost to the Owner.
9. Provide training as specified.
10. Prior to starting the start-up and testing, the Contractor shall provide and field calibrate certified flow meters (by using volumetric calibration), flow recorders, all electrical meters, and electrical recorders. The Contractor shall provide a test procedure, wiring diagram of field test recorders and instrumentation, and a field calibration report on the installed meter.
11. Review procedures for performance testing.
12. Attend meetings related to the review of start-up plan(s).
13. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract Documents.

C. The Owner's Responsibilities

1. Assist in the start-up testing activities. The Owner will endeavor to be cooperative with the Contractor when required. However, it is emphasized that the existing facilities operations and treatment take precedence and only requests that do not adversely affect the flow or treatment will be considered. Additionally, any assistance given to the Contractor must be completed when the Owner's schedule and manpower permit. There may be instances when the Owner cannot provide assistance at the time of the Contractor's request and this shall not be the basis for a claim by the Contractor.
2. Provide staff to operate and maintain equipment, systems, and facilities requiring start-up.

**1.13 - TREATMENT EQUIPMENT USAGE**

A. Any partial or full usage of the proposed equipment by the Contractor, and/or his employees or agents, prior to acceptance shall be the responsibility of the Contractor.

**1.14 - OPERATIONAL EXPENSES**

A. During the construction stage and start-up period, before Substantial Completion, the Contractor shall bear all expenditures and operational expenses of all systems included in the project including, but not limited to, labor, equipment, tools, electrical power, chemicals, maintenance, and fuel.

B. The Contractor shall be responsible for the proper handling, sampling, and lab testing and analysis from the testing and start-up of facility processes.

C. During Performance Testing, the Contractor shall bear the costs for Contractor and manufacturer/suppliers, including but not limited to labor, equipment and tools.

**1.15 - GUARANTEE**

A. The Contractor shall guarantee the materials and equipment furnished and the performance thereof to be in accordance with the requirements of the Contract Documents.

B. The Contractor agrees upon written notice to make promptly and without charge, all necessary changes, corrections, and replacements (including installation of replacement parts) required to make good all defects developing in the material or equipment, under ordinary use and proper care, within a period of twelve months after substantial completion of the Project.

**PART 2 - PRODUCTS**

**2.01 - TEST EQUIPMENT**

A. The Contractor shall provide all test equipment, including kWh demand meters and recorders, instruments, analyzers, handling equipment, etc., required to sample and test the various systems. All test equipment must have been tested and calibrated within six months of their use on this contract.

**PART 3 - EXECUTION – Not Used**

**END OF TEXT**

See Attachment

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# AquaSBR - Sequencing Batch Reactor - Design Summary

**Design#: 158326**

**Project:** ORLEANS MA

**Option:** Sample Start up Conditions for SBR

*Designed by Tamera Knapp on Thursday, November 7, 2019*

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

## DESIGN INFLUENT CONDITIONS

**Avg. Design Flow** = 0.05 MGD = 189 m3/day

**Max Design Flow** = 0.05 MGD = 189 m3/day

## DESIGN PARAMETERS

| | Influent | mg/l | Effluent Required | <= mg/l | Effluent Anticipated | <= mg/l |
|---|---|---|---|---|---|---|
| **Bio/Chem Oxygen Demand:** | BOD5 | 200 | BOD5 | 15 | BOD5 | 15 |
| **Total Suspended Solids:** | TSS | 200 | TSS | 15 | TSS | 15 |
| **Total Kjeldahl Nitrogen:** | TKN | 40 | -- | -- | -- | -- |
| **Total Nitrogen:** | -- | -- | TN | 7 | TN | 7 |
| **Phosphorus:** | Total P | 4 | -- | -- | -- | -- |

## SITE CONDITIONS

| | Maximum | Minimum | Design | Elevation (MSL) |
|---|---|---|---|---|
| **Ambient Air Temperatures:** | 77 F 25.0 C | 30 F -1.1 C | 77 F 25.0 C | 60 ft |
| **Influent Waste Temperatures:** | 68 F 20.0 C | 50 F 10.0 C | 68 F 20.0 C | 18.3 m |

## SBR BASIN DESIGN VALUES

**No./Basin Geometry:** = 1 Rectangular Basin(s)

**Freeboard:** = 2.0 ft = (0.6 m)

**Length of Basin:** = 65.0 ft = (19.8 m)

**Width of Basin:** = 45.0 ft = (13.7 m)

| | Water Depth | | Basin Vol./Basin | | |
|---|---|---|---|---|---|
| **Min** | = 14.5 ft | = (4.4 m) | **Min** | = 0.318 MG | = (1,203.4 m³) |
| **Avg** | = 15.7 ft | = (4.8 m) | **Avg** | = 0.343 MG | = (1,298.0 m³) |
| **Max** | = 15.7 ft | = (4.8 m) | **Max** | = 0.343 MG | = (1,298.0 m³) |

| | | |
|---|---|---|
| **Number of Cycles:** | = 2 per Day/Basin (advances cycles beyond MDF) | |
| **Cycle Duration:** | = 12.0 Hours/Cycle | |
| **Food/Mass (F/M) ratio:** | = 0.026 lbs. BOD5/lb. MLSS-Day | |
| **MLSS Concentration:** | = 1200 mg/l @ Min. Water Depth | |
| **Hydraulic Retention Time:** | = 6.858 Days @ Avg. Water Depth | |
| **Solids Retention Time:** | = 43.6 Days | |
| **Est. Net Sludge Yield:** | = 0.799 lbs. WAS/lb. BOD5 | |
| **Est. Dry Solids Produced:** | = 66.6 lbs. WAS/Day | = (30.2 kg/Day) |
| **Est. Solids Flow Rate:** | = 100 GPM (1997 GAL/Day) | = (7.6 m³/Day) |
| **Decant Flow Rate @ MDF:** | = 333.0 GPM (as avg. from high to low water level) | = (21.0 l/sec) |
| **LWL to CenterLine Discharge:** | = 3.0 ft | = (0.9 m) |
| **Lbs. O2/lb. BOD5** | = 1.25 | |
| **Lbs. O2/lb. TKN** | = 4.60 | |
| **Actual Oxygen Required:** | = 181 lbs./Day | = (82.1 kg/Day) |
| **Air Flowrate/Basin:** | = 154 SCFM | = (4.4 Sm3/min) |
| **Max. Discharge Pressure:** | = 8.4 PSIG | = (58 KPA) |
| **Avg. Power Required:** | = 181.2 KW-Hrs/Day | |

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**SECTION 16050**

**ELECTRICAL WORK – GENERAL**

**(Filed Sub-Bid Required)**

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# PART 1 - GENERAL

**1.00 - SUBBID REQUIREMENTS**

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 16, ELECTRICAL shall include the complete Work specified in all of the following Sections:

1. SECTION 16050, ELECTRICAL WORK – GENERAL
2. SECTION 16110, ELECTRICAL RACEWAY SYSTEMS
3. SECTION 16120, ELECTRIC WIRES AND CABLES
4. SECTION 16160, PANELBOARDS
5. SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT
6. SECTION 16320, GENERAL PURPOSE DRY-TYPE TRANSFORMERS
7. SECTION 16359, ELECTRICAL SYSTEM STUDIES
8. SECTION 16366, LOW VOLTAGE SWITCHBOARD
9. SECTION 16400, SURGE PROTECTION DEVICES
10. SECTION 16402, UNDERGROUND DISTRIBUTION SYSTEM
11. SECTION 16450, GROUNDING
12. SECTION 16481, ELECTRIC HEAT TRACING
13. SECTION 16601, LIGHTNING PROTECTION
14. SECTION 16721, FIRE ALARM SYSTEM
15. SECTION 16724, SECURITY SYSTEM
16. SECTION 16761. VIDEO SURVEILLANCE SYSTEM
17. SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT
18. SECTION 16920, 600-VOLT MOTOR CONTROL CENTER
19. SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

1. None

D. Reference Drawings

1. The Work of DIVISION 16, ELECTRICAL is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 10 ED-001 | 10 ED-002 | 10 ED-003 | 10 E-001 |
| 10 E-002 | 10 E-003 | 10 E-004 | 10 E-005 | 10 E-006 | 10 E-007 | 10 E-101 |
| 10 E-102 | 10 E-103 | 10 E-104 | 10 E-201 | 10 E-202 | 10 E-203 | 10 E-204 |
| 10 E-205 | 10 E-206 | 10 E-301 | 10 E-302 | 10 E-303 | 10 E-601 | 10 E-602 |
| 10 E-603 | 10 E-604 | 10 E-605 | 10 E-606 | 10 E-607 | 10 E-608 | 10 E-609 |
| 10 E-610 | 10 E-611 | 10 E-612 | 10 E-613 | 10 E-614 | 10 E-615 | 10 E-616 |
| 10 E-617 | 15 E-101 | 15 E-102 | 15 E-601 | 15 E-602 | 25 E-101 | 30 E-001 |
| 30 E-002 | 30 E-101 | 30 E-601 | 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 |
| 10 FA-101 | 10 FA-102 | 10 FA-201 | 10 FA-202 | | | |

2. The Work of DIVISION 16, ELECTRICAL for Alternative A-1is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 20 E-101 | 20 E-102 | 20 E-601 | 20 E-602 |
| 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 | 20 FA-101 | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: DIVISION 16, ELECTRICAL

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide General Electric Work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Division 1: General Requirements

D. Division 16: Electrical

E. The Diesel Generator System shall be supplied under Section 11398. Provide all conduit, wiring and terminations for system operation as indicated.

F. Provide conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Install vendor furnished cables specified under Specification Section 13300.

G. Provide conduits, wiring and terminations for power feeders for HVAC equipment provided under Division 15 and as shown on the electrical drawings.

H. Provide and install control stations shown on the electrical drawings local to equipment supplied under other divisions.

I. Provide and install safety disconnect switches shown on the electrical drawings local to equipment supplied under other divisions.

J. Motors shall be provided by the Contractor under Section 01171. All associated conduit, wire and terminations of motors shall be provided under Division 16.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop Drawings and Data: Include manufacturer's drawings, bills of material, panel and equipment layouts, catalog data, schematics diagrams, interconnection diagrams, wiring diagrams and other documentary or descriptive information for each assembly submitted in one package.

    1. Bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or identification on all other drawings where item appears.

    2. Submit equipment installation instructions in separate submittals from other shop drawings.

    3. Mark shop drawings and data submitted showing only items applicable to specific contract.

    4. Make submission of drawings for those components where dimensions of equipment, location of conduit entrances, are required to facilitate construction in accordance with the construction schedule.

    5. Include one-line diagrams, schematic diagrams, wiring diagrams, control sequence diagrams, relay diagrams, and metering. Submit only completed drawings showing all local and remote devices associated with each item. Submit one complete package of shop drawings. Partial submittals will be returned without action.

    6. Submit time-current characteristic curves for all circuit breakers and fuses.

    7. Submit instruction manuals for installation, operation, and maintenance of equipment, and parts list. Mark standard publications forming a part of this contract. Cross out, blank out, or otherwise delete non-applicable items. Submittals which do not clearly indicate items and features provided will be rejected.

    8. Install permanent nameplates on all devices or pieces of equipment for which use or identification is not readily apparent, such as starters, relays, contactors, pushbuttons, indicating lights, and switches. Make sure position of nameplates are readable after equipment installation.

    9. Provide services of the manufacturer's representative as specified in the applicable specification sections.

2. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.

3. Submit data sheets for the insulation resistance testing of conductors and equipment prior to performing operating testing. List all cables and equipment to be tested.

4. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide operational systems for both normal and standby electric power systems, normal and emergency lighting systems, security systems, CCTV systems, grounding systems, electrical heat tracing, lightning protection systems, fire alarm systems, radio system and other specified systems, including the installation and wiring of miscellaneous equipment and devices. Perform all Work and testing as indicated and specified to provide operationally ready electrical systems.

1. Provide conduit, wiring and connections for power, motors, motor controllers, control devices, lighting, control panels, instrumentation and alarms and for equipment furnished by others as indicated on the Contract Drawings.

2. Provide temporary circuits, overcurrent devices, conduit and wiring, and other temporary electrical equipment required to complete the Work of DIVISION 16, ELECTRICAL. All other temporary electrical Work including site temporary power service shall be provided under SECTION 01500, TEMPORARY FACILITIES.

3. Disconnect and remove existing electrical systems indicated for demolition under this Contract.

4. Engage the services of an Independent Electrical Testing Firm to perform the field inspections, tests and adjustments specified in SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

5. Provide the services of a specialty firm to provide short circuit, coordination and Arc Flash analysis for the electrical distribution system in accordance with SECTION 16359, ELECTRIAL SYSTEM STUDIES.

6. Provide lightning protection, fire alarm, radio system and telephone systems as specified herein.

7. Install all raceways and equipment to meet the seismic requirements of SECTION 01900, SEISMIC REQUIREMENTS. Raceways supports and equipment anchoring shall be provided as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

8. All electrically powered equipment and devices provided under other Sections are connected to electrical systems as part of the Electrical Work, as indicated. Provide all conduits, wiring and wiring terminations as indicated.

9. Provide all supervision, labor, materials, tools, test instruments or other equipment or services and expenses to test, adjust, set, calibrate, functionally and operationally check all Work and components of the various electrical systems and circuitry throughout the installation.

D. Provide set up, and maintain all derricks, hoisting machinery, staging, and planking and perform all hoisting required to complete the Electrical Work.

E. General Contractor to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints required for Electrical work.

F. Obtain all necessary permits required to complete the work of DIVISION 16 – ELECTRICAL WORK.

**1.07 - QUALITY ASSURANCE**

A. Install electrical Work in conformance with latest rules and requirements of National Fire Protection Association Standard No. 70 (National Electrical Code) and the Massachusetts Electrical Code.

**1.08 - REFERENCES**

A. National Electrical Safety Code (NESC)

B. Occupational Safety and Health Administration (OSHA)

1. OSHA Part 1910; Subpart S, 1910.308

2. OSHA Part 1926; Subpart V, 1926.950 through 1926.960

C. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70B: Electrical Equipment Maintenance

2. NFPA 70E: Electrical Safety Requirements for Employer Workplaces

3. ANSI/NFPA 70: National Electrical Code

4. ANSI/NFPA 780: Lightning Protection Code

5. ANSI/NFPA 101: Life Safety Code

D. National Electrical Manufacturers Association (NEMA)

E. American National Standards Institute (ANSI)

1. ANSI C2: National Electrical Safety Code

2. ANSI Z244-1: American National Standard for Personnel Protection

F. Insulated Cable Consultants Association (ICEA)

G. Instrument Society of America (ISA)

H. Underwriters Laboratories (UL)

I. Factory Mutual (FM)

J. International Electrical Testing Association (NETA) – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD)

K. Institute of Electrical and Electronics Engineers (IEEE)

L. Massachusetts Electrical Code

M. All inspections and tests shall utilize the following references:

1. Project Design Specifications

2. Project Design Drawings

3. Project Short Circuit and Coordination Study

4. Manufacturer’s shop drawings submittals and instruction manuals applicable to each particular apparatus.

N. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - INTERFERENCE AND ERRONEOUS LOCATIONS**

A. Verify in field, all data and final locations of Work installed under other Sections required for placing of electrical Work.

B. Do not run conduit in floor slabs or walls of buildings unless indicated.

**1.10 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on structural drawings and as specified in SECTION 01900, SEISMIC REQUIREMENTS and as specified herein.

**1.11 - APPROVAL AND MARKING EQUIPMENT**

A. All devices and materials shall be listed and/or labeled by Underwriters' Laboratories, Inc., wherever standards have been established by that agency. Where Underwriters' Laboratories listing is not available for equipment, submit certified test reports of recognized, independent testing laboratory, approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements.

B. Mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other information on a nameplate.

**1.12 - ELECTRICAL SYSTEM STUDIES**

A. Provide electrical system studies as specified in SECTION 16359, ELECTRICAL SYSTEM STUDIES. The specialty firm performing the study shall have no contractual or business ties with the electrical distribution system supplier.

B. The electrical system protection trip settings resulting from the study shall be provided to the electrical testing firm specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS to adjust and set the electrical system parameters in the field.

C. The Arc Flash Labels shall be generated by the specialty firm under SECTION 16359, ELECTRICAL SYSTEM STUDIES and installed in the field by the Contractor under Division 16.

**1.13 - ELECTRIC SERVICE**

A. Electrical power system for the facility shall operate at 480 volt, 3-phase, 3-wire, 60-Hertz.

B. Provide electrical low voltage distribution system that operates on 120/208 volt, 3-phase, 4 wire, 60-Hertz obtained from the power system by step down transformer(s).

C. Contact the following organization for coordinating the incoming power requirements for the project:

EVERSOURCE
Kathleen White
484 Willow Street
Yarmouth, MA 02673
Kathleen.white@eversource.com
(508) 790-9021

D. The organization identified above will furnish and install:

1. Pad-mounted transformer, including metering equipment.
2. Primary cable.
3. Connection and terminations of all primary cables at the service transformer.

E. The following shall be provided under other divisions:

1. Poured and pre-cast concrete, construction joints, and form work for ductlines, manholes, and handholes.
2. Concrete pad for transformer in accordance with Eversource standards.
3. Rebar, inserts, embedments, windows, ladders, pulling iron and related material.
4. Excavation and backfill.
5. Manhole and handhole frames and covers.
6. Manhole and handhole waterproofing.

F. The following shall be furnished and installed under this division:

1. Secondary cables of sufficient length for termination at the transformer.
2. Connection and terminations of all secondary cables at the service transformer.
3. Grounding at pad.
4. Hardware in manholes and handholes including cable supports, ground rods, ground cables, and associated equipment.

**1.14 - INCOMING FIBER OPTIC TELEPHONE AND DATA SERVICE**

A. Contact the following organization for coordinating the incoming fiber optic requirements for the project:

OpenCape Corporation
Barnstable County Complex
3195 Main Street
Barnstable, MA 02630
508-362-2224
https://opencape.org/

B. The organization identified above will furnish and install:

1. Telephone and Data Service Conductors from overhead service poles to telephone system handhole (THH.10-1).
2. Comcast network switch and hardware at WWTF telephone/data backboard.

C. The following shall be furnished and installed under this division:

1. Telephone and Data Service Conductors from telephone system handhole (THH.10-1) and WWTF telephone/data backboard at
2. Telephone/data service backboard at the WWTF electrical room.
3. Dual telephone/data service outlets as shown on Contract electrical drawings.
4. Telephone/data service conduit and cabling from Comcast hardware to dual telephone/data service outlets.

**1.15 - EQUIPMENT SPECIFIED ELSEWHERE**

A. Certain items of control equipment and other equipment are indicated on electrical drawings for connection, but are specified and provided in other sections pertaining to plumbing, heating, ventilating and air conditioning, mechanical process, diesel generator system, and instrumentation, etc.

B. Electrical Ductline System:

1. The following shall be provided under other divisions.
    1. Poured and pre-cast concrete, construction joints, and form work for ductlines, manholes, and handholes.
    2. Rebar, inserts, embedments, windows, ladders, pulling iron and related material.
    3. Excavation and backfill.
    4. Core drilling of existing concrete.
    5. Manhole and handhole frames and covers.
    6. Manhole and handhole waterproofing.

2. The following shall be provided under this Division.

    1. Conduit, fittings, and supports.

    2. Hardware in manholes and handholes including cable supports, ground rods, ground cables, and associated equipment.

    3. Wires, cables. And conductors, including splicing.

**1.16 - HAZARDOUS AREAS**

A. Equipment, materials and installation in areas designated as hazardous shall comply with NEC Articles 500, 501, 502 and 503.

B. Equipment and materials installed in hazardous areas shall be UL listed for the hazardous area classification.

**1.17 - CODE, INSPECTION AND FEES**

A. Equipment, materials and installations shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all permits and arrange for all inspections.

**1.18 - TESTS AND SETTINGS**

A. Test systems and equipment furnished under Division 16 and replace all defective Work and equipment at no additional cost. Refer to the individual equipment sections and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS for additional specific testing requirements. Employ the services of an Independent Testing Company, other than the manufacturer of the electrical distribution system, to perform the tests specified.

B. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. A typed test report for each component tested shall be submitted. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Five complete copies shall be provided. Reports shall be signed by the person in charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Subcontractor.

D. In addition to the specific testing requirements listed in the individual sections, the following tests and settings shall be performed:

    1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for operation.

    2. Check the full load current draw of each motor. Check ampere rating of thermal overloads for motors and submit a typed record of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

    3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

    4. Check settings of the motor circuit protectors. Adjust settings to allow the motor to be started when under load conditions.

    5. Check motor nameplates for correct phase and voltage.

    6. Check rotation of motors prior to testing the driven load.

    7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function as indicted by control schematic and wiring diagrams.

8. Inspect each piece of equipment in areas designated as HAZARDOUS to make sure that installed equipment has rating as specified in Paragraph 1.14.

9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to “A”, “B” and “C” phases.

**1.19 - INTERPRETATION OF DRAWINGS**

A. Coordinate the conduit installation with other trades and the actual supplied equipment. Coordinate equipment conduits top and/or bottom entries as required for the equipment installation and as specified and indicated on the Contract Drawings.

B. Install each 3-phase circuit in a separate conduit unless otherwise indicated.

C. Install all conduits and wiring system as indicated on and matching the Contract drawings. Conduits shall not be combined unless otherwise indicated on Contract drawings.

D. Conduit shown exposed shall be installed exposed; conduit shown concealed should be installed concealed.

E. All fittings and boxes shall be provided for a complete raceway installation.

F. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installations.

G. Except where dimensions are shown, the locations of equipment, fixtures, and outlets indicated are approximate only. Obtain information relevant to the placing of electrical Work and in case of any interference with other Work.

H. Circuit layouts are not intended to show the number of fittings, pull boxes, or other installation details. Furnish all labor and materials to install and place in operation all power, lighting and other electrical systems indicated.

I. Raceways and conductors for the fire alarm and telephone systems are not indicated. Interconnection descriptions are indicated in their Riser Diagrams as indicated. Provide raceways and conductors, as required by the system manufacturer, for a complete and operating system. Raceways shall be installed concealed in all finished spaces and installed exposed in process spaces.

J. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal systems as specified are not indicated. Raceways and conductors shall be provided for lighting, switches and receptacles for a complete and operating system.

**1.20 - PHASE BALANCING**

A. The drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in SECTION 16120, ELECTRIC WIRES AND CABLES.

**1.21 - SIZE OF EQUIPMENT**

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling.

C. Equipment shall not be physically larger than what is shown on the Contract Drawings.

**1.22 - EQUIPMENT IDENTIFICATION**

A. Identify equipment furnished under Division 16 with the name of the equipment it serves. Switchboard, motor control centers, control panels, panelboards, junction or terminal boxes shall have nameplate designations as indicated. Equipment nomenclature and identification system shall be as specified herein.

B. Nameplates shall be engraved, laminated plastic, 1/16-in. thick by 3/4-in by 2-1/2-in. with 3/16-in. high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using a waterproof epoxy adhesive. Two-sided foam adhesive tape shall not be used. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

**1.23 - SEQUENCING AND SCHEDULING DEMOLITION WORK**

A. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of power. Obtain Owner's consent before removing any circuit from continuous service.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.01 - REMOVAL AND RELOCATION OF MATERIAL AND EQUIPMENT**

A. Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

B. Remove from site and dispose of material and equipment removed.

**3.02 - DEMOLITION**

A. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades and civil site work prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

B. Where equipment is to be removed all associated ancillary components (e.g. supports, handholes, poles, fixtures, etc.) and associated wiring and conduit shall also be removed.

C. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect and remove all electrical power, communications, controls, alarm and signal system.

D. Existing underground electrical systems feeding equipment, building or structures scheduled for complete demolition shall be made safe, disconnected and removed.

E. Equipment scheduled to be turned over to the Owner shall be carefully disconnected, removed and delivered to the Owner where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

F. Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

G. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

H. Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

I. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

L. Trace out existing wiring that is to be relocated or removed and perform the relocation or removed work as required for a complete operating and safe system.

M. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

**3.03 - PROTECTION OF ELECTRICAL EQUIPMENT**

A. Store equipment in compliance with manufacturer's recommendations and as specified herein.

B. Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

C. Do not store equipment outdoors.

D. Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

**3.04 - DEFECTIVE OR DAMAGED EQUIPMENT**

A. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost.

B. All equipment showing signs of damage shall be rejected regardless of dielectric test results.

C. All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

D. Equipment that found to be damaged or failed the field inspection and acceptance tests specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS shall be replaced at no additional cost.

**3.05 - STARTING EQUIPMENT DATA LIST**

A. Obtain data from the equipment supplier shop drawing submittals or equipment nameplates and prepare a complete tabulation of all motors over 1/3 hp, electric heaters over 1 kW, air conditioning units and starting equipment, to be furnished on the project.

1. Include in tabulation form the following information:

a. Name and identification of equipment.

b. Manufacturer.

c. Horsepower or kilowatt rating.

d. Voltage.

e. Phase.

f. Speed.

g. Full load current.

h. Locked rotor current or code letter.

i. Type of enclosure (open drip-proof, totally enclosed, fan cooled, etc.).

j. NEMA size of starter or contactor.

k. Overload heater size.

l. Type of starter (full-voltage, reduced-voltage, autotransformer, etc.).

m. Breaker trip setting or fuse size.

n. Voltage of starter operating coil.

o. If starter is at a motor control center, list motor control center number.

2. Final acceptance of the electrical system is contingent upon submittal of the complete motor and equipment tabulation.

3. Arrange tabulation in groups by building location.

4. Furnish six copies of the tabulation to the Engineer when a submission is made.

**3.06 - EQUIPMENT ENCLOSURE**

A. The equipment enclosure classification of the plant areas are indicated within the Area Classification Schedule shown on the drawings. Provide all equipment, devices, installations and material meeting the requirements of this schedule.

**3.07 - AS BUILT DRAWINGS**

A. At the completion of the Project, provide two sets of contract drawings that are marked to show the as-installed equipment, devices, conduits, underground duct lines locations, layouts, wiring and any revisions to the Contract Drawings occurred during construction. As built drawings markup shall be complete and provide a detailed and accurate representation of as installed field conditions of all equipment provided under this Contract.

**3.09 - INSTALLATION**

A. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions.

1. All dimensions shall be field verified at the job site and coordinated with the Work of all other trades.

2. Provide electrical installation working drawings containing the following:

1. Concealed and buried conduit layouts, shown on floor plans. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, junction or pull boxes, instruments and other electrical devices connected to concealed or buried conduits.

2. Coordinate all Work with other divisions.

**3.10 - SLEEVES AND FORMS FOR OPENINGS**

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions. Locate all slots for electrical Work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other Subcontractors and locate the concealed conduit before the slab is poured.

C. Seal all openings, sleeves, penetration and slots as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

**3.11 - CUTTING AND PATCHING**

A. Arrange installation of all Work such that cutting and patching is not required.

B. Do not cut joints, beams, girders, columns or any other structural members.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16110**

**ELECTRICAL RACEWAY SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16110, ELECTRICAL RACEWAY SYSTEMS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16110, ELECTRICAL RACEWAY SYSTEMS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Raceway Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data for all raceway systems, accessories, supports and miscellaneous hardware in accordance with the requirements of SECTION 16050, ELECTRICAL WORK – GENERAL.

2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide raceway systems, with matching accessories, fittings and boxes, as indicated and specified.

D. All raceway runs are indicated diagrammatically to outline general routing of raceway. Unless specifically identified for installation in concrete walls or slabs, raceways shall be run exposed with raceway supporting systems. Avoid interfering with pipes, ducts, structural members, or other equipment.

E. Raceways and conductors between lighting, switches, receptacles and other miscellaneous low voltage and signal systems as specified and indicated are not shown on the Plan View Drawings. Raceways and conductors shall be provided for complete and operating systems. Conduit and wiring descriptions are indicated on the Riser Diagrams for the Fire Alarm, Telephone and Instrumentation Systems. Raceways shall be installed exposed unless otherwise indicated. Avoid conflicts with HVAC ducts, cranes, hoists, monorails, equipment hatches, doors, windows, structural beams and process equipment.

F. Provide raceway systems in accordance with the following:

1. In NEMA 1, NEMA 4 or NEMA 12 areas, use galvanized rigid steel raceway systems, fittings and accessories.

2. In chemical areas and those areas designated NEMA 4X, use PVC coated rigid steel raceway systems, fittings and accessories.

3. In classified hazardous areas designated as Class I, Division I and Class 1, Division 2, use PVC coated rigid steel raceway systems, fittings and accessories with tapered threads and sealing fittings as required by the Massachusetts Electrical Code for hazardous applications.

G. All raceway systems shall be installed in accordance with the criteria described in this section.

1. Use Type 316 stainless steel support systems for exterior application, hazardous areas, NEMA 4 and in NEMA 4X areas.

2. NEMA 1 and NEMA 12 areas shall use hot dipped galvanized steel support systems.

H. Aluminum conduit and boxes shall not be used.

I. Provide fire stops for all electrical penetrations through fire rated walls and floors.

**1.07 - REFERENCES**

A. National Fire Protection Association (NFPA):

1. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriter's Laboratories, Inc. (UL):

1. U.L.-1: Electrical Flexible Metal Conduit

2. U.L.-6: Rigid Metal Electrical Conduit

3. U.L.-360: Electrical Liquid-Tight Flexible Steel

4. U.L.-651: Schedule 40 and 80 PVC Conduit

5. U.L.-886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class 1, Groups A, B, C, and D and Class 11, Groups E, F, and G

D. National Electrical Manufacturers Association (NEMA):

1. RN-1: Polyvinylchloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

2. TC-2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

**1.08 - SEISMIC REQUIREMENTS**

A. All raceways shall be supported to Massachusetts Electrical Code requirements and conform to the requirements as indicated on the structural drawings and as defined in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. Rigid Metal Conduit and polyvinylchloride-coated rigid steel conduit:

1. Triangle/PWC, Inc.

2. Perma-Cote Industries.

3. Republic Steel Corporation.

4. Robroy Industries.

5. Or equal.

B. Polyvinylchloride (PVC) Conduit:

1. Triangle/PWC, Inc.

2. Robroy Industries.

3. Carlon Electrical Sciences, Inc.

4. Or equal.

C. Flexible Conduit:

1. American Flexible Conduit Company.
2. Anamet, Inc.
3. Electri-Flex Company.
4. International Metal Hose Company.
5. Eaton Crouse-Hinds.
6. Or equal.

D. Boxes and Fittings:

1. O.Z./Gedney Company.
2. Crouse-Hinds Electrical Construction Materials.
3. Appleton Electric Company.
4. Or equal.

E. Fiberglass-Reinforced Polyester Boxes:

1. Crouse-Hinds Electrical Construction Materials.
2. Fibox.
3. Hoffman Engineering Company.
4. Vynckier Enclosure Systems.
5. Or equal.

F. Support Systems:

1. Michigan Hanger Co., (O-Strut).
2. Thomas & Betts (Superstrut).
3. Unistrut Corp.
4. Or equal.

G. Fire Stop Material and Barriers:

1. Nelson Fire Stop Products.
2. Dow Corning Corporation.
3. 3 M Company.
4. Or equal.

**2.02 - MATERIALS AND COMPONENTS**

A. Rigid Metal Conduit:

1. Provide galvanized rigid metal conduit, each with a coupling on one end and thread protector on other end.
2. Hot-dip galvanize rigid steel conduit over entire length, along interior and exterior surfaces, including threads. Conduit shall conform to U.L.-6.

B. Flexible-Metal Conduit:

1. Provide flexible-metal conduit for use in NEMA-1 and NEMA-12 dry areas and match fittings, size, and material to rigid conduit to which it is connected. Flexible-metal conduit shall conform to U.L.-1.

2. Provide liquid-tight PVC coated flexible-metal conduit for use in NEMA-4 damp areas consisting of flexible-metal conduit, with liquid-tight, sunlight-resistant jacket extruded over the conduit. All fittings and accessories shall be PVC coated. Provide stainless steel, braided flexible conduit in NEMA 4X, corrosive areas. On larger than 1-1/4-in., furnish separate external ground wire. Liquid-Tight flexible-metal conduit shall conform to U.L.-360.

3. Provide stainless steel braided flexible conduit in all hazardous areas.

C. Polyvinylchloride (PVC) Conduit:

1. Provide PVC conduit, Schedule 40 conforming to NEMA Standard TC-2 and UL-651. PVC Schedule 40 conduit shall not to be used unless embedded in concrete and unless otherwise indicated on the drawings.

D. Polyvinylchloride-Coated Rigid Steel Conduit:

1. Provide polyvinylchloride-coated (PVC-Coated), rigid steel conduit conforming to NEMA Standard RN-1 consisting of hot-dipped galvanized rigid steel conduit, with a polyvinylchloride jacket bonded to the outside of all conduit surfaces with a nominal thickness of 40 mils meeting the requirements of NEMA RN-1, 3.1. The adhesive strength of the bonding to equal or exceed tensile strength of the coating. Provide couplings and fittings for this conduit conforming to the requirements of NEMA RN-1, 3.5.

2. A two-part urethane coating shall be applied to the interior of all conduit and fittings at a two mil thickness. The interior coating shall be flexible to allow field bending without cracking or flaking.

E. Boxes:

1. In NEMA 1 and NEMA 12 areas, provide standard, sheet-metal, outlet and junction boxes constructed of code-gauge, galvanized sheet steel. Size each box by the Massachusetts Electric Code.

2. Provide boxes containing fixture studs for hanging fixtures. Use concrete-tight boxes for installation in concrete. Do not use shallow boxes unless building construction is such that it is impossible to use standard-depth boxes.

3. Provide outlet boxes and fittings for hazardous locations conforming to U.L.-886 for class, group, and division indicated. Outlet boxes and fittings for hazardous areas shall also meet requirements of NEMA 4 areas.

4. Provide boxes and covers for polyvinylchloride-coated steel conduit made of 316L stainless steel or, in classified areas and outside, galvanized cast iron, with a polyvinylchloride factory-applied coating over the galvanizing. Provide coating thickness of 40- mil. Boxes shall have hubs with extruded sleeves extending beyond the hub in the same manner as specified for conduit couplings. Provide cover screws of Type 316 stainless steel.

5. Provide cast boxes with covers or device plates that can be used for the area classification. Use cover screws of Type 316 stainless steel or high brass for iron boxes.

6. Provide boxes for use with polyvinylchloride conduit made of polyvinylchloride for use as junction boxes and provide high impact strength fiberglass-reinforced polyester boxes for use as device boxes, pull boxes, and terminal boxes. Size each box as required by the Massachusetts Electrical Code.

7. Where designated in the drawings, provide pull boxes above or below motor control center installations 20 inches by 20 inches by 12 inches deep. Boxes of dimensions 10 inches by 10 inches by 6 inches deep and larger shall be hung from ceilings constructed of angle or channel frames. Provide neoprene gaskets for sealing. Sectionalize covers longer than 36-in. to facilitate handling and gasket sectionalized covers where covers meet, using angle iron or channel cross members at the joint. Sheet metal shall be No. 12-gauge galvanized sheet steel. Fabricate interior angles and supports of galvanized steel. Provide each box with a grounding lug for connection to the nearest ground bus. Current capacity of ground lug shall be that required by the Massachusetts Electrical Code for the largest feeder entering the equipment.

8. Provide terminal blocks in all terminal boxes, panels, and instrumentation cabinets/panels requiring terminations as indicated or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white markers.

9. In NEMA 4 and NEMA 4X areas, provide 316L stainless steel outlet and junction boxes. Size each box as required by the Massachusetts Electric Code.

F. Fittings:

1. Provide cast-iron fittings of malleable iron or a mixture of gray iron and cast steel.

2. Provide expansion fittings where conduits cross expansion joints. Equip these fittings with grounding straps, clamps, and copper bonding jumpers.

3. For PVC conduit, provide PVC fittings that can be solvent welded to match conduit.

4. Provide PVC-coated coupling and fittings for PVC-coated conduit with an integral, bonded, overlapping pressure-sealing sleeve of the same thickness as conduit coating. Provide extended sleeves one pipe diameter or 2-in. (whichever is less) beyond the end of the coupling so sleeve of coupling makes a watertight fit with the plastic jacket on the conduit when coupled together. Sealing sleeves at threaded connections shall seal out vapors and liquids.

5. Provide PVC coated fittings and accessories with PVC-coated rigid galvanized steel conduit.

G. Supports:

1. Provide raceway component supports which are meant to function with the raceway, and will support the raceway as indicated and meet the NEC and manufacturer’s requirements.

2. Provide Type 316 stainless steel hangers, threaded rods, channels, straps, clips, and clamps for raceways provided in hazardous areas, NEMA-4 and NEMA-4X areas. Provide stainless steel bolts, nuts and washers.

3. Provide hot dipped galvanized steel support system for raceways installed exposed in NEMA-1 and NEMA-12 areas.

4. Provide support for flexible conduit with components which do not compress and do not deform conduit.

**2.03 - FIRESTOP PRODUCTS**

A. Only firestop systems listed and tested to the UL 1479 Standard complete with prototype test data showing their individual applications shall be used.

B. Fire resistance ratings of installed firestop systems shall not be less than the fire resistance rating of the surrounding fire separation or firewall.

C. All listed system designs selected for use shall have a smoke seal incorporated within the rated firestop systems.

D. All firestop materials that will come directly in contact with plastic pipe or plastic coated wire shall have undergone Firestop Material compatibility testing by the Firestop Systems manufacturer and/or the pipe or wire manufacturer.

E. All firestop materials and smoke seals shall have elastomeric characteristics to allow for building settling and seismic movement.

F. All firestop materials and smoke seals shall be free of asbestos.

G. Site firestop systems must be installed in accordance with the UL 1479 Standard listed system design limitations.

H. All listed system designs used must provide a Flame (F), Temperature (T) and Hose (H) stream rating in accordance with those outlined in the most recent BOCA codes, include any additional requirements of the Work in this Section.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide all material, equipment, and labor to install the electrical raceway systems as indicated and as specified herein.

B. Perform all Work in accordance with the Massachusetts Electric Code.

C. Use no conduit less than 3/4-in. in diameter.

D. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's printed instructions.

**3.02 - METHODS OF RESTRAINING RACEWAYS**

A. Utilize threaded rod with rod stiffeners and transverse channel braces at 45 degrees angle, at 15-ft. on center, maximum, and on one side of rod support.

B. Utilize longitudinal bracing with channel braces at 30 feet on center, maximum.

C. Strap raceways directly to transverse channel braces, using pipe strap with both ends of strap bolted into the channel brace.

D. Do not rigidly brace raceways to different parts of a building that may respond differently during an earthquake. Seismic restraints shall not limit expansion and contraction of the raceway support system.

E. Provide flexible connections for conduits 2-in. outside diameter or greater than when terminating to fixed equipment to prevent loss of raceway integrity in the event of an earthquake.

**3.03 - INSTALLATION OF FITTINGS**

A. Install expansion fittings and bonding jumpers wherever conduits cross structural expansion joints. Keep the fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

B. Do not install fittings to replace elbows and pull boxes. Use oversize fittings whenever large cable is installed, in order to maintain bending radius.

C. Terminate ends of all floor conduits installed for future use with couplings and readily removable plugs set flush with finished floor surface. Cap spare wall conduits at wall where they enter building.

D. Equip ends of all conduits with conduit fittings. Fit conduits terminating at motor control center or power distribution equipment, or in box above or below, with grounding type bushings, or solidly ground by locknuts or other fittings. Connect each grounding bushing to ground bus by a bare or green-covered copper wire. Do not use ground wire smaller than 12 awg. Install ground wire larger than 12 gauge when indicated. Where conduits terminate in unprotected areas or where bonding is required over expansion joint, flexible conduit or equivalent; use ground wires No. 6 Awg. copper or larger. Copper bonding jumpers are required over expansion joints.

E. Terminate conduits entering gasketed sheet-metal boxes or gasketed sheet-metal equipment enclosures with gasketed hubs.

F. Terminate conduits entering nongasketed sheet-metal boxes or enclosures with double locknuts and insulated bushings, or equivalent.

G. Make joints tight. Use raceway fittings compatible with raceway use and location.

**3.04 - INSTALLATION OF RACEWAYS**

A. Install exposed raceways parallel or at right angles to walls and ceiling beams. Make all changes in directions with bends, elbows, and pull boxes. Space parallel runs evenly throughout. Attach in place with hangers and fasteners. Ground raceways by connection to grounded enclosures, bonding, or other means, to obtain permanent low resistance path to ground throughout installation. Raceway sections in single run and in parallel runs shall be of same type and finish.

1. Run parallel or banked raceways together, on common supports.

2. Install raceways level and square. Provide minimum 7 ft. headroom.

B. Support raceways concealed above suspended ceilings from slab above ceiling in same manner as exposed raceways. Do not support raceways from ceiling supports.

C. Provide cast-in-place inserts in concrete to support all runs, unless otherwise permitted. Use stainless steel sleeve type concrete anchors for installing boxes, and conduit supports. Provide Type 316 stainless steel nuts, bolts, and washers, for use with concrete anchors. Wedge inserts shall not be used.

D. Support conduits by hangers or pipe straps spaced according to Massachusetts Electrical Code, but in no case more than 10 feet on centers.

E. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with PVC coated rigid steel conduit. Flexible metal conduit may be used 6 inches above the floor.

F. Provide sleeves passing through exterior walls and slabs which are wall entrance seals of watertight construction. Furnish watertight seal between slab and sleeve, and between sleeve and conduit or cable. Use wall-entrance seals of malleable iron with watertight sealing gland which may be tightened any time after installation.

G. Do not use dissimilar metals in conjunction with each other. Use insulation between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. Maintain electrical continuity of system. Use bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers as insulation.

H. Install fittings to match raceway being used.

I. Install expansion fittings wherever conduits cross structural expansion joints. Keep fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

J. Where conduits pass through firewalls, grout hole around the conduit to the full depth of the material penetrated using U.L. listed fire stop material.

K. Provide separate metallic raceways for all low voltage instrumentation raceways 50 volts and below shielded wiring, data highway wiring, and fire alarm wiring and install 12-inches from control and power raceways.

L. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box; use two locknuts, one inside and one outside the box.

M. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

N. Install pull wires in all empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having 200-lb. tensile strength. Leave 12 inches of slack at each end of the pull wire.

O. Keep raceways 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

P. Complete raceway installation before beginning conductor installation.

Q. Use temporary closures to prevent foreign matter from entering raceway.

R. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

S. Conduit in transition (from below to above grade, through walls and through concrete) shall be PVC coated rigid galvanized steel (PVC-RGS). The transition shall be made below grade at the final sweep before the transition for exposed conduit. PVC-RGS conduit shall extend one (1) foot minimum above transition finished floor.

**3.05 – BENDS**

A. Make all bends to prevent distortion of circular cross section. Field bent conduit shall have an inside radius of nine diameters.

B. The maximum number of bends in any single conduit run shall be in accordance with the Massachusetts Electrical Code requirements.

**3.06 - CUTTING, THREADING AND CONNECTING**

A. Make all field cuts in conduits squarely, file cut ends, ream to remove rough edges and thread in accordance with Massachusetts Electric Code. No running thread shall be permitted. Make all connections mechanically strong and tight, with connectors. Where conduit surface coating is damaged or removed in the cutting, threading or reaming process, restore the surface to its original condition.

**3.07 - CONDUIT CLEANING**

A. Clean conduits before and after installation, ream ends free of burrs, and free inside surfaces from all imperfections.

B. After installation of each new conduit run, snake the run with band to which is attached a tube cleaner with cylindrical mandrel of a diameter 85 percent of nominal diameter of conduit. Remove and replace all conduit through which mandrel will not pass.

C. Use a sponge with steel brush to clean steel conduit and use a sponge with nylon brush to clean PVC conduits.

D. After cleaning, protect ends of all conduit with standard caps to prevent entrance of water, concrete, debris, or other foreign substance.

**3.08 - CONDUIT DRAINAGE**

A. Pitch conduit to drain to outlet boxes, or install so as to avoid trapping moisture. Where dips are unavoidable in exposed conduits, install fitting to match conduit system with drain hole at low point.

**3.09 - INSTALLATION OF BOXES**

A. Unless otherwise indicated, install NEMA 1 or NEMA 12 sheet metal boxes only in dry, accessible locations. Install NEMA 4 and 4X rated boxes in exterior concrete or masonry walls, in floor slabs, in basements, all other below grade locations and elsewhere as indicated. Unless otherwise indicated, cast metal boxes shall be used where vapor-tight fixtures are required, for all surface mounting of wall switches and receptacles and for all outdoor use.

B. Install boxes in conformance with all the requirements of Massachusetts Electric Code. Install boxes designed for type of construction involved. Support boxes in same manner as conduit. Size boxes to provide bending radius for wire or cable of eight times diameter or in accordance with Massachusetts Electric Code, whichever is larger.

C. Center all outlets in panels, or spaces and adjust to structural finish. Where specific locations are not indicated, locate outlets with respect to equipment served.

D. Place all outlet boxes, junction boxes and pull boxes, in accessible locations when they are installed above or behind plastered ceilings, furred spaces, or suspended ceilings. Install access panels. Mark all access panels for all boxes so panels can be readily located in future. Mark, using metal tabs or plastic buttons which cannot mark ceilings or walls, that can be used for type of construction being used.

E. Assemble cast-metal boxes with threaded conduit hubs in such manner that conduit connections and gasketed covers are watertight. Close all unused threaded openings with pipe plugs and compound.

F. Provide cast boxes with covers and device plates that can be used for the area classification. Install screws of Type 316 stainless steel or high brass for iron boxes.

**3.10 - FLEXIBLE CONNECTIONS TO MOTORS AND EQUIPMENT**

A. At all motors and electrically operated equipment to which conduit connections are made, install with a connection between end of conduit and terminal box of motor or other equipment.

B. Install the conduits in locations permitting direct connection to motors.

C. Make connections between rigid raceway and motor or equipment subject to vibration and adjustment using flexible conduit. Make each connection with one quarter bend so that no vibration can be transmitted beyond flexible connection.

D. Use maximum of 6 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install liquid-tight flexible metal conduit in areas subject to wetting due to fire protection sprinklers or broken or ruptured water line. Locate conduit to reduce the possibility of damage to the exterior flexible conduit jacket. Use fittings that screw into flexible conduit and provide gaskets. Install separate ground conductor across flexible connections.

**3.11 - HAZARDOUS AREAS**

A. Install all conduits, fittings, equipment and devices within areas to comply with requirements of Massachusetts Electrical Code including Hazardous Locations, Class, Division, and Group as indicated on the Contract Drawings.

B. In such hazardous locations, seal conduits terminating at boxes enclosing circuit-opening equipment at entrance to enclosure with compound-filled, commercial, sealing fittings to prevent passage of explosive or combustible gases through conduits.

C. Seal all conduits leading from or entering such hazardous locations at points of exit or entrance with two-part epoxy sealant.

D. Install conduit connections with five threads tightly engaged, and made up with thread compound.

E. Where drain/seal fittings are required, they shall be of malleable iron construction with an internal drainage path which provides a visual means to see that the compound chamber is filled. The installation shall enable the drain/breather fitting and filler plug to be installed right after the compound is poured.

F. Provide stainless steel braided flexible conduit rated for hazardous area locations when making connection between rigid raceway and motor or equipment subject to vibration and adjustment.

**3.12 - FIRESTOP INSTALLATION**

A. Firestop and smoke seal gaps and holes in all fire separation and firewall construction through which conduit, wire, cable, pass as a result of Electrical Work using a Listed System Design.

B. In combustible construction, firestop and smoke seal all through electrical penetrations of the faces as above and firestop and smoke seal all penetrations that enter or exit (transverse) the edges of one fire separation into another fire separation. (i.e. where the header or sill plate is penetrated in the interior of a wall separation into the hollow ceiling or floor cavity of the adjacent separation.)

C. Apply firestop systems at unpenetrated electrical openings and sleeves installed for future use through fire separations and firewalls.

D. All Electrical items that pass through, transverse or terminate within fire separations or firewalls must be firestopped. Firestopping forms part of the Work of this Section.

E. All recessed electrical boxes or panels in fire separations shall be noncombustile (steel) and must be separated by one stud or joist cavity. Back to back installations and/or combustible (plastic) boxes and panels are not allowed unless the gypsum board trade has constructed a fire rated enclosure equal to that of the fire separation rating around each box or panel.

F. All holes or voids created in fire separations or firewalls for single penetrating wires, cables and conduit the annular spare shall not exceed 1” (25mm) for penetrating items up to 2” (50 mm) in outside diameter. For penetrating items over 2” (50 mm) in outside diameter the annular space must not exceed 1½” (37 mm).

G. All holes or voids created in fire separations or firewalls for multiple penetrating electrical items must have a fill ratio 50% of the overall void or hole size.

H. In all firestop systems that require mineral wood or ceramic fiber backer or filler materials, these materials must be dry and free of other contaminants before, during and after installation of sealant firestop materials. Alkaline water contamination of the backer or filler materials may cause corrosion of metallic penetrating items.

I. Apply firestop systems and smoke seals in strict accordance with manufacturer's instructions and Listed Systems Designs to provide temperature and flame rated seals, to prevent the passage of fire and smoke.

**3.13 - PROTECTION**

A. Provide protection and install in accordance with manufacturer printed instructions such that coatings, finishes, and enclosures are without damage or deterioration at completion of Project.

B. Repair damage to PVC with matching touch-up coating recommended by the manufacturer.

**3.14 - CHECKOUT AND TESTING**

A. Provide in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

B. Check overhead conduit system installation by using the following check list:

1. Conduits are supported on independent supports (i.e., not on process piping, pipe ways, or piping hangers).
2. Exposed conduits are run, parallel or perpendicular to structural members.
3. Conduits are routed far away from fire hazards and heat sources.
4. Conduits are supported at the specified intervals.
5. Pull boxes and fittings are installed so that covers are removable. Verify that covers are installed and tightly bolted with gaskets provided where needed.
6. Circular cross sectional area is same at conduit bends. Single bends do not exceed 90 degrees.
7. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.
8. Conduits joints are tight.
9. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture and gases into equipment and/or where indicated.
10. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture and gases.
11. Flexible conduit is installed at motors and other equipment as specified. Verify that cabling and conduit runs are identified at each end.

**3.15 - CONDUIT SEALS**

A. Furnish and install sealant to maintain fire ratings of walls and floors in annular space between conduit and building finish.

B. Apply sealant after cable installation and all testing.

C. Furnish and install moisture/fire proof sealant in conduit interior and cable interstitial space where conduits enter/leave electric rooms, in all control panels, terminal boxes, motor control centers, and switchboard.

**3.16 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16721**

**FIRE ALARM SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16721, FIRE ALARM SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK -.

B. The Work of SECTION 16721, FIRE GENERAL ALARM SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide, test, and place into operating condition an electrically operated, microprocessor based, UL listed, four-wire, analog/addressable, electrically supervised, Class “A” fire detection and evacuation system as indicated and specified.

B. The System shall include, but not be limited to: Fire Alarm Control Panels FACP or panels required for each building, remote annunciator panel, power supplies, fire alarm initiating and indicating devices including addressable monitor and control modules, fire alarm dialer, fire alarm radio communicator, interfaces to building sprinkler system, conduit, wire, fittings, and accessories required to provide a complete operating system. All devices and units shall be located in accordance with the Contract Drawings.

C. The fire alarm system shall be tied into the Town of Orleans, Massachusetts Fire Alarm System Remote Monitoring Service provider via radio transmitted signal.

D. Provide radio fire alarm communicator hardware in accordance with the Town of Orleans Fire Department requirements. Provide radio Intellinet 7788F-ULP Series with accessories 7041E (Subscriber Handheld Programmer) and 7794 (IntelliPro Fire Full Data Module) or equal. Provide the main Fire Alarm Panel with compatible means to network with the specified radio communicator for full data reporting.

E. Prior to the installation of the system, the manufacturer of the system and system installer shall obtain from the Town of Orleans, an Application for Fire Alarm Service, and a copy of all local requirements and obtain all permits and approvals.

F. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1) Failure to include a copy of the marked-up specification sections will result in return of the entire submittal with no further review and consideration.

2. Submit installer and system supplier qualifications and list of three similar projects with name and phone number of contact person.

3. Provide a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop drawings shall contain complete wiring and schematic diagrams for the equipment furnished, riser diagrams with cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

4. Submit manufacturer's printed installation instructions.

5. Submit a statement indicating that the battery size selected is a minimum of 125% of the provided system load. The specified limit shall include supervisory power requirements for all equipment, and alarm power requirements for all equipment.

6. Submit a statement indicating that voltage drop is within ratings of all devices.

7. Wiring diagrams from the fire alarm system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.

8. Spare Parts Data - Submit list of spare parts provided.

9. Operating and Maintenance Instruction Manuals:

    1) Operating instruction manuals, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features.

    2) Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.

    3) Performance Test Reports: Upon completion of the installed system the Electrical Subcontractor shall submit in booklet form all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

10. Submit Certificate of Compliance, signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

11. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1. Type of System

a. Fire Alarm System: The fire alarm system shall operate as a low voltage analog/addressable type system and shall automatically initiate fire alarm signals whenever any manual or automatic fire detecting devices are placed into an alarm mode. The system shall indicate areas of alarm and sound local alarms. Alarm signals shall be consistent throughout the building. Initiating loops and bell loops shall be wired as four-wire class A loops. All initiating loops and horn/light loops shall be complete with necessary switches, meters, relays, pilot lights, surge arresters and addressable modules as required. A minimum of one thermal cut-out or fuse and surge arrestor for every bell circuit shall be provided.

b. The system shall be capable of operating with a single break or ground fault condition in the initiating or alarm sounding circuits.

c. Evacuation Alarms: Coded evacuation alarm: A fire alarm signal shall be employed for notifying the occupants to evacuate. An annunciator shall indicate the specific location of the fire. The fire alarm system security provider shall be signaled automatically through the fire alarm radio reporting system.

d. Trouble Signals: During abnormal conditions such as an open wire or a ground fault, or where both conditions occur at one point, the system shall be capable of automatically transmitting clear, intelligible trouble signals.

e. Power Supply for the System: A dedicated branch-circuit for supplying power to the alarm system shall be provided for the Fire Alarm Control Panel (FACP). The branch circuits shall be automatically energized from an auxiliary electrical power system during failures of the normal power supply. Battery backup power shall be through use of rechargeable, sealed type storage batteries and battery charger.

f. The system shall interface to HVAC and fire sprinkler system, and other building systems as required by applicable codes to provide monitoring and control functions as described herein.

2. Network Communication

a. The network architecture shall be based on a Local Area Network (LAN), a firmware package which utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent.

b. There shall be no master, polling computer, central file computer, display controller or other central element.

c. There shall be no cascading of CPUs or master-slave relationships at the network level to facilitate network communications.

d. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations.

3. Sequence of Operation

a. When a fire-alarm condition is detected by one of the system's initiating devices, the following functions shall immediately occur:

1) All automatic programs assigned to the alarm point shall be executed and the associated indicating devices and relays activated.

2) All fire-alarm horns/strobes and beacons shall operate.

3) The system alarm on the Fire Alarm Control Panel and Remote Annunciator Command Center will indicate condition.

4) The Town Fire Alarm System Remote Monitoring Service provider shall be signaled automatically via transmitted radio signal.

5) Fan systems, i.e., shutdown, exhaust and pressurization operations to be initiated.

6) Auxiliary contact shall be provided to connect to facility PLC system to indicate fire alarm condition.

b. When a trouble condition is detected by one of the system's initiating or indicating circuits, the following functions shall immediately occur

1) System Trouble will be indicted on FACP and Annunciator Command Center.

2) A local trouble-sounding device in the FACP and Annunciator Command Control shall be activated. This sound shall be distinct from the alarm sound.

3) The appropriate message will appear on the LCD display at the FACP and Annunciator Command Center.

4) Auxiliary contact shall be provided to connect to facility PLC system to indicate system trouble.

C. Seismic Design Requirements

1. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900. SEISMIC AND WIND REQUIREMENTS.

**1.07 - QUALITY ASSURANCE**

A. Regulatory Agencies:

1. National Fire Protection Association (NFPA)

2. Underwriters' Laboratories (UL)

3. Massachusetts Electrical Code

4. Town of Orleans Fire Department

B. Standard Products: Material and equipment shall be the latest standard products of a single manufacturer regularly engaged in the manufacture of the product for the 5 years as a minimum.

C. Qualifications of the installer before commencing work: Submit information demonstrating that the supplier has successfully installed fire alarm systems of the same scope, type and design as specified.

1. Submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

2. Installer shall be qualified by the Underwriter's Laboratories to certify the complete system to be UL listed upon completion of the installation.

D. Nameplates: All components of equipment shall have the manufacturer's name, address, type or style, and catalog number on a plate securely attached to the equipment.

E. Tags: Tags with stamped identification number shall be furnished for keys and locks. Tags shall be furnished to identify cable and conduit runs, wiring circuits, and all spare parts.

F. Keys and Locks: All locks shall be keyed alike.

G. Onsite Technician Services

1. Provide the services of a representative or technician certified by the manufacturer of the system, experienced in the installation and operation of the type of system provided.

2. The representative shall be licensed in the State.

3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system, and Underwriters Laboratories listing certification requirements.

4. Provide services of the manufacturer's service representative during installation, startup and testing, for a period of three (3) working day(s) plus travel where a working day is equivalent to 8 hours.

5. Provide one person-day of vendor training.

**1.08 - REFERENCES**

A. NFPA-13 Standard for the Installation of Sprinkler Systems

B. NFPA-13A Recommended Practice for the inspection, Testing and Maintenance of Sprinkler Systems

C. NFPA-70 National Electrical Code (NEC)

D. NFPA-72 National Fire Alarm Code

E. NFPA-90A Air Conditioning and Ventilating Systems

F. NFPA Life Safety Code Handbook 94

G. Fire Protection Regulation 527 CML

H. UL Fire Protection Equipment Directory

I. Factory Mutual Systems Approval Guide

J. NFPA-1221 Public Fire Service Communication Systems

K. Underwriters' Laboratories (UL)

1. UL 1971, Standard for Visual Signaling Appliances

2. UL 864, Control Units for Fire Protective Signaling Systems

L. BOCA National Building Code and the BOCA Fire Code; Standard Building Code and the Standard Fire Code; Uniform Building Code, Uniform Fire Code or other State and Local Building Codes as adopted and/or amended by the Authority Having Jurisdiction (AHJ).

M. Department of Justice Rules for Building Accessibility by the Handicapped, and/or State and local equivalency standards as adopted by local AHJ’s.

N. Local requirements for the Town of Orleans, Massachusetts.

O. Massachusetts Electric Code.

P. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Simplex.

B. Honeywell, Inc.

C. Notifier.

D. Or approved equal.

**2.02 - MATERIAL AND EQUIPMENT**

A. Provide following system:

1. Provide an analog and addressable fire detection system. System shall be fully programmable at the FACP interface without the need for any external communication/programming device.

B. General Product Description:

1. The Fire-Alarm Control Panel (FACP) shall be capable of fire detection, equipment supervision and control, alarm management, and historical data collection and archiving.

2. The fire detection system shall have the following features:

   a. Analog/Addressable Devices

   b. Field programmability

   c. Individual ground fault annunciation

C. Communications

1. The FACP shall have sufficient memory to support its operating system and databases including:

   a. Fire management

   b. Alarm management

   c. Historical/Trend Data

   d. Maintenance Support Applications

   e. Custom Processes

   f. Operator/IO

2. Communication Ports: Provide data communication ports for simultaneous operation of devices such as industry standard printers, programming terminal, PC, transponder and annunciator.

3. Integrated On-Line Diagnostics: The FACP shall continuously perform self-diagnostics, communication diagnostics and diagnostics on all subsidiary equipment.

4. Surge and Transient Protection: Isolation shall be provided at all field point terminations to suppress induced voltage transients where required. Surge arrestors shall provide protection from all non-signal electrical surges that could cause damage to the equipment. Line surge arrestors shall be isolated from the electrical circuitry that they are protecting.

D. System Software Features:

1. All necessary software to form a complete operating system as described in this specification shall be provided.

2. The software programs specified in this section shall be provided as an integral part of the panel and shall not be dependent upon any higher-level computer for execution.

3. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. The control unit shall have capability of performing alarm analysis and signaling. At no time shall the panel's ability to report alarms be affected by operator activity.

4. Status Change Report: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

5. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided.

6. Report Routing: Alarm reports shall be archived for future recall.

7. Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.
8. The FACP shall be capable of storing a library of at least 900 events.
9. History Mode:
    a. The system shall be able to store and display at least 900 system events that have occurred in a non-volatile buffer memory.
    b. Display of these events shall be accomplished on-site through the use of the front control panel indicators and switches.
10. Field Configurable:
    a. The system shall be fully configurable and expandable without the need for EPROM programmers. All configuration shall be accomplished through downloading of programs from a computer.
    b. Reconfiguration shall not require knowledge of any programming languages or require any special training.
    c. All programs shall be stored in non-volatile memory.
    d. Entry into program mode shall require a special key and a special password entered into the front panel.

E. Analog Device Interface:

1. The Analog Device Interface will be capable of supporting devices as indicated on drawings with minimum of 25% spare capacity for future devices.
2. The analog addressable device interface shall contain its own microprocessor control.
3. The analog addressable device interface shall communicate and provide power to all devices on its loop over a single pair of wires. The fire-alarm system shall function as a Class A system.
4. The analog interface board shall receive analog information from all intelligent detectors and shall process this information to determine normal, alarm, or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.
5. Communication with all connected devices shall be performed every 5 seconds or less. Average time to detect an alarm shall be less than 10 seconds (longer for alarm verification detectors).

F. Notification Appliance Circuit:

1. The FACP shall provide supervised Class A notification circuits as indicated on drawings with 50 percent spare capacity for future devices. The circuit capacity shall be 2.0 amperes maximum per circuit, maximum of 8.0 amperes from the FACP's power supply. If a short-circuit trouble occurs on one of the circuits, it will not affect the operation of the remaining circuits.

G. Function Relays:

1. The FACP shall provide of Form "C" relay contacts, quantity as required, rated at 2 A at 120 VAC. These relays may be programmed to activate on alarm from any initiating zone or any combination of initiating zones, analog devices or addressable modules.

H. Central Processing Unit (CPU)

1. The CPU shall communicate with the operator interface, LCD display, LED display and control all other modules in the panel. Removal, disconnection or failure of any control panel shall be detected and reported by the Central Processing Unit.

2. The CPU shall contain and execute all control-by-event programs for specific action to be taken if a fire situation is detected in the system. Such control-by-event programs shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs. The CPU shall also provide a real time clock for time annotation on the display and remote optional printer.

I. Operator Display

1. The operator display shall provide all controls and indicators used by the system operator. The display shall contain, and display as needed, custom alphanumeric message for all intelligent detectors and addressable modules. Such message information shall be stored in programmable non-volatile memory.

2. The display board shall provide an 80-character alphanumeric Liquid Crystal Display (LCD). It shall also 24 LEDs for system indication such as AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; ACKNOWLEDGE; SIGNAL SILENCE, etc.

3. Factory programmable system indications and keys shall be available for unique functions. Keys shall be referred to as “Hot Keys”.

4. The Display Interface shall provide a 15-key touch keypad with control capability to command all system functions, and entry of any numeric information. The keypad shall include means to enter a minimum of two different passwords to prevent unauthorized manual control.

5. Ground fault indication shall be displayed on a system and initiating zone basis.

J. Communications Ports

1. The system shall provide the following interfaces:

a. One port for remote annunciator command center

b. One port for Central Station/Town-tie connection

c. One port for service and field programming

d. One port for Printer

K. Mechanical Design

1. The Fire Alarm Control Panel (FACP) shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include an opening for viewing.

2. The FACP shall be modular in structure for ease of installation and maintenance.

L. One Person Test Feature

1. The control unit shall include a special one-person test feature, which will allow a single person to test all initiating devices and indicating appliance in a system without returning to the panel to reset the system. A special password shall be required to enter the test mode. The service-technician shall be able to re-select the initiating and indicating circuits that are to be included in the one-person test mode. The Walk-Test shall include a special audible indication that a trouble has been detected on an analog device, for the service-technician to check proper system wiring.

M. Provide addressable monitor modules to interface manual FACP to stations, sprinkler system pressure switches, and other detection components as required.

N. Provide isolator modules in addressable loops between groups of devices in a loop to isolate short-circuit problems to within a section of a loop. The module shall be capable of being mounted in a 4 x 4 x 2 1/8-inch junction box.

O. Fire-Alarm Initiating Devices

1. Addressable Devices: All addressable detectors shall:

   a. Provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

   b. Provide address-setting means on the detector head using rotary decimal switches. The detectors shall also store an internal identifying code which the FACP shall use to identify the type of detector.

   c. Provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

   d. Include a twist-lock base.

2. Addressable pull stations shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. All operated stations shall have a positive, visual indication of operation and utilize a key type reset. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Mount stations inside a red, weatherproof enclosure with a clear polycarbonate hinged front cover where station is indicated on the drawings as NEMA 4, NEMA 4X and hazardous areas.

3. Beam Smoke Detector shall be provided as indicated on the Contract Drawings and shall consist of infrared light beam based transmitter/receiver unit and a reflector mounted on the opposite wall. The Beam Smoke Detector shall be provided with a reset device.

4. Analog/Addressable Thermal Detectors: Thermal detectors shall use an electronic sensor to respond to temperatures exceeding 135 deg. F or 190 deg. F as noted on the plans. Sensing elements shall be replaced without removing the detector base. The detector shall, on command from the control panel, send data to the panel representing the analog temperature level. These addressable detectors shall connect with two wires to one of the control addressable input circuits.

5. Thermal detectors provided in NEMA-4 and NEMA-4X areas shall be rate compensation type as manufactured by Edwards Series 302, Honeywell Series 302 or approved equal.

6. Each detector shall be provided with a steel mounting plate, and the entire unit shall mount on a double gang electrical box.

7. Sprinkler System Pressure and Tamper Switches: Furnish and wire addressable monitor modules to send signals to the FACP for monitoring of sprinkler system flow and pressure tamper switch operation where indicated on drawings.

8. Provide devices to match the NEMA ratings indicated within the Area Classification Schedule on the Contract Electrical Drawing 00 E-601.

P. Fire Alarm Indicating Devices

1. Visual appliances shall be installed as shown on the drawings in accordance with the requirements of the U.L. 1971 standard and NFPA 72. Where multiple visual signals are visible from any location, circuitry shall be incorporated for the synchronization of the flash rate.

   a. UL 1971 Listed for Emergency Devices for Hearing Impaired in all public mode installations.

   b. Strobes shall meet UL 1971 flash rate.

c. All visual signals shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.

d. The strobe intensity shall be rated per UL 1971.

e. The strobes shall be available for semi-flush or surface mounting and in conjunction with audible signals as required.

2. Alarm Horns: Audible evacuation signals shall be furnished and installed as shown on the drawings meeting the following requirements:

a. Audible Notification appliance shall be electronic and use solid state components.

b. Each electronic signal shall provide four (4) field selectable alarm tones. The tones shall consist of slow hoop, continuous, temporal or interrupted.

c. The device shall provide U.L. dBA measurement at 10 feet shall be a minimum of 85 dBA for separately mounted audible signals.

d. The device shall have provisions for standard reverse polarity type supervision and in/out field wiring using terminals that accept #14 AWG wiring.

3. Audiovisual Alarm Horns: Audiovisual Alarm Horns shall have a high intensity flashing light and alarm horn as an integral unit. Both audio and visual components shall operate from the 24 volt dc polarized indicating circuits. The horn assembly shall be housed in a rugged, die-cast enclosure, and the electronic light source shall be sealed in silicone and protected by a Lexan lens. The word FIRE shall appear on the lens. Audiovisual alarm devices shall meet the requirements of visual appliances and alarm horns above. Single and/or dual projectors shall be supplied as shown on the plans.

4. In NEMA-4 and NEMA-4X areas provide weatherproof rated indicating devices or devices enclosed in weatherproof enclosure with clear Polycarbonate front cover.

Q. Power Supply

1. The power supply for the FACP and fire alarm peripherals shall be integral to the FACP. The power supply shall provide FACP and peripheral power needs.

2. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs.

3. Input power shall be 120 VAC 60 Hz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be sized as required to meet system requirements.

4. The main power supply shall provide a battery charging circuit consisting of a fully automatic standby battery charger, rate compensated, capable of maintaining battery in fully charged state and be capable of recharging batteries to 70% of alarm capacity within 12 hours. Provide for normal operation of entire system for 24 hours with power remaining to sound alarms for 5 minutes.

5. Provide charger with the following supervised functions: circuit protection for shorts, open, disconnected or reversed polarity battery connection, supervision or protection of high or low voltage, overcharging and charger failure. Automatic load shedding or battery disconnect on deep discharge to prevent battery damage.

6. Batteries shall be 24 V, rechargeable, gelled electrolyte, totally sealed, fully charged with al interconnections ready for service, maintenance free, long-life.

R. Wiring: Wiring shall be in accordance with NFPA No. 70 and as indicated. All wiring shall be color coded.

S. Remote Annunciator Command Center

1. The remote Annunciator Command Center shall be an 80 (4 x 20) character back-lit LCD type capable of displaying up to 3200-point messages. The remote annunciator shall have the capability of driving up to 576 LEDs for future graphic notification. They shall be sixteen switch inputs that can be used for various system functions; lamp test, trouble silence, general alarm, scroll, system reset, network reset, etc. All fire-alarm controls shall be operational from the Annunciator Command Center.

2. The remote annunciator shall have non-volatile memory. Annunciators which rely on the FACP for memory will not be accepted.

3. The remote Annunciator Command Center shall be flush mounted with switches located with a locked panel, and easily visible through a glass or plastic viewing plate. Panel door shall have a keyed lock identical to the lock on the main fire alarm control panel (FACP).

T. Duct Mounted Smoke Detectors:

1. Furnish and install all duct mounted addressable type smoke detectors in accordance with NFPA 90A and 72. Detectors shall be 4-wire, addressable, Class A. Duct mounted smoke detectors shall be of the self-contained ionization type used for duct mounting rated for the air speed to be encountered in the duct, and with sampling tube and box assembly. Each smoke detector shall be provided with double pole, double throw alarm contacts. The locking cover box shall house a POWER ON light, an alarm indicator light, a reset switch, and a detector, all prewired ready for final wiring connections. Sampling tubes shall extend the full width of the ducts in which they are mounted. Each smoke detector shall be provided with remote test station capable of reset and detector status and alarm test function. Smoke detectors shall be as listed by the U.L., Inc. When any one of the smoke detectors is activated it shall:

e. Activate a visual alarm at the smoke detector and a visual and audible alarm at fire alarm system.

f. Close relay dry contracts wired to its associated temperature control panel terminal strip, to close a remote alarm.

**2.03 - SPARE PARTS AND SPECIAL TOOLS**

A. Provide one spare FACP mother board and two (of each type provided) of the following:

1. Pull Stations
2. Manual Pull Stations
3. Smoke Detectors
4. Thermal Detectors
5. Alarm Horns
6. Alarm Strobes

B. Three sets of special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps for each type shall be furnished. Spare parts shall be listed on submittal list.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install fire alarm system as indicated on the drawings, in accordance with the manufacturer's diagrams and printed instructions, except where otherwise indicated.

1. Wiring: Wiring for systems shall be installed in rigid conduit, as specified in Section 16110: ELECTRICAL RACEWAY SYSTEMS.

2. External wiring between the control panel and the stations and horns/lights shall connect to terminal strips in accessible locked cabinets. Connections to the terminal strips shall be made with terminal spade lugs or with approved type terminal blocks. Terminal cabinets shall be installed at each point where a station circuit riser originates or any point along a circuit where a tap is made. The conductors for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit. Gutter space to accommodate all necessary wiring shall be provided.
3. Panels: Panel enclosures shall comply with the requirements of UL 864. Enclosures having doors over 48 inches in height shall be provided with a three-point catch and lock; all other doors shall contain a cabinet type cylinder lock. Inserts shall be blind fastened so that no screws show on the panel front.
4. Detectors: Detectors shall be installed in accordance with manufacturer's printed instructions.
5. All wiring for the system shall be in accordance with Massachusetts Electric Code.
6. Provide complete wiring and conduit between all equipment. All devices shall be mounted upon UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.
7. All junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings.
8. Fire Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled “FIRE ALARM.”

**3.02- PERMITS AND CERTIFICATIONS**

A. Obtain all required local permits.

1. Provide UL certification of the installation.

**3.03 - FIELD TESTING**

A. Notify the Owner 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Owner or his authorized representative. Furnish all instruments and personnel required for the tests. Tests shall be conducted for the following:

1. Verify that the system is free of grounds or open circuits. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. The FACP shall indicate when a ground or open circuit exists.
2. All alarm initiating devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
3. Verify that all strobes, horns, stations, transmitters, automatic detectors and supervisory devices are functioning as specified.
    a. Strobes and horns shall deliver the correct foot-candle and sound pressure levels decibels of the specified device.
    b. Stations shall close the circuits specified and deliver specified alarm codes.
    c. Automatic detectors shall actuate the specified zones when the appropriate fire or smoke conditions are generated. The detectors shall be exposed to actual smoke used to simulate this test on each and every smoke detector as located in the building; no other test will be accepted.
    d. Panels and supervisory devices shall display and control functions as specified. Loss of AC system power shall also be tested.
    e. Radio communication of alarms to the Town fire alarm security provider shall be demonstrated and documented.

B. System tests to be performed under the supervision of the fire alarm system contractor's qualified representative and the local fire authority.

C. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance-inspector, shall be corrected.

D. Perform all tests to verify the correction of any defect found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform all required work and retest the system.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16724**

**SECURITY ALARM SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16724, SECURITY ALARM SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16724, SECURITY ALARM SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide and test a complete security detection and alarm system as indicated and specified. Contract Drawings contain plan and riser diagrams showing the location and type of all alarm points and equipment.

B. The security alarm system shall monitor the integrity of all alarm initiating circuits and shall be provided with automatically charged standby batteries to maintain system operation for 4 hours in the normal supervisory mode plus have sufficient capacity to operate in the alarm mode for 15 minutes at the conclusion of this supervisory time period. Batteries shall be supervised for connection to the system and a low voltage threshold. The automatic battery charger shall be capable of charging fully the discharge system batteries to 100 percent in 8 hours.

C. All equipment and components shall be Underwriters Laboratory (UL) listed.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings in conformance to UL 1076 and UL 681 and consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts and battery sizing calculation.
2. Submit complete system wiring schematic diagrams and point to point wiring diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that system has been coordinated and will properly function as a unit.
3. Provide a list of recommended spare parts.
4. Provide Operating and Maintenance Instruction Manual.
5. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed to prove compliance with specified performance criteria including final position of controls.
6. Provide a final as-built system wiring diagrams.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with Section 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Sequence of Operation

1. Door or window entry will be annunciated at the control panel and will initiate a remote alarm to Distributed Control System. Keypad bypass switches shall be provided at all doors.

D. Service

1. The equipment manufacturer shall have a local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

**1.07 - QUALITY ASSURANCE**

A. Standard Products: Material and equipment to be the latest standard products of a manufacturer regularly engaged in the manufacture of the products.

B. Nameplates: Major components of equipment to have the manufacturer’s name, address, type or style, and catalog number on a plate securely attached to the equipment.

C. Tags: Tags with stamped identification number to be furnished for keys and locks and all spare parts furnished for the Authority’s stock to maintain the system. Furnish and install tags to identify cable and conduit runs and wiring circuits on the installed system.

D. Keys and Locks: Key all locks alike.

E. Accessibility: Provide enclosures with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, provide the units installed in a single cabinet large enough to accommodate all units, and allow ample gutter space for interconnections of panels and field wires.

F. Verify that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation.

1. Provide Services of Service Technician, specifically trained on type of equipment specified.

G. 1.09 - SEISMIC DESIGN REQUIREMENTS

1. Conform to the requirements indicated on the structural drawing S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

2. It shall be the responsibility of manufacturer and supplier along with the Electrical Contractor to conform to the seismic design requirements for this project and for the work of this specification section.

**1.08 - REFERENCES**

A. National Fire Protection Agency (NFPA)

1. NFPA 72: National Electrical Code (NEC)

B. Underwriter's Laboratories, Inc. (UL).

1. UL 1076: UL Standard for Safety Proprietary Burglar Alarm Units and System.

2. UL 681: UL Standard for Safety Installation and Classification of Mercantile and Bank Burglar Alarm Systems.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Robert Bosch, Inc. ON, Canada.

B. Honeywell, Inc., S. Minneapolis, MN.

C. Tyco Simplex Grinnell, BC, Canada.

D. Or equal

**2.02 - ALARM SYSTEM OPERATION**

A. The system shall be comprised of ten zones. Zones shall be programmable for Instant, Delay, Day Supervisory, Silent, Priority (non shuntable). Loop Response Time shall be programmable. System shall detect faulty read only memory (ROM) on power up. System shall be continually supervised by a watch dog Microprocessor Timer.

B. The system shall be armed, disarmed, reset, monitored and altered by the use of the system main keypad. The system shall provide fail safe arming preventing arming of the system if a zone has been violated or is not fully closed. System shall indicate which zone has door(s) not fully closed.

C. Actuation of any device shall cause the following to occur.

1. Sound the interior audible device at the Control Panel.

2. Activate the built-in digital telephone dialer or communicator, seize the protected premises telephone line and automatically report the alarm to a remote location.

3. Indicate the alarm condition at keypads.

D. Acknowledgment of alarms or troubles, in conjunction with interrogation of other systems activity (i.e. alarm memory, bypassing of zones, etc) shall require the use of a Personal Authorization Code (PAC) number to be entered in the keypad.

E. Up to ninety (30) user PAC codes can be utilized with the system. Programming of these codes shall be field programmable into EEProm memory without the use of any special programming tools (i.e. Prom burners or factory programming methods). Programming will occur through the systems digital remote keypad. A user programming code will be required to make such changes. The remote keypad shall provide a means to verify programmed instructions through binary information displayed by the system's status indicators. No special displays or other associated hardware will be permitted to review program contents. Power outages or complete battery discharge shall not affect programmed field instructions.

F. Provide capability for all door entrances to be programmable for exit/entry time delays (1 to 255 seconds), providing a warning tone when in the timing sequence. All other system contacts shall provide an instant alarm if system has been armed and in the timing sequence.

G. During a daytime disarmed condition, all door or window switches or any initiating alarm appliance shall be indicated through the system status indicators if in alarm condition. If the panel is armed these appliances will actuate the control, sound the signals and alert the monitoring station through the built in communicator.

H. Signal cut off time shall be programmable from 1 to 255 minutes.

I. The panel shall contain a daytime disarmed supervisory mode. It shall be configurable to either provide a latching or auto-restore mode of operation. With this function any zone that is violated will provide local annunciation without sounding the signals or activating the communicator. If in the auto-restore mode, the keypad sounder will activate and restore when the contact is open then closed. If in the latching mode, the keypad will sound until reset from the keypad with the PAC code. A SPDT relay will be provided in the control to activate auxiliary sounding devices.

J. The system shall incorporate a door strike output timed or toggled (on/off) to provide either automatic timed entrance when disarmed or manual activation through the keypad with PAC number.

K. System alarms shall be retained in EEProm memory until reset using the PAC number. Complete power outage shall not affect alarm memory recall.

L. An auxiliary beacon at the front door shall be provided when system is alarm.

M. The system shall include the following features as a minimum.

1. Supervised monitoring of all indicating appliance wiring both in the daytime or bypassed condition.
2. Separate alarm, trouble, bypass, ready to arm and secure indicators at each keypad control station. Keypads shall be flush mounted.
3. Dead front design control panel/with all indicators and control switches located behind a locked door.
4. Automatic transfer to standby batteries upon power failure.
5. Inclusion for a digital dialer compatible with Owner's requirements and all major receivers including Adcor; Ademco; Franklin; Osborne; Hoffman; Radionics; Sescoa; ADT; Silent Knight and Varitech.
6. Watch dog microprocessor monitoring.
7. Fully field keypad programmable EEProm memory.
8. Dynamic 24 hour battery load test.
9. Continuous monitoring of fuses for auxiliary voltage outputs.
10. Six stage lightning protection.
11. Shunt by zone from keypad.
12. Zone auto shunt or auto/restore after alarm.
13. Retained alarm memory.
14. Digital communicator shall be approved to comply with applicable FCC codes. Unit shall feature either pulse or touch tone dialing. "Call Waiting" tones shall not prevent proper operation. The following communicator parameters shall be programmable from the keypad and not require either Prom burners or other factory programming methods.
    a. Report by zone.
    b. Single or two line extended reporting.
    c. Two account codes.
    d. Split reporting.
    e. Opening and closing reports by user codes.
    f. Closing ring back.
    g. Restoral reporting.
    h. Programmable abort.
    i. Supervisory reporting of all trouble conditions.

j. Programmable delay before dialing.

k. Programmable dial attempts.

l. Programmable delay between dial attempts.

m. Programmable test reporting for intervals of 12 hours up to 7 days.

n. Shunt by zone reporting.

o. AC failure and AC restoral reporting.

p. Low battery and battery restoral reporting.

q. Memory error reporting.

r. Listen in capabilities.

15. Bell test on arming.

16. Auxiliary light output during alarm conditions.

17. Door strike output either timed or keypad accessible.

18. Keypad tamper.

19. Uploading of memory contents available to IBM PC compatible host.

20. Provide optional cellular telephone service as back-up system should phone lines be interrupted.

21. Output contacts to transmit a signal to the General Alarm Panel.

22. Output contacts to transmit a signal to the Distributed Control System.

**2.03 - ALARM SYSTEM COMPONENTS**

A. System shall include a local security alarm control panel with alarm indicating lights, door switches, window detectors, motion detectors, key pad by-pass switches, power supply, conduit, and wiring. Quantity of contacts to be monitored as required.

1. Provide multi-zone control panel surface mounted as indicated.

2. Control panel shall have built-in battery backup and shall provide up to 900 mA power auxiliary devices. Voltage shall be regulated at 13.8 VDC. Automatic system shutdown will occur at 7.5 VDC to prevent false alarming.

3. During alarm condition sup to 3.0 Amps of power shall be available to drive sirens and auxiliary functions.

4. Control panel shall be provided with a two sound siren driver.

5. Control panel shall be listed UL Commercial Grade A Local Burglar, Grade B and C Central Station Burglar. Unit shall be provided with a Simplex; Honeywell; Johnson & Controls or equal, attack proof enclosure featuring heavy gauge/welded seam construction and be provided with two tamper switches to supervise front and rear tampering.

6. Provide zone expander module permitting the connection of 3 N/O zones in addition to the basic eight zones.

7. Provide equipment and enclosures to comply with National Electric Code including Hazardous Locations, Class, Division, and Group as indicated on Contract Drawings.

8. Keypads - Provide weatherproof keypads as indicated. Keypads shall be provided with a built in sounder for audible system signaling. Keypads are not to be externally mounted unless mounted in weatherproof enclosures. Keypads shall operate via multiplex communications to provide total system indication and access code authorization over four conductors.

9. Door/Window Contacts/Switches - Provide UL listed magnetic flush mounted contacts and magnets. Each contact shall be provided with matching magnet. All contacts shall be hermetically sealed for long term 10,000,000 cycle contact. Switch contacts shall be of the reed blade type with rhodium plating eliminating cold-welding; sticking and resistance build-up. All switches shall be 100 percent factory tested prior to installation.

10. Outside High Powered, Weather Resistant, Siren Speaker - Provide, as indicated, weatherproof 30 Watt Siren Speaker. Unit shall feature 125 dB at 10-ft. sound output and shall be provided with N/C tamper loop to supervise against removal.

11. Outside Tamper Resistant Weatherproof Enclosure - Provide tamper resistant enclosure provided with two tamper switches to supervise against front cover and wall mounting.

12. Glass Break Detectors - Provide UL listed Glass Break Detectors as indicated. Units shall feature state of the art, thick film technology and be of the solid state Piezo electric glass break detector type. Device type shall contain discriminating circuits that detect only the specific mechanical ultrasonic frequencies generated by breaking glass. Sensors shall protect a 10-ft. radius of glass area. Sensors shall be of the N/C variety and shall each feature a latching LED to indicate the appropriate detector in alarm.

13. Provide programmable timers for entry delay, exit delay, access, alarm cut-off, and audible output.

14. Provide zone alarms which are selectable as instant or delay.

15. Electronics provided with memory to retain arm and disarm status and alarm memory.

16. Microprocessor monitoring circuit shall be provided.

17. Lightning and surge protection devices shall be provided.

18. Provide resonating type sounder device for the annunciation of an alarm condition at the panel.

B. Provide touch tone digital communication device with primary and secondary dialing capability.

C. Size and type of wire for the systems shall be as recommended by the system supplier.

**2.04 - SPARE PARTS**

A. Provide recommended spare parts list.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide security system complete and operating as indicated and specified. Provide all equipment, wiring, conduit and outlet boxes required for the installation of a complete and operating system in accordance with applicable codes, the manufacturer's recommendations, as indicated and this Section. All wiring shall be a completely separate conduit system. Color coded wires shall be used throughout. Wiring shall conform to the National Electrical Code.

B. Devices and Panel: Install security alarm devices and panel in accordance with manufacturer's printed instructions.

**3.02 - FIELD TESTING**

A. Provide checkout, field and functional testing to verify all features of the system are fully operational.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16761**

**VIDEO SURVEILLANCE SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16761, VIDEO SURVEILLANCE SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16761, VIDEO SURVEILLANCE SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide and test a fully-integrated Video Surveillance System to accomplish the specified access control and monitoring functions.

B. Include all system design, configuration, programming, installation, wiring, electrical service, connection to the monitoring system, mounting hardware, appurtenance, and testing necessary for a fully functional Video Surveillance to meet operational requirements.

C. Provide and test all wiring and cabling required for the Video Surveillance System to operate in compliance with the specified requirements. Include system component installation, interfacing equipment items, and interconnecting wiring.

D. Provide all software, hardware, devices, workstations, power supplies, accessories, wiring, special cables, training, and support required for the specified system operation.

E. Provide all required electrical work in accordance with Division 16.

F. Provide specific design with detail drawings and associated documentation extending the general requirements specified into a complete and operating system.

G. Connect, test, demonstrate and commission all system hardware, software, and system controls.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Provide Bill of Materials with manufacturer catalog cut sheets that are clearly annotated to show which devices and options are being submitted.

2. Provide CCTV control panel dimensional drawings and panel elevations showing component layouts. Drawings shall be to-scale.

3. Provide control panel wiring schematics clearly indicating all required field wiring.

4. Indicate all components and network topology. Include the following as a minimum:

   a. Overall system block diagram, hardware placement, rack and equipment panel arrangements and layouts.

   b. A functional description of the block diagram. Describe the overall system operation, interaction between system elements, and system operator interactions.

   c. Include the manufacturer's name and model number for each hardware item shown on the block diagram, as well as auxiliary equipment such as power supplies.

   d. Include a system architecture drawing showing the system controller, monitors, recorders, cameras and point-to-point connection diagrams showing cable types and device terminal numbers; layout drawings for the control consoles, including front, side and plan views with all components identified; and pole, pole base and mounting bracket detail drawings.

   e. Include web-based connections between facilities on system architecture drawings.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. System Description

   1. Work includes furnishing, calibrating, adjusting, testing, documenting, and start-up of a complete video surveillance, recording, and access control system.

   2. Provide equipment for a complete and operational system.

   3. Provide system architecture as shown on Contract drawings.

   4. Provide electrical and communications wiring and installation required for a fully functional system. As part of the system, provide all appurtenance, including electrical service and mounting hardware to make the system complete, including all duct banks, CCTV camera poles, conduit and wire, and transformers required for the CCTV system.

**1.06 - QUALITY ASSURANCE**

A. Standard Products: Material and equipment to be the latest standard products of a manufacturer regularly engaged in the manufacture of the products. All equipment shall be new. Provide quality assurance in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL.

B. Accessibility: Provide enclosures with ample clearance to allow proper separation between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, provide the units installed in a single cabinet large enough to accommodate all units, and allow ample clearance for interconnections of panels and field wires.

C. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation. Services of Service Technician specifically trained on type of equipment specified. Person-day requirements listed exclusive of travel time.

1. Assist in location of devices, methods of mounting, and field erection -2 person-day
2. Start-up and testing -2 person-day
3. Person-day is defined as one 8-hour day, excluding travel time.

**1.08 - REFERENCES**

A. Underwriters Laboratories (UL).

B. American National Standards Institute (ANSI):

1. ANSI C136.3 – Roadway Lighting Equipment-Luminaire Attachments.

C. American Society for Testing and Materials (ASTM)

D. National Electrical Manufacturers Association (NEMA).

E. Electronic Industries Association (EIA).

F. National Electrical Code (NEC).

G. Massachusetts Electrical Code.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - CCTV CAMERAS**

A. Provide quantities of cameras at locations shown on Contract drawings.

B. Provide CCTV Cameras with:

1. Pan/tilt drives and weatherproof housing.
2. Hardware for building and pole mounting.
3. CCTV infrared illuminators.
4. Power over Ethernet (PoE).

C. CCTV cameras shall continuously monitor:

1. WWTF entrances and exits.
2. WWWTF main site entrance gate.
3. Locations as indicated on Contract electrical drawings.

**2.02 - CONTROL PANELS**

A. Provide CCTV Control Panels (CCTV CPs) as indicated:

1. Waste Water Treatment Facility CCTV Control Panel (CCTV-CP.10-1)

B. Provide 120VAC rated, UL listed Control Panel with:

1. Uninterruptable power supplies (UPS) to supply standby power to entire camera, monitoring and recording system. UPS shall be sized to provide 15 minutes of operation time upon loss of normal power.
2. Surge Protection Devices (SPD)
3. Power supplies as required for CCTV system devices

**2.03 - CCTV WORKSTATION**

A. Provide a dedicated CCTV Monitoring Workstation at the Waste Water Treatment Plant Control Room (RM 116).

B. Provide CCTV Display Monitor:

1. Flat Screen CRT display monitor with minimum viewable image size of 19.8 inches.
2. 300 cd/m2 minimum brightness.
3. Digital on-screen controls.
4. Maximum resolution of 1600x900@85Hz or better.

C. Provide CCTV Monitoring Workstation with:

1. Flat Screen CRT display monitor with minimum viewable image size of 19.8 inches.
2. Video management software
3. Video storage
4. Programmable automatic controls for CCTV equipment.
5. System software capable of web-based monitoring of remote facility CCTV camera feeds.
6. Power supply: 110 VAC, 60Hz. Power cords supplied.
7. Audio: 1-channel (line in or microphone in, line out).

**2.04 - WIRE AND CABLE**

A. Provide wire, cable and raceways in accordance with Div. 16 requirements and in accordance with SECTION 16120 – ELECTRIC WIRES AND CABLES.

1. Communications cabling and ancillary components necessary to provide a complete and functional system.
   a. Links between CCTV-CP.10-1 (Network Rack) cameras shall be Ethernet.
   b. Provide web-based link for the CCTV camera system to allow remote viewing.

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Inspect facility that is to be monitored by this Section.

**3.02 - INSTALLATION**

A. Configure, install, interconnect, and test all system equipment as specified.

B. Provide all labor, materials and equipment necessary to furnish and install the CCTV System as specified.

C. Install in accordance with the manufacturer's instructions and locate equipment as indicated, unless otherwise directed.

D. Installation shall be in accordance with the Massachusetts Electrical Code.

E. System Grounding: Isolate video components from multiple grounds by use of insulating spacers, nylon camera mounting bolts, and electrical tape around coaxial splices.

F. Provide terminal blocks for all necessary interconnecting wiring. Secure all cable bundles with cable ties. Provide support bars in enclosures for cable bundles.

G. Label all indicators, switches, monitors, jacks and controls. Permanently tag all cables with wire markers covered with clear heat-shrink tubing.

H. Terminate spare equipment outputs with appropriate terminators.

I. Provide continuous wiring between equipment or junction box terminals.

**3.03 - ADJUSTING**

A. Conduct process operational assistance for each system component as placed into service.

**3.04 - DEMONSTRATION**

A. Provide start-up services, include programming required to make the system fully functional, energizing all equipment, testing each camera, testing viewing and recording system, and fully demonstrating each component of the system.

B. Start up

1. Inspect each System for conformity and compliance of materials, equipment and construction.

2. Adjust all control components to provide stable control of System.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16900**

**ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Control and Miscellaneous Electrical Equipment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data, brochures including wiring diagrams in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Wiring diagrams to show control interface points provided with other equipment.

3. Shop drawings to include:
    a. Outline drawings with elevations.
    b. Equipment arrangement drawings.
    c. Anchor bolt location drawings.
    d. Electrical schematics and wiring diagrams.
    e. Electrical fuse/circuit breaker characteristic.
    f. Equipment performance curves and technical data.
    g. Bill of installation/assembly materials.
    h. Equipment weights.
    i. Completed manufacturer’s data sheets.
    j. Assembly sizes and weights.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

A. Underwriter's Laboratories, Inc. (U.L.):
    1. UL-467: UL Standard for Safety, Grounding and Bonding Equipment.
    2. UL-489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
    3. UL-823: Electrical Heaters for Use in Hazardous (Classified) Locations.

B. National Electrical Manufacturers Association (NEMA):
    1. 250: Enclosures for Electrical Equipment (1000 volts maximum).
    2. ICS 1: General Standards for Industrial Control and Systems.
    3. ICS 2: Industrial Control Devices, Controllers and Assemblies.
    4. ICS 4: Terminal Blocks for Industrial Use.

C. American Society for Testing and Materials (ASTM) Publications:
    1. D 178: Specification for Rubber Insulating Matting.

D. National Fire Protection Association (NFPA):

1. NFPA-70 National Electric Code (NEC).

E. Massachusetts Electric Code.

**1.08 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on Structural Drawing 00-S-001 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**1.09 - DESCRIPTION**

A. Provide and connect the electrical control equipment and miscellaneous electrical equipment, including such instruments and devices indicated and specified. Device enclosures for electrical equipment shall comply with the requirements of Massachusetts Electric Code including Hazardous Locations, Class, Division, and Group as indicated.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE ELECTRICAL DISTRIBUTION MANUFACTURERS**

A. Allen-Bradley.

B. General Electric Company.

C. Cutler-Hammer.

D. Square D Company.

E. Appleton Electric Company.

F. Crouse-Hinds Company.

G. O-Z/Gedney.

H. Or equal.

**2.02 - ACCEPTABLE STAINLESS STEEL/GALVANIZED STEEL CHANNEL MANUFACTURERS**

A. Unistrut Corp.

B. Power-Strut.

C. B-Line Systems, Inc.

D. Or equal.

**2.03 - ACCEPTABLE FIBERGLASS CHANNEL MANUFACTURER**

A. Omnistrut, Champion Fiberglass.

B. Durostrut, Enduro Composite Systems.

C. Struttech, Entrum Industries.

D. Or equal.

**2.04 - SAFETY DISCONNECT SWITCHES**

A. Provide heavy duty type, safety switches, with external operating handles, 3 PST, rated 600 volt, 60 Hertz with ampere rating as indicated, and having provisions for padlocking.

B. Provide rejection type fuses, 600 volts, 200,000 A.I.C., dual element, time delay, Class RK-5.

C. Heavy duty safety switches to be UL listed, and meet or exceed NEMA Standard KS1.

**2.05 - PUSHBUTTON AND SELECTOR SWITCH STATIONS**

A. Provide RUN-OFF-REMOTE (ROR) switches, start-stop, push buttons, tumbler switches and other accessory devices as necessary for the control of motors and other electrical equipment or devices as indicated where shown on the wiring schematics and/or plan drawings.

B. Provide pushbutton and selector switch stations made for heavy-duty service and with momentary or maintaining contacts as indicated or as necessary for starting and stopping of equipment with 10 amp contact ratings.

C. Acceptable manufacturers of heavy-duty switches and pushbuttons are Square D, Cutler-Hammer, Allen Bradley or equal. Indicating lights to be led cluster type.

D. At stations provide nameplates with white letters on black background.

E. Provide explosion proof stations approved for use in Massachusetts Electric Code, Class I, Division 1, Group C & D areas. Stations shall also meet NEMA 4X area requirements.

F. Provide galvanized cast-iron enclosures for NEMA Type 4 watertight stations.

G. Provide fiberglass reinforced polyester NEMA Type 4X enclosures for stations located in highly corrosive areas. Provide gaskets and Type 316 stainless steel screws, to prevent entry of chemicals.

**2.06 - MANUAL MOTOR STARTERS**

A. Provide manual motor starters where indicated and for 120-volt, 60-Hertz fractional horsepower motors.

B. Provide each manual motor starter with overload heater or heaters of suitable capacity for motor-running over-current protection for motor it controls. Provide manual starters as single or 2 pole, as necessary, and with toggle mechanisms indicating OFF and ON positions. Provide manual starters with built-in HAND-OFF-AUTO switches. Provide enclosures as indicated.

C. Manual starters to be located within sight of motors, as defined by Massachusetts Electric Code.

**2.07 - WALL-MOUNTED COMBINATION STARTERS**

A. Unless otherwise indicated, provide each combination starter with motor circuit protector and full-voltage magnetic starter. Provide starters in an enclosure that meets the requirements of the enclosure schedule. Provide motor circuit protectors and starters as specified in SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS.

B. Indicating lights shall be LED cluster type, heavy-duty, oil-tight units. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.

**2.08 - CONTROL PANELS AND ELECTRICAL ENCLOSURES**

A. Provide enclosures with back panels constructed of at least 14 gage steel and provided with terminal blocks for connection of external wiring. Provide door and body stiffeners in panels over 36 inches in length. NEMA 4 and NEMA 4X panels shall be provided with hand operated quick disconnects of 316 stainless steel material.

B. Provide UL listed and NEMA rated pushbuttons, LED cluster type indicator lights and switches of heavy duty, oil tight types. Provide relays of industrial types, with 120-volt, 60-Hertz operating coils, and contacts rated for intended service. Power from fused control power transformers.

C. Provide nameplates for each panel and each device on panel. Nameplates of laminated plastic material, at least 3/32 in. thick, and with white letters on a black background.

D. Secure nameplates with self-tapping, Type 316 stainless steel metal screws.

E. Terminal Blocks:

1. Provide terminal blocks rated for 600 volts with screw type terminals.

2. Terminal blocks to be one piece with full barriers.

3. Acceptable manufacturers of terminal blocks are General Electric, Marathon, Weidmuller or equal.

F. Provide print pocket on inside of enclosure and include as-built drawings.

G. Where 480V AC and 120 VAC are required within the same enclosure, install components to insure separation of wiring for the panel voltage circuits.

H. Free standing enclosures shall be provided with light fixtures, light switch and 20 amp GFI protected receptacle. Light fixtures shall be UL listed for wet locations and provided with glass globe, metal guard and 100 watt incandescent lamp.

I. Where visual strobe or warning lamps are required, provide heavy duty beacon. Acceptable manufacturers are Edwards Signal Catalogue No. 93, Hubbell, Gamewell or equal.

J. Where audible horn alarms are required, provide from the following acceptable manufacturers: Edwards Signal 870P, Simplex, Faraday, or equal.

K. Where intrinsically safe wiring is required within the panels, the following requirements shall be met:

1. Within enclosures, conductors or intrinsically safe (IS) circuits shall be separated two inches from conductors of any non-intrinsically safe circuit. Within the enclosure the conductors shall be secured.

2. Intrinsically safe wiring shall not be routed in the same conduit as non-IS wiring.

3. Terminals in panels with IS wiring shall be identified in a manner that will prevent unintentional interference with the control circuits during testing and servicing.

L. All indicating lamps to be LED cluster type. Provide “Red” lights to indicate equipment on status. Provide “Green” lights to indicate equipment off status. Provide “Amber” to indicate alarm conditions.

M. Provide enclosures types to meet the requirement of the area classification schedule indicated on the Contract Electrical Drawings.

**2.09 - RUBBER MATS**

A. Provide insulating rubber mats conforming to ASTM D-178 Type I, Class I: Mats shall be 3 ft. wide and have a length equal to the equipment before which they are to be placed. Provide two spare mats, each 12-feet long as spares.

B. Provide mats for transformers, switchboard, panelboards, motor control centers, control panels, SCADA racks, Fire Alarm Panels and variable frequency drives.

**2.10 - CONTACTORS AND RELAYS**

A. Provide mechanically held, heavy duty industrial type contactors (relays) for lighting control, rated 30 amps, 600 volts, with number of poles as indicated.

B. Provide contactor in the required NEMA enclosure suitable for wall mounting. Provide circuit breaker or fuse protection on each ungrounded pole. Provide mechanically held contactor from the following acceptable manufacturers: Automatic Switch Company 917 series, Cutler-Hammer, Square D or equal.

C. Provide control power transformer with primary and secondary fuse protection. Control power to be 120 volts, single phase.

D. Provide solid-state, industrial grade timing relays from the following acceptable manufacturers: Allen Bradley Series 700, Cutler-Hammer, Siemens or equal.

E. Provide industrial grade relays, NEMA rated, from the following acceptable manufacturers: Square D Class 8501, Cutler-Hammer, Allen Bradley or equal.

**2.11 - NAMEPLATES**

A. Provide nameplates for equipment (including pushbutton and selector switch stations) listed in this Section to designate the equipment controlled and their function.

B. Nameplates shall be laminated black bakelite with one-quarter inch (1/4-in.) high, white, recessed letters. Securely attach to the equipment with Type 316 stainless steel screws, or rivets. Adhesives, glue or cements will not be permitted.

C. Provide all junction boxes, pull boxes, disconnect switches and control panels with a nameplate to designate the system wiring contained within.

D. Install nameplates in a location near or on the equipment or devices.

**2.12 - TERMINAL BLOCKS**

A. Provide terminal blocks in all terminal boxes panels, control and instrumentation cabinets/panels requiring terminations as indicated on drawings or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white wire markers.

**2.13 - CHANNEL**

A. Provide Type 316 stainless steel channel or fiberglass channel with corresponding accessories as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS and herein.

B. Provide hot-dipped galvanized after fabrication for steel channel and accessories.

C. Provide channel of the proper material to match equipment classifications, per SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

**PART 3 - EXECUTION**

**3.01 - CHANNELS**

A. Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas, NEMA 4 or 4X areas, and on below grade, outside building and structure walls.

B. Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed in Paragraph 3.02.A of this Section.

C. Install fiberglass channel in chemical areas with NEMA 4X enclosures.

**3.02 - PHYSICAL CHECKOUT AND TESTING**

A. Provide field and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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## DIAGRAMS

1200/800 — CIRCUIT BREAKER, 3-POLE UNLESS OTHERWISE NOTED. UPPER NUMBER IS FRAME SIZE. LOWER NUMBER IS TRIP SETTING. WHERE ONLY ONE NUMBER IS SHOWN, NUMBER IS TRIP SETTING.

MCP — MOTOR CIRCUIT PROTECTOR

MAGNETIC STARTER
FVNR = FULL VOLTAGE, NON-REVERSING
FVR = FULL VOLTAGE, REVERSING
FVTS = FULL VOLTAGE, TWO SPEED
RVNR = REDUCED VOLTAGE, NON-REVERSING,
AUTO-TRANSFORMER TYPE
PW = PART WINDING
C = MAGNETIC CONTACTOR (WITHOUT OL.)
RVSS = REDUCED VOLTAGE, SOLID STATE
FVNR 2 — NUMBER INDICATES NEMA STARTER SIZE

30A — UNFUSED DISCONNECT SWITCH. NUMBER DENOTES AMPERE RATING.

100/70 — FUSED DISCONNECT SWITCH, 3-POLE UNLESS OTHERWISE NOTES. UPPER NUMBER INDICATES FUSE CLIP AMPERE SIZE. LOWER NUMBER INDICATES FUSE RATING.

J — FUSE - LETTER DENOTES CLASS

TRANSFORMER, SIZE AS NOTED, DELTA CONNECTION-PRIMARY. WYE CONNECTION GROUNDED-SECONDARY (LOW VOLTAGE).

VFD — VARIABLE FREQUENCY DRIVE

INPUT LINE REACTOR

dV/dT — dV/dT OUTPUT FILTER

5 — SQUIRREL CAGE INDUCTION MOTOR. NUMBER DENOTES HORSEPOWER OR KW

5 — PACKAGED MOTOR WITH MOTOR, STARTER AND CONTROLS. NUMBER INDICATES KILOWATT RATING OR HORSEPOWER.

F 10KW — ELECTRIC UNIT HEATER 10KW INDICATES KILOWATT SIZE

600:5 (3) — CURRENT TRANSFORMER. UPPER NUMBERS ARE RATIO. NUMBER IN ( ) IS QUANTITY.

GFP — GROUND FAULT PROTECTION

ST — SHUNT TRIP RELAY

R — INDICATING LIGHTS: R=RED, B=BLUE, G=GREEN, A=AMBER, W=WHITE

K — KEY INTERLOCK

K — MECHANICALLY INTERLOCKED (KEY)

E — ELECTRICALLY INTERLOCKED

NORMALLY OPEN CONTACT

NORMALLY CLOSED CONTACT

VS — VOLTMETER SELECTOR SWITCH

AS — AMMETER SELECTOR SWITCH

CS — CIRCUIT BREAKER CONTROL SWITCH

CTB — CURRENT TEST BLOCK

PTB — POTENTIAL TEST BLOCK

SYS — SYNCHRONIZING SWITCH

TB — TEST BLOCK

26 — PROTECTIVE RELAY
2-TIME DELAY RELAY
25 - SYNCHROCHECK RELAY
26 - THERMAL DEVICE
27 - UNDER VOLTAGE RELAY
43 - TRANSFER DEVICE
50 - INSTANTANEOUS OVER CURRENT RELAY
64 - GROUND PROTECTIVE RELAY
67 - DIRECTIONAL OVER CURRENT
74 - ALARM RELAY
83 - TRANSFER RELAY
86 - LOCKOUT RELAY, HAND RESET

A — A = AMMETER
D = DEMAND METER
F = FREQUENCY METER
KW = KILOWATT-HOUR METER
PF = POWER FACTOR METER
V = VOLTMETER
VAR = VARMETER
W = WATT METER
WH = WATT-HOUR METER

## DIAGRAMS

480:120 / (1) CPT — DRAWOUT DEVICE
CPT = CONTROL POWER TRANSFORMER
PT = POTENTIAL TRANSFORMER.
UPPER NUMBERS ARE RATIO.
NUMBER IN ( ) IS QUANTITY

## PLANS

SD — SMOKE DUCT DETECTOR

MANUAL MOTOR STARTER

MAGNETIC MOTOR STARTER

COMBINATION MAGNETIC MOTOR STARTER AND DISCONNECT SWITCH

UNFUSED DISCONNECT SWITCH

F — FUSED DISCONNECT SWITCH

PANELBOARD

M — MOTOR FURNISHED AND INSTALLED UNDER OTHER DIVISION, CONNECTED UNDER DIVISION 16.

M — PACKAGED MOTOR WITH MOTOR STARTER AND CONTROL FURNISHED AND INSTALLED UNDER OTHER DIVISIONS, CONNECTED UNDER DIVISION 16.

EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER DIVISIONS, CONNECTED UNDER DIVISION 16.

J — JUNCTION BOX

TYPICAL DUCT BANK SECTION
[XX] 5" — INDICATES WIRE WIRE TYPE AND QUANTITY WITHIN DUCT.
SPARE 5" — INDICATES SIZE OF DUCT.
SECTION #

G — GROUND ROD: TYPE AND SIZE AS INDICATED ON PLAN OR IN SPECIFICATIONS.

G-G-G — EXOTHERMIC CONNECTION

GROUND ROD AND TEST WELL

GROUND PLATE: TYPE AND SIZE AS INDICATED ON PLAN OR IN SPECIFICATIONS.

G-G-G — EXOTHERMIC CONNECTION

G-G-G — BOLTED CONNECTION

G — GROUNDING CABLE

CONDUIT RUNS UNDERGROUND OR EMBEDDED IN CONCRETE

CONDUIT RUNS OVERHEAD

CONDUIT RUNS
PIPE LINE HEAT TRACING. FOR RATING SEE SPECIFICATIONS AND PLANS

XXX — SEE ABBREVIATION FOR ITEM TYPE

ELECTRICAL UTILITY POLE

DT3 1 a — SURFACE, RECESSED OR PENDANT MOUNTED LUMINARIE

SURFACE, RECESSED OR PENDANT MOUNTED LUMINARIE

SURFACE, RECESSED OR PENDANT MOUNTED NON-SWITCHED LUMINARIE (NIGHT LIGHT)

WALL MOUNTED INCANDESCENT, FLUORESCENT OR HIGH INTENSITY DISCHARGE LUMINARIE

POLE OR POST-TOP MOUNTED LUMINARIE

ROADWAY LUMINARIE

WALL MOUNTED EXIT LIGHT. ARROW (IF SHOWN) INDICATES DIRECTION OF EGRESS

CEILING OR PENDANT MOUNTED EXIT LIGHT. ARROW (IF SHOWN) INDICATES DIRECTION OF EGRESS

BATTERY OPERATED AUXILIARY LIGHTING UNIT, MOUNT 7'-6" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED

REMOTE MOUNTED AUXILIARY LIGHTING HEAD MOUNTED 7'-6" ABOVE FLOOR UNLESS OTHERWISE NOTED.

"1" DENOTES PANELBOARD BRANCH CIRCUIT #1. "a" DENOTES CONTROLLED BY LOCAL SWITCH "a". "DT3" DENOTES FIXTURE TYPE. "E" DENOTES EXISTING FIXTURE

## PLANS

$S_a$ — SINGLE POLE SWITCH CONTROLS FIXTURES MARKED "a"

$S_{2_b}$ — DOUBLE POLE SWITCH CONTROLS FIXTURES MARKED "b"

$S_{3_c}$ — THREE-WAY SWITCH CONTROLS FIXTURES MARKED "c"

$S_{4_d}$ — FOUR-WAY SWITCH CONTROLS FIXTURES MARKED "d"

$HOA_e$ — HAND-OFF-AUTO SELECTOR SWITCH CONTROLS FIXTURES MARKED "e"

$S_{MD}$ — MOTION DETECTOR INTERGRAL TO WALL SWITCH

OS — OCCUPANCY SENSOR (CEILING MOUNTED)

FLOOR/CEILING MOUNTED QUAD RECEPTACLE/DATA RECEPTACLE REFER TO FLOOR PLANS AND LEGEND FOR ADDITIONAL INFORMATION (GROUND TYPE)

FLOOR/CEILING MOUNTED QUAD RECEPTACLE REFER TO FLOOR PLANS AND LEGEND FOR ADDITIONAL INFORMATION (GROUND TYPE)

FLOOR/CEILING MOUNTED DUPLEX RECEPTACLE REFER TO FLOOR PLANS AND LEGEND FOR ADDITIONAL INFORMATION (GROUND TYPE)

FLOOR/CEILING MOUNTED DATA RECEPTACLE REFER TO FLOOR PLANS AND LEGEND FOR ADDITIONAL INFORMATION

GFCI — DUPLEX RECEPTACLE (GROUND TYPE) GFCI DENOTES GROUND FAULT CIRCUIT INTERRUPTER

WPG — DUPLEX RECEPTACLE (GROUND TYPE) GFCI WITHIN WEATHERPROOF ENCLOSURE

GFCI — QUAD RECEPTACLE (GROUND TYPE) GFCI DENOTES GROUND FAULT CIRCUIT INTERRUPTER

SPECIAL PURPOSE RECEPTACLE, TYPE AND AMPERE RATING AS INDICATED ON PLAN

WP — DUPLEX RECEPTACLE (GROUND TYPE), "WP" DENOTES WEATHERPROOF, "XP" DENOTES EXPLOSION PROOF

RECESSED TELEPHONE/DATA OUTLET, MOUNTED 48" AFF

SURFACE MOUNTED TELEPHONE/DATA OUTLET MOUNTED 48" AFF

RECESSED DATA OUTLET MOUNTED 48" AFF

SURFACE MOUNTED DATA OUTLET, MOUNTED 48" AFF

RI — REMOTE INDICATOR

I — SURFACE MOUNTED INTERCOM WALL OUTLET AND HAND STATION, MOUNTED 48" A.F.F.

I — CEILING FLUSH MOUNTED INTERCOM SPEAKER

I — TRUMPET TYPE INTERCOM LOUDSPEAKER

## SECURITY

CR — CARD ACCESS READER (MOUNTED 3'-6" A.F.F.)

KP — KEYPAD ENTRY (MOUNTED 3'-6" A.F.F.)

EDL — ELECTRONIC DOOR LOCK (COORD. MOUNTING HEIGHT WITH ARCHITECTURAL PLANS AND DOOR HARDWARE REQUIREMENTS)

MD REX — REQUEST TO EXIT DETECTOR (COORD. MOUNTING HEIGHT WITH ARCHITECTURAL PLANS AND DOOR HARDWARE REQUIREMENTS)

CCTV CAMERA WITH INFRARED ILLUMINATOR (CEILING MOUNTED)

CRCP — CARD READER CONTROL PANEL (MOUNTED 3'-6" A.F.F.

SSCP — SECURITY CONTROL PANEL (MOUNTED 3'-6" A.F.F.)

MD — MOTION DETECTOR (CEILING MOUNTED)

MD REX — REQUEST TO EXIT MOTION DETECTOR (CEILING MOUNTED)

IS-D — INTRUSION SWITCH - DOOR

IS-W — INTRUSION SWITCH - WINDOW GLASS/BREAK

## LEGEND:

DEMOLITION WORK - COORDINATE DISCONNECTING AND REMOVING ELECTRICAL WORK WITH DEMOLITION WORK PROVIDED UNDER OTHER DIVISIONS AND EXISTING CONDITIONS.

NEW WORK

EXISTING WORK

## ABBREVIATIONS

| | |
|---|---|
| AFF | ABOVE FINISHED FLOOR |
| AFG | ABOVE FINISHED GRADE |
| AHU | AIR HANDLING UNIT |
| AL | ALARM |
| AN | ANNUNCIATOR |
| ARMS | ARC REDUCTION MAINTENANCE SWITCH |
| ATO | AUTOMATIC THROW-OVER SYSTEM |
| ATS | AUTOMATIC TRANSFER SWITCH |
| CAH | CHEMICAL ALARM HORN |
| CHS | CHEMICAL ALARM INITIATING HAND SWITCH |
| CACP | CARD ACCESS CONTROL PANEL |
| CAP | CHEMICAL ALARM PANEL |
| CLF | CURRENT LIMITING FUSE |
| CMS | COMBINATION MOTOR STARTER |
| CP | CONTROL PANEL |
| CPT | CONTROL POWER TRANSFORMER |
| CR | CONTROL RELAY |
| CS | CONTROL SWITCH |
| DB | DUCT BANK |
| DP | DISTRIBUTION PANEL |
| DS | DISCONNECT SWITCH |
| EE | ELECTRICAL ENCLOSURE |
| EF | EXHAUST FAN |
| EHH | ELECTRICAL HAND HOLE |
| EL | ELEVATION |
| EMH | ELECTRICAL MANHOLE |
| EOV | ELECTRICALLY OPERATED VALVE |
| ES | EMERGENCY STOP SWITCH (MAIINTAINED CONTACT) (PROVIDE DEVICE THAT CAN BE LOCKED IN THE OFF POSITION) |
| EUH | ELECTRIC UNIT HEATER |
| EWC | ELECTRIC WATER COOLER |
| FAA | FIRE ALARM ANNUNCIATOR PANEL |
| FACP | FIRE ALARM CONTROL PANEL |
| FANM | FIRE ALARM NETWORK MODULE |
| FS | SPRINKLER SYSTEM FLOW SWITCH |
| FSL | FIRE ALARM STATUS LIGHT |
| FIS | IONIZATION SMOKE DETECTOR STATUS STATION |
| FSR | FORWARD-STOP-REVERSE |
| FTC | FIRE FIGHTER'S TELEPHONE STORAGE CABINET |
| GANP | GENERATOR ANNUCIATOR PANEL |
| GEN | GENERATOR |
| GFP | GROUND FAULT PROTECTION |
| GFCI | GROUND FAULT CIRCUIT INTERRUPTER |
| GND | GROUND |
| GSC | GROUNDED SERVICE CONDUCTOR |
| GSCT | GROUND SENSING CURRENT TRANSFORMER |
| G | GROUND |
| HA | HAND-AUTOMATIC |
| HH | HAND HOLE |
| HOA | HAND-OFF-AUTOMATIC |
| HP | HORSEPOWER |
| HS | HAND SWITCH |
| HTR | MOTOR HEATER |
| IL | INDICATING LIGHT |
| IR | IN REMOTE |
| ISB | INTRINSICALLY SAFE BARRIER |
| JB | JUNCTION BOX |
| KP | KEY PAD |
| KS | KEY SWITCH |
| KW | KILOWATT |
| LCS | LOCAL CONTROL STATION |
| LOR | LOCAL-OFF-REMOTE |
| LP | LIGHTING PANEL |
| LR | LOCAL-REMOTE |
| LS | LIMIT SWITCH |

## ABBREVIATIONS

| | |
|---|---|
| MH | MANHOLE |
| MCC | MOTOR CONTROL CENTER |
| MCP | MOTOR CIRCUIT PROTECTOR |
| MM | MAINTENANCE MODE |
| MS | MOTOR STARTER |
| MOV | MOTOR OPERATED VALVE |
| MVT | PAD-MOUNTED TRANSFORMER |
| NATS | NON-AUTOMATIC TRANSFER SWITCH |
| NIR | NOT IN REMOTE |
| NO | NORMALLY OPEN |
| NC | NORMALLY CLOSED |
| OC | OPEN-CLOSE |
| O/C/T | OPEN/CLOSE/TRIP |
| OL'S | MOTOR OVERLOADS |
| OSC | OPEN-STOP-CLOSE |
| PB | PULL BOX |
| PLC | PROCESS LOGIC CONTROLLER |
| PM | POWER MONITOR |
| ROA | RUN-OFF-AUTOMATIC |
| ROR | RUN-OFF-REMOTE |
| SAAP | SECURITY ALARM ANNUNCIATOR PANEL |
| SSCP | SECURITY SYSTEM CONTROL PANEL |
| SEL | SELECTOR SWITCH |
| SF | SLOW-FAST |
| SFS | SLOW-FAST-STOP |
| SOFA | SLOW-OFF-FAST-AUTOMATIC |
| SPD | SURGE PROTECTION DEVICE |
| SS | START-STOP |
| SV | SOLENOID VALVE |
| SW | SWITCH |
| T | TRANSFORMER |
| TC | TIMED CLOSE |
| TD | TIME DELAY RELAY |
| TO | TIMED OPEN |
| TI | TIMER |
| TMH | TELEPHONE MAN HOLE |
| TQ | TORQUE ALARM SWITCH |
| TR | TRANSFORMER |
| TS | TEMPERATURE SENSOR |
| TX | TRANSFORMER, DRY-TYPE |
| TTC | TELEPHONE TERMINAL CABINET |
| TYP | TYPICAL |
| UPS | UNINTERRUPTIBLE POWER SUPPLY |
| VFD | VARIABLE FREQUENCY DRIVE |
| W | DENOTES WATERTIGHT EQUIPMENT |
| WP | DENOTES WEATHERPROOF EQUIPMENT |
| XFMR | TRANSFORMER |
| XP | DENOTES EXPLOSION PROOF EQUIPMENT |
| XST | EXISTING |
| ZSS | ZERO SPEED SWITCH |
| AE | ANALYZER SENSOR |
| AIT | ANALYZER INDICATING TRANSMITTER |
| CFS | CHEMICAL FILL STATION PANEL |
| FE | FLOW ELEMENT |
| FIT | FLOW INDICATING TRANSMITTER |
| LIT | LEVEL INSTRUMENT TRANSMITTER |
| LSH | LEVEL SWITCH HIGH |
| LSHH | LEVEL SWITCH HIGH-HIGH |
| LSL | LEVEL SWITCH LOW |
| LSLL | LEVEL SWITCH LOW-LOW |
| MSH | MOISTURE SWITCH HIGH |
| O2 | OXYGEN MONITOR |
| PS | PRESSURE SWITCH |
| TIT | TEMP INDICATING TRANSMITTER |
| TSH | TEMP SWITCH HIGH |

## GENERAL NOTES

1. SWITCHBOARD AND MCC COMPARTMENT DESIGNATIONS AS FOLLOWS:
   - BLANK: NOT INTENDED FOR USE, PLATE ONLY.
   - SPACE: CONTAINS NECESSARY BUS AND HARDWARE FOR FUTURE ADDITION OF BREAKERS OR STARTERS WITHIN SIZE RANGE SHOWN
   - SPARE: CONTAINS A COMPLETE BREAKER, VFD OR STARTER INSTALLED, SIZE AS INDICATED AVAILABLE FOR FUTURE USE.
2. CONDUIT INSTALLATIONS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURAL CONDITIONS. EXPOSED CONDUITS SHALL BE INSTALLED PARALLEL TO BEAMS AND WALLS.
3. CONDUIT AND WIRE (NOT SHOWN) FOR LIGHTING FIXTURES, SWITCHES AND/OR RECEPTACLES SHALL BE FURNISHED AND INSTALLED AND SHALL BE:
   - A. 3/4" (MIN.) RIGID METAL CONDUIT
     - A1. EXPOSED IN UNFINISHED AREAS.
     - A2. CONCEALED ABOVE SUSPENDED CEILINGS AND IN WALLS IN FINISHED AREAS.
   - B. NO. 12 CU. WIRE (MIN.) TYPE "THWN/THHN" NO. OF WIRES AS REQUIRED, INCLUDING GROUND. PROVIDE TRAY RATED CABLE WHEN RUN IN CABLE TRAY.
4. PROVIDE COMPONENTS AND DEVICE ENCLOSURES RATED IN ACCORDANCE WITH THE NEMA RATINGS ON THE AREA CLASSIFICATION SCHEDULE.
5. DUCT BANK CONDUIT SIZES ARE GIVEN IN THE DUCT BANK CALLOUTS. WHERE THE SAME CONDUIT NUMBER IS USED BOTH IN THE DUCT BANK AND IN A BUILDING, THE CONDUIT SIZE GIVEN IN THE CONDUIT SCHEDULE APPLIES TO THE CONDUIT IN THE BUILDING ONLY.
6. FURNISH METAL PIPE SLEEVES FOR CONDUITS ROUTED THROUGH WALLS TO THE CONTRACTOR FOR PLACING IN WALLS PRIOR TO POURING OF CONCRETE.

## ELECTRICAL SHEET NUMBERING

XY E-ZZZ

ZZZ - DRAWING NUMBER
- 000: GENERAL
- 100: PLANS - ELECTRICAL PLANS - LOWER/GRADE LEVELS
- 200: PLANS - ELECTRICAL PLANS - UPPER LEVEL
- 300: PLANS - ELECTRICAL PLANS - ROOF LEVEL
- 500: DETAILS
- 600: DIAGRAMS

XY - SITE LOCATION
- 00: GENERAL
- 10: WASTE WATER TREATMENT FACILITY (WWTF)
- 15: SBR NO.1 & NO.2
- 20: EQUIPMENT STORAGE FACILITY
- 25: IN-PLANT SANITARY PUMP STATION
- 30: WICK DISTRIBUTION VAULT & WICK WELLS
- 99: DETAILS

EXAMPLE:
10 E-001 - WWTF - ELECTRICAL SITE PLAN
15 E-101 - SBR NO.1 & NO.2 - ELECTRICAL POWER PLAN - GRADE LEVEL

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS — ANDREA ABRAHAM — ELECTRICAL — REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# ELECTRICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES

**SHEET NUMBER**

# 00 E-001

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\00 E-001.DWG
LAST UPDATE: Tuesday, March 24, 2020 1:46:27 AM
PLOT DATE: Tuesday, March 24, 2020 4:11:22 AM

## CONDUIT AND WIRE SCHEDULE

MEDIUM VOLTAGE POWER WIRING

[MV-1] 5"C, CABLE PROVIDED AND INSTALLED BY ELECTRICAL UTILITY.

LOW VOLTAGE POWER WIRING

[PA] 1"C, 2-12 AWG, 1-12 AWG (G)
[PA-4] 1"C, 4-12 AWG, 1-12 AWG (G)
[PA-6] 1"C, 6-12 AWG, 1-12 AWG (G)
[PB] 1"C, 3-12 AWG, 1-12 AWG (G)
[PC] 1C, 3-10 AWG, 1-10 AWG (G)
[PC-2] 1"C, 2-10 AWG, 1-10 AWG (G)
[PC-10] 2"C, 10-10 AWG, 1-10 AWG (G) 1
[PD] 1"C, 3-8 AWG, 1-10 AWG (G)
[PD-1] 1"C, 3-8 AWG, 1-10 AWG (G)
[PD-2] 1"C, 2-8 AWG, 1-10 AWG (G)
[PD-4] 1"C, 4-8 AWG, 1-10 AWG (G)
[PE] 1"C, 3-6 AWG, 1-10 AWG (G)
[PE-2] 1"C, 2-6 AWG, 1-10 AWG (G)
[PE-4] 1"C, 4-6 AWG, 1-10 AWG (G)
[PF] 1"C, 3-4 AWG, 1-10 AWG (G)
[PF-4] 1 1/2"C, 4-4 AWG, 1-10 AWG (G)
[PG] 1"C, 3-4 AWG, 1-8 AWG (G)
[PG-4] 1"C, 4-4 AWG, 1-8 AWG (G)
[PH] 1 1/4"C, 3-2 AWG, 1-8 AWG (G)
[PH-4] 1 1/2"C, 4-2 AWG, 1-8 AWG (G)
[PJ] 1 1/2"C, 3-1 AWG, 1-8 AWG (G)
[PJ-4] 1 1/2"C, 4-1 AWG, 1-8 AWG (G)
[PK] 1 1/2"C, 3-1 AWG, 1-6 AWG (G)
[PK-4] 1 1/2"C, 4-1 AWG, 1-6 AWG (G)
[PL] 1 1/2"C, 3-1/0 AWG, 1-6 AWG (G)
[PL-4] 1 1/2"C. 4-1/0 AWG, 1-6 AWG (G)
[PM] 1 1/2"C, 3-2/0 AWG, 1-6 AWG (G)
[PM-4] 2"C, 4-2/0 AWG, 1-6 AWG (G)
[PN] 2"C, 3-3/0 AWG, 1-6 AWG (G)
[PP] 2"C, 3-4/0 AWG, 1-4 AWG (G)
[PQ] 2 1/2"C, 3-250 KCM, 1-4 AWG(G)
[PR] 3"C, 3-350 KCM, 1-4 AWG(G)
[PS] 3"C, 3-350 KCM, 1-2 AWG(G)
[PT] 3"C, 3-500 KCM, 1-2 AWG(G)
[PU] 2-2"C, 6-3/0 AWG, 2-2 AWG(G)
[PV] 2-2"C, 6-4/0 AWG, 2-2 AWG(G)
[PW] 2-2"C, 6-250 KCM, 2-2 AWG(G)
[PX] 2-3"C, 6-350 KCM, 2-1 AWG(G)
[PY] 2-3"C, 6-500 KCM, 1-1/0 AWG(G)
[PZ] 3-3"C, 9-350 KCM, 3-1/0 AWG(G)
[PPB] 3-3"C, 9-500 KCM, 3-2/0 AWG(G)
[PPC] 3-3"C, 9-500 KCM, 3-3/0 AWG(G)
[PPD] 4-3"C, 12-350 KCM, 4-3/0 AWG(G)
[PPD-4] 4-3"C, 16-350 KCM, 4-3/0 AWG(G)
[PPE] 4-3"C, 12-500 KCM, 4-4/0 AWG(G)
[PPF] 5-3"C, 15-500 KCM, 5-4/0 AWG(G)
[PPF-4] 5-3"C, 20-500 KCM, 5-4/0 AWG(G)
[PPG] 6-3"C, 18-500 KCM, 6-250 KCM(G)
[PPG-4] 6-4"C, 24-500 KCM, 6-250 KCM(G)
[PPH] 7-4"C, 21-500 KCM, 7-350 KCM(G)
[PPJ] 8-4"C, 32-500 KCM, 8-500 KCM(G)

SIGNAL WIRING

[D2] 3/4"C, 2-14 AWG, 1-14 AWG (G)
[D3] 3/4"C, 3-14 AWG, 1-14 AWG (G)
[D4] 3/4"C, 4-14 AWG, 1-14 AWG (G)
[D5] 3/4"C, 5-14 AWG, 1-14 AWG (G)
[D6] 3/4"C, 6-14 AWG, 1-14 AWG (G)
[D7] 3/4"C, 7-14 AWG, 1-14 AWG (G)
[D8] 3/4"C, 8-14 AWG, 1-14 AWG (G)
[D9] 3/4"C, 9-14 AWG, 1-14 AWG (G)
[D10] 3/4"C, 10-14 AWG, 1-14 AWG (G)
[D11] 1"C, 11-14 AWG, 1-14 AWG (G)
[D12] 1"C, 12-14 AWG, 1-14 AWG (G)
[D13] 1"C, 13-14 AWG, 1-14 AWG (G)
[D14] 1"C, 14-14 AWG, 1-14 AWG (G)
[D15] 1"C, 15-14 AWG, 1-14 AWG (G)
[D16] 1"C, 16-14 AWG, 1-14 AWG (G)
[D17] 1"C, 17-14 AWG, 1-14 AWG (G)
[D18] 1"C, 18-14 AWG, 1-14 AWG (G)
[D19] 1"C, 19-14 AWG, 1-14 AWG (G)
[D20] 1"C, 20-14 AWG, 1-14 AWG (G)
[D28] 1"C, 28-14 AWG, 1-14 AWG (G)
[D30] 1"C, 30-14 AWG, 1-14 AWG (G)
[D34] 1 1/2"C, 34-14 AWG, 1-14 AWG (G)
[D40] 1 1/2"C, 40-14 AWG, 1-14 AWG (G)
[D50] 1 1/2"C, 50-14 AWG, 1-14 AWG (G)
[D60] 1 1/2"C, 60-14 AWG, 1-14 AWG (G)

CONTROL WIRING

[VSC] 1"C, VENDOR SUPPLIED CABLE
[CX] 1" C, COAXIAL CABLE
[E1] 1"C, 1-CAT 6 CABLE
[E2] 1"C, 2-CAT 6 CABLES
[FO1] 1"C, 1-FIBER OPTIC MEDIA CABLE
[FO2] 1"C, 2-FIBER OPTIC MEDIA CABLES
[C1] 1"C, 1-TSP 16 AWG
[C2] 1"C, 2-TSP 16 AWG
[C3] 1"C, 3-TSP 16 AWG
[C4] 1 1/2"C, 4-TSP 16 AWG
[C5] 1 1/2"C, 5-TSP 16 AWG
[C6] 1 1/2"C, 6-TSP 16 AWG
[C7] 1 1/2"C, 7-TSP 16 AWG
[C8] 1 1/2"C, 8-TSP 16 AWG
[C9] 2"C, 9-TSP 16 AWG
[C10] 2"C, 10-TSP 16 AWG
[C11] 2"C, 11-TSP 16 AWG
[C12] 2"C, 12-TSP 16 AWG
[C13] 2"C, 13-TSP 16 AWG
[C19] 2 1/2"C, 19-TSP 16 AWG
[C20] 2/1/2" C, 20-TSP 16 AWG
[T2] 1"C, 1-2 PAIR TELEPHONE CABLE
[T10] 2" C, 1-1O PAIR TELEPHONE CABLE

GROUNDING:

NOTE: ALL G SERIES WIRING SHALL BE CONNECTED TO GROUNDING BUS BAR LOCATED IN THE ELECTRICAL ROOM UNLESS OTHERWISE INDICATED. INSTALL IN PVC CONDUIT. 1

| | | |
|---|---|---|
| [G1] 1"C, 1-12 AWG(G) | [G6] 1"C, 1-2 AWG(G) | [G11] 1 1/2"C, 1-250 KCM(G) |
| [G2] 1"C, 1-10 AWG(G) | [G7] 1"C, 1-1/0 AWG(G) | [G12] 2"C, 1-350 KCM(G) |
| [G3] 1"C, 1-8 AWG(G) | [G8] 1"C, 1-2/0 AWG(G) | [G13] 2"C, 1-500 KCM(G) |
| [G4] 1C, 1-6 AWG(G) | [G9] 1 1/2"C, 1-3/0 AWG(G) | |
| [G5] 1"C, 1-4 AWG(G) | [G10] 1 1/2"C, 1-4/0 AWG(G) | |

CONDUIT AND WIRE SCHEDULE NOTES:

1. FOR CIRCUITS RUN IN DUCT BANKS, THE DUCT SIZE INDICATED ON THE DUCT BANK SCHEDULE GOVERNS THE CONDUIT SIZE IN THE DUCT BANK. CONDUIT SIZES SHOWN HERE GOVERNS CONDUIT SIZE WHEN NOT RUN IN DUCT BANK.

## ENVIRONMENTAL CLASSIFICATIONS*

| LOCATION | NEMA TYPE | | | | | HAZARDOUS CLASS 1 GROUP D** | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 1 | 3R | 4 | 4X | 12 | DIV. 1 | DIV. 2 | SEE BELOW |
| **(10) - WASTE WATER TREATMENT FACILITY (WWTF)** | | | | | | | | |
| VEST-1 | x | | | | | | | 1 |
| 101 - TRUCK BAY/SEPTAGE RECEIVING | | | | | | x | | |
| 102 - GARAGE | | | | x | | | | |
| 103 - BREAK ROOM | x | | | | | | | |
| 104 - CHEM STORAGE ROOM - SH & PACL | | | | x | | | | |
| 105 - CONFERENCE ROOM | x | | | | | | | |
| 106 - SUPER. OFFICE | x | | | | | | | |
| 107 - COPY ROOM | x | | | | | | | |
| 108 - ELECTRICAL ROOM | x | | | | | | | |
| 109 - MECHANICAL ROOM | | | | | x | | | |
| 110 - STORAGE ROOM | | | | | x | | | |
| 111 - MENS ROOM | x | | | | | | | |
| 112 - MENS SHOWER | | | | | x | | | |
| 113 - WOMENS ROOM | x | | | | | | | |
| 114 - WOMENS SHOWER | | | | | x | | | |
| 115 - LABORATORY | x | | | | | | | |
| 116 - CONTROL ROOM | x | | | | | | | |
| 117 - CHEM STORAGE ROOM - POLYMER | | | | x | | | | |
| 118 - HEADWORKS ROOM | | | | | | x | | R3 |
| 119 - DISK FILTER ROOM | | | | x | | | | |
| 120 - CORRIDOR | x | | | | | | | |
| 121 - WASTE SLUDGE STORAGE TANK NO.2 | | | | | | x | | R3 |
| 122 - THICKENED SLUDGE STORAGE TANK | | | | x | | | | |
| 123 - POST EQUALIZATION TANK | | | | x | | | | |
| 124 - PRE-EQUALIZATION TANK NO.1 | | | | | | x | | R3 |
| 125 - PRE-EQUALIZATION TANK NO.2 | | | | | | x | | R3 |
| 126 - BASEMENT PUMP ROOM | | | x | | | | | |
| STR-1, STR-2 | | | | | x | | | |
| 130 - CLOSET | | | | | x | | | |
| 132 - MOP AREA | | | | | x | | | |
| 133 - LAUNDRY | x | | | | | | | |
| 134 - WASTE SLUDGE STORAGE TANK NO.1 | | | | | | x | | R3 |
| 135 - CHEM STORAGE ROOM - SODA ASH | | | | x | | | | |
| ODOR CONTROL | | | | | | | x | R5 |
| | | | | | | | | |
| **(15) - SBR TANKS** | | | | | | | | |
| 128 - SBR TANK NO. 1 | | | | | | | x | R4 |
| 129 - SBR TANK NO.2 | | | | | | | x | R4 |
| | | | | | | | | |
| **(20) - EQUIPMENT STORAGE FACILITY** | | | | | | | | |
| 201 - EQUIPMENT STORAGE FACILITY | | | x | | | | | |
| 202 - EQUIPMENT STORAGE FACILITY ADMIN | x | | | | | | | |
| | | | | | | | | |
| **(25) - SANITARY PUMP STATION** | | | | | | | | |
| SANITARY PUMP STATION | | | | | | x | | R3 |
| | | | | | | | | |
| **(30) -WICK DISTRIBUTION** | | | | | | | | |
| WICK DISTRIBUTION VAULT | | | x | | | | | |
| WICK WELLS NO.1/2/3/4/5 | | | | x | | | | |
| | | | | | | | | |
| OUTDOORS (UNLESS OTHERWISE COVERED ABOVE) | | | | x | | | | R1 |

REMARKS:

* PROVIDE EQUIPMENT AND INSTALLATION TO COMPLY WITH AREA CLASSIFICATION REQUIREMENTS.

** RADIUS SHALL EXTEND TO ALL DIRECTIONS UNLESS SPECIFICALLY IDENTIFIED AS A HORIZONTAL OR VERTICAL RADIUS.

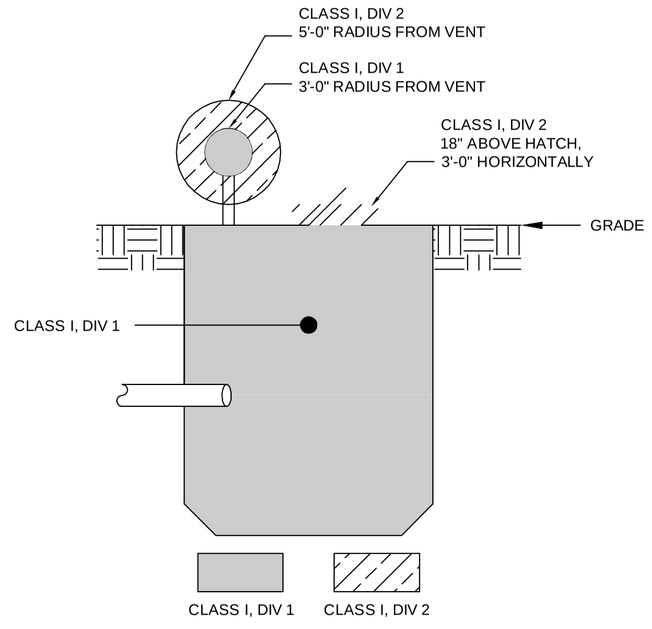
R1 = OUTDOORS ARE AREAS NOT ENCLOSED BY WALLS AND CEILING.

R2 = SEE FIGURE R2 THIS SHEET.

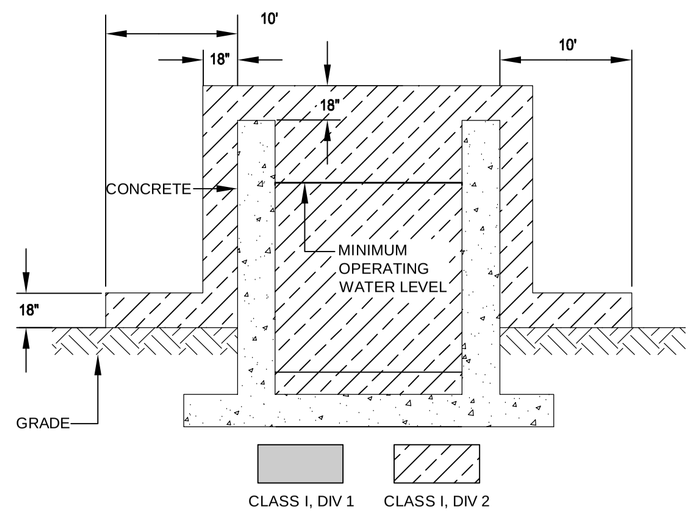
R3 = TANKS AND ENCLOSED STRUCTURES 1
CLASS 1 DIVISION 1 INSIDE TANK/STRUCTURE
CLASS 1 DIVISION 1 WITHIN 0.9 M (3 FT) RADIUS FROM VENT
CLASS 1 DIVISION 2 WITHIN 1.5 M (5 FT) RADIUS FROM VENT
CLASS 1 DIVISION 2 WITHIN 0.9 M (3 FT) HORIZONTAL RADIUS FROM HATCH
CLASS 1 DIVISION 2 WITHIN 1.5 M (5 FT) VERTICAL RADIUS FROM HATCH
NEMA 4X AREA BEYOND CLASSIFIED RADIUS
SEE FIGURE R3 THIS SHEET.

R4 = TANKS NOT ENCLOSED, OPEN TO ATMOSPHERE
CLASS I DIVISION 2 INSIDE TANK FROM MINIMUM OPERATING WATER SURFACE TO THE TOP OF THE TANK WALL
CLASS I DIVISION 2 RADIUS EXTENDS 0.46 M (18 IN.) ABOVE THE TOP OF THE TANK AND EXTENDING 0.46 M (18 IN.) BEYOND THE XTERIOR WALL.
CLASS I DIVISION 2 RADIUS 0.46 M (18 IN.) ABOVE GRADE EXTENDING 3 M (10 FT) HORIZONTALLY FROM THE EXTERIOR TANK WALLS.
SEE FIGURE R4 THIS SHEET.

R5 = PRIMARY ODOR ODOR CONTROL
CLASS I DIVISION 2 EXTENDS 0.9 M (3 FT) RADIUS FROM VENT. NEMA 4X BEYOND.




R3
ENCLOSED TANKS AND STRUCTURES
CLASSIFICATION DETAIL




R4
TANKS NOT ENCLOSED, OPEN TO ATMOSPHERE
CLASSIFICATION DETAIL

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
NO. 34962
REGISTERED
PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# ELECTRICAL SCHEDULES I

**SHEET NUMBER**

# 00 E-601


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E00 E-601.DWG
LAST UPDATE: Tuesday, March 24, 2020 12:36:47 AM
PLOT DATE: Tuesday, March 24, 2020 11:29 AM

## LUMINAIRE SCHEDULE

| LUMINAIRE TYPE | LUMINAIRE MTG | LAMP TYPE | LAMP WATTS | VOLTAGE | GUIDELINE MANUFACTURER | OR EQUAL | REMARKS AND OPTIONS |
|---|---|---|---|---|---|---|---|
| BM1 | PEND | LED | 45 | MVOLT | LITHONIA SERIES FEM LED | OR EQUAL | LUMINAIRE 4'-0", ONE-PIECE FIBERGLASS HOUSING, LED'S MOUNTED TO CORE CIRCUIT BOARD, SPREAD LIGHT DISTRIBUTION, POLYCARBONATE LENS, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S (6,000 LUMENS), CRI OF 80, NEMA 4X LISTED. |
| BM2 | PEND | LED | 59 | MVOLT | LITHONIA SERIES FHE LED | OR EQUAL | LUMINAIRE 2'-0", ONE-PIECE FIBERGLASS HOUSING, LED'S MOUNTED TO CORE CIRCUIT BOARD, MEDIUM LIGHT DISTRIBUTION, CLEAR POLYCARBONATE LENS, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S (9,000 LUMENS), CRI OF 80, NEMA 4X LISTED. |
| BM3 | PEND | LED | 79 | MVOLT | LITHONIA SERIES FHE LED | OR EQUAL | LUMINAIRE 2'-0", ONE-PIECE FIBERGLASS HOUSING, LED'S MOUNTED TO CORE CIRCUIT BOARD, MEDIUM LIGHT DISTRIBUTION, CLEAR POLYCARBONATE LENS, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S (12,000 LUMENS), CRI OF 80, NEMA 4X LISTED. |
| BM4 | PEND/ WALL/ CEILING | LED | 20 | MVOLT | LITHONIA SERIES CLX LED STRIP | OR EQUAL | LUMINAIRE 4'-0", STEEL HOUSING, BAKED WHITE POLYESTER FINISH, LED'S MOUNTED TO CORE CIRCUIT BOARD, WIDE LIGHT DISTRIBUTION, DIFFUSE ACRYLIC LENS, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S (3,000 LUMENS), CRI OF 80, UL LISTED. |
| CJ1 | GRID | LED | 16 | 120 | LITHONIA SERIES 2VTL | OR EQUAL | LUMINAIRE 2'-0" x 2'-0" RECESSED GRID MODEL, ACRYLIC LINEAR PRIMATIC DIFFUSER, VOLUMETRIC LIGHT DISTRIBUTION, WHITE PAINTED REFLECTOR, DIE-FORMED FRAME, HIGH EFFICIENCY LED DRIVERS, LED'S MOUNTED TO CORE CIRCUIT BOARDS, 0-10V DIMMING DRIVER, 2,000 NOMINAL LUMENS, 4000K LED'S, MINIMUM OF 80 CRI, IC RATED, CSA CERTIFIED. PROVIDE DRYWALL CEILING ADAPTER WITH TRIM KIT WHEN NOT USED WITH A DROP CEILING |
| CJ2 | GRID | LED | 26 | 120 | LITHONIA SERIES 2VTL | OR EQUAL | LUMINAIRE 2'-0" x 2'-0" RECESSED GRID MODEL, ACRYLIC LINEAR PRIMATIC DIFFUSER, VOLUMETRIC LIGHT DISTRIBUTION, WHITE PAINTED REFLECTOR, DIE-FORMED FRAME, HIGH EFFICIENCY LED DRIVERS, LED'S MOUNTED TO CORE CIRCUIT BOARDS, 0-10V DIMMING DRIVER, 3,000 NOMINAL LUMENS, 4000K LED'S, MINIMUM OF 80 CRI, IC RATED, CSA CERTIFIED. PROVIDE DRYWALL CEILING ADAPTER WITH TRIM KIT WHEN NOT USED WITH A DROP CEILING |
| CJ3 | GRID | LED | 33 | 120 | LITHONIA SERIES 2VTL | OR EQUAL | LUMINAIRE 2'-0" x 2'-0" RECESSED GRID MODEL, ACRYLIC LINEAR PRIMATIC DIFFUSER, VOLUMETRIC LIGHT DISTRIBUTION, WHITE PAINTED REFLECTOR, DIE-FORMED FRAME, HIGH EFFICIENCY LED DRIVERS, LED'S MOUNTED TO CORE CIRCUIT BOARDS, 0-10V DIMMING DRIVER, 4,000 NOMINAL LUMENS, 4000K LED'S, MINIMUM OF 80 CRI, IC RATED, CSA CERTIFIED. PROVIDE DRYWALL CEILING ADAPTER WITH TRIM KIT WHEN NOT USED WITH A DROP CEILING |
| DD1 | GRID | LED | 112 | 120 | CROUSE-HINDS SERIES HAZARD-GARD EVLL | OR EQUAL | CLASS I, DIVISION 1 LUMINAIRE, COPPER FREE ALUMINUM HOUSING, GRAY POWDER COAT FINISH, HIGH EFFICIENCY LED DRIVERS, LED'S MOUNTED TO CORE CIRCUIT BOARDS, 11,000 NOMINAL LUMENS, 4000K LED'S, MINIMUM OF 80 CRI, STAINLESS STEEL HARDWARE, UL LISTED. |
| DD2 | GRID | LED | 149 | 120 | CROUSE-HINDS SERIES HAZARD-GARD EVLL | OR EQUAL | CLASS I, DIVISION 1 LUMINAIRE, COPPER FREE ALUMINUM HOUSING, GRAY POWDER COAT FINISH, HIGH EFFICIENCY LED DRIVERS, LED'S MOUNTED TO CORE CIRCUIT BOARDS, 13,000 NOMINAL LUMENS, 4000K LED'S, MINIMUM OF 80 CRI, STAINLESS STEEL HARDWARE, UL LISTED. |
| EM1 | WALL | LED | 50 | MVOLT | PARAFLEX SERIES DCSLM | OR EQUAL | WALL MOUNTED LUMINIARE, DIE CAST ALUMINUM HOUSING, THERMOSET POWDER COAT FINISH, (CUSTOM COLORED FINISH TO BE APPLIED TO THIS FIXTURE, COORDINATE COLOR WITH ARCHITECT), 4000K LED'S (5,193 LUMENS), HIGH EFFICIENCY DRIVER, BUTTON TYPE PHOTOCELL, FIELD ADJUSTABLE DISTRIBUTION, POLYCARBONATE LENS, CRI OF 80, WET LOCATION LISTED. |
| EM2 | WALL | LED | 40 | 120/277V | DIALIGHT SERIES SAFESITE LED AREA LIGHT | OR EQUAL | CLASS I, DIVISION 1, WALL MOUNTED LUMINAIRE, COPPER FREE ALUMINUM HOUSING, GRAY POLYESTER FINISH, GLASS LENS, STAINLESS STEEL HARDWARE, 0 DEGREE WALL MOUNT ACCESSORY, 4000K LED'S (4,001 - 5000 LUMENS), 0-10V DIMMING, HIGH EFFICIENCY DRIVER, -40°C to +65°C OPERATING TEMPERATURE RANGE, 6kv SURGE SUPPRESOR, MINIMUM CRI OF 80, UL LISTED. |
| EU1 | WALL | LED | **2-6** | MVOLT | EMERGI-LITE SERIES JS-HP | OR EQUAL | EMERGENCY BATTERY UNIT, GRAY STEEL HOUSING, 12 VOLT, 40 WATT BATTERY WITH TWO 6 WATT LED HEADS, NON-AUDIBLE ADVANCED DIAGNOSTICS AND SELF-TEST, NEMA 1 LISTED, UL LISTED. PROVIDE BACKUP BATTERY POWER TO REMOTE HEADS RH1A/1B AND RH2A/2B AS SHOWN ON CONTRACT DRAWINGS. |
| EU2 | WALL | LED | 2-6 | MVOLT | EMERGI-LITE SERIES HP | OR EQUAL | EMERGENCY BATTERY UNIT, GRAY FIBERGLASS HOUSING, STAINLESS STEEL HARDWARE, 12 VOLT, 40 WATT BATTERY WITH TWO 6 WATT LED HEADS, NON-AUDIBLE ADVANCED DIAGNOSTICS AND SELF-TEST, NEAM 4X LISTED, UL LISTED. PROVIDE BACKUP BATTERY POWER TO REMOTE HEADS RH1A/1B AND RH2A/2B AS SHOWN ON CONTRACT DRAWINGS. |
| EU3 | WALL | LED | 2-4 | MVOLT | AZZ SERIES XPEL | OR EQUAL | CLASS I, DIVISION 1, EMERGENCY BATTERY UNIT, COPPER FREE ALUMINUM HOUSING, GRAY BAKED ON EPOXY FINISH, STAINLESS STEEL HARDWARE, TWO 4 WATT LED HEADS, MEDIUM BEAM DISTRIBUTION HEADS, NICKEL-CADIUM BATTERY, UL LISTED. PROVIDE BACKUP BATTERY POWER TO REMOTE HEAD K2 AS SHOWN ON CONTRACT DRAWINGS. |
| FA | PEND/WALL /CEILING | LED | - | 120 | LITHONIA SERIES CONTRACTOR SELECT EXR LED EXITS | OR EQUAL | EXIT SIGN, INJECTION-MOLDED THERMOPLATIC HOUSING, SINGLE FACE, RED LETTERS, WHITE BACKGROUND, NICKEL-CADIUM BATTERY, TEST SWITCH, STATUS INDICATOR, NEMA 1 |
| FB | PEND/WALL /CEILING | LED | - | 120 | CROUSE-HINDS SERIES UX | OR EQUAL | EXIT SIGN, CAST ALUMINUM HOUSING (WHITE) WITH CLEAR POLYCARBONATE LENS, EQUIPPED WITH NICKEL CADIUM BATTERY, LONG LIFE LED'S, RED LETTERING, SELF DIAGNOSTICS/SELF TESTING, TIME DELAY, NEMA 4X LISTED. |
| FC | WALL/ PEND | LED | - | 120 | AZZ SERIES XPEX | OR EQUAL | EXIT SIGN, CLASS I, DIVISION 1, COPPER FREE ALUMINUM HOUSING, GRAY POWDER COAT FINISH, EQUIPPED WITH NICKEL CADIUM BATTERY, LONG LIFE LED'S, ACRYLIC LENS, SINGLE FACE, RED LETTERING, SELF DIAGNOSTICS, STAINLESS STEEL HARDWARE, UL LISTED. |
| K1 | WALL | LED | 1-4.1 | - | SURE-LITES SERIES SEL SERIES REMOTE | OR EQUAL | EMERGENCY WEATHER-RESISTANT REMOTE HEAD, POLYCARBONATE HOUSING, UNIVERSAL VOLTAGE INPUT FROM 4.8V THROUGH 12V, 1-4.1 WATT HEADS (285 LUMENS), GREY FINISH, WET LOCATION, UL LISTED. |
| K2 | WALL | LED | 1-4 | - | AZZ SERIES XPEL REMOTE HEAD | OR EQUAL | CLASS I, DIVISION I REMOTE HEAD, COPPER FREE HOUSING, PROVIDE EXPLOSION PROOF MOUNTED BOX FOR REMOTE HEAD UNIT, 1-4 WATT HEADS (285 LUMENS), GREY FINISH, UL LISTED. (TO BE POWERED ONLY OFF OF EU3 LUMINAIRES) |
| RH1A | WALL | LED | 1-4.1 | - | SURE-LITES SERIES SEL SERIES REMOTE | OR EQUAL | EMERGENCY WEATHER-RESISTANT REMOTE HEAD, POLYCARBONATE HOUSING, UNIVERSAL VOLTAGE INPUT FROM 4.8V THROUGH 12V, 1-4.1 WATT HEAD (285 LUMENS), WHITE FINISH, WET LOCATION, UL LISTED. |
| RH1B | WALL | LED | 2-4.1 | - | SURE-LITES SERIES SEL SERIES REMOTE | OR EQUAL | EMERGENCY WEATHER-RESISTANT REMOTE HEAD, POLYCARBONATE HOUSING, UNIVERSAL VOLTAGE INPUT FROM 4.8V THROUGH 12V, 2-4.1 WATT HEADS (285 LUMENS), WHITE FINISH, WET LOCATION, UL LISTED. |
| RH2A | WALL | LED | 1-5 | - | EMERGI-LITE SERIES SURVIVE-ALL EF39 | OR EQUAL | SURFACE REMOTE EMERGENCY FIXTURE, ALUMINUM BACKPLATE, CLEAR POLYCARBONATE LIGHT COVER, FULLY GASKETED, 1-5 WATT 12V VOLT LED HEAD, NEMA 4X, UL LISTED, STAINLESS STEEL ACCESSORIES. |
| RH2B | WALL | LED | 2-5 | - | EMERGI-LITE SERIES SURVIVE-ALL EF39 | OR EQUAL | SURFACE REMOTE EMERGENCY FIXTURE, ALUMINUM BACKPLATE, CLEAR POLYCARBONATE LIGHT COVER, FULLY GASKETED, 2-5 WATT 12V VOLT LED HEADS, NEMA 4X, UL LISTED, STAINLESS STEEL ACCESSORIES. |
| RC1 | RECESSED | LED | 23 | MVOLT | GOTHAM LIGHTING - SERIES 6" EVO | OR EQUAL | RECESSED MOUNTED DOWN LIGHT, STEEL HOUSING, POLYCARBONATE LENSED LIGHT ENGINE, WHITE FLANGE FINISH, WIDE LIGHT DISTRIBUTION, SEMI SPECULAR DIFFUSER, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S, (2,000 LUMENS), MINIMUM CRI OF 80, WET LOCATION WITH COVERED CEILINGS, UL LISTED. |
| SL1 | POLE | LED | 107 | 120-277V | STERNBERG LED E450LED EURO SERIES | OR EQUAL | LUMINAIRE WITH CAST ALUMINUM HOUSING, EURO LANTERN DESIGN, BLACK TEXTURED FINISH, TYPE T3 DISTRIBUTION, 21 HIGH OUTPUT 3500K LED'S (6485 LUMENS), LED'S MOUNTED TO CORE CIRCUIT BOARD, FLAT ACRYLIC LENS, 0-10V DIMMING, HIGH EFFICIENCY 1400mA DRIVER, MINIMUM CRI OF 80, R3 SLIP FITTER, POST TOP MOUNTING, WET LOCATION, BUTTON STYLE PHOTOCELL, UL LISTED. (MOUNTED ON LUMEC POLE BY SIGNIGY; RA61U-14-BKTX). |
| ST1 | STAN. | LED | 30 | UNIV. | AZZ (RIGALITE) SERIES SAFJ LED | OR EQUAL | CLASS I, DIVISION 2 LUMINAIRE, LOW COPPER ALUMINUM HOUSING, WIDE LIGHT DISTRIBUTION PATTERN, CLEAR LOW PROFILE GLASS LENS, STAINLESS STEEL LENS GUARD, HIGH EFFIENCY DRIVER, 0-10V DIMMING, 30 WATTS, 4000K LED'S @ 1250ma (3,059 LUMENS), 10kV SURGE PROTECTION, BAKED-ON EPOXY GREY FINISH, MINIMUM CRI OF 70. MOUNTED ON 1-1/2" CONDUIT WITH 1-1/2" 90° STANCHION MOUNT ADAPTER, 110 MPH RATED ASSEMBLY, STAINLESS STEEL HARDWARE, UL LISTED. |
| WC1 | WALL | LED | 27 | MVOLT | LITHONIA SERIES CONTEMPORARY CYLINDER 2'-0" LED VANITY WITH SWITCHABLE COLOR TEMP. | OR EQUAL | LUMINAIRE 2'-0", STEEL HOUSING BRONZE FINISH, LED'S MOUNTED TO CORE CIRCUIT BOARD, ACRYLIC DIFFUSER LENS, 0-10V DIMMING, HIGH EFFICIENCY DRIVER, 4000K LED'S, (1,850 LUMENS), MINIMUM CRI OF 90, DAMP LOCATION, UL LISTED. |

EMERGENCY FIXTURES

### TABLE OF RESPONSIBILITY - FIBER NETWORK SCOPE FOR WWTF & COLLECTION SYSTEM CONTRACTS

| | ELEMENT | COLLECTION SYSTEM/ PUMP STATIONS CONTRACT 2019-01 | WWTF/EFFLUENT DISPOSAL CONTRACT 2019-02 |
|---|---|---|---|
| 1 | FURNISH AND INSTALL FIBER OPTIC NETWORK CABLE | | X |
| 2 | FURNISH AND INSTALL CONDUITS FOR FIBER CONNECTION FROM WWTF TO RT. 7 CROSSING (TRENCH SECTIONS S1, S2) (EHH-S1, EHH-S2) 1 | | X |
| 3 | FURNISH AND INSTALL CONDUITS FOR FIBER CONNECTION FROM RT.7 CROSSING TO PS #1 (TRENCH SECTION S3) (EHH-S3.01/02/03/04) 1 | X | |
| 4 | FURNISH AND INSTALL CONDUITS FOR FIBER CONNECTION FROM PUMP STATION #1 TO LOTS HOLLOW RD. (TRENCH SECTION S4) (EHH-S4.01/02/03/04/05/06/07/08/09/10/11/12) 1 | X | |
| 5 | FURNISH AND INSTALL CONDUITS FOR FIBER CONNECTION FROM LOTS HOLLOW RD. TO WICK DIST. VAULT (TRENCH SECTION S5) (EHH-S5) 1 | | X |

### EQUIPMENT GROUNDING SCHEDULE

PROVIDE GROUNDING CONDUITS AND WIRES INDICATED FROM EQUIPMENT LISTED TO THE GROUNDING LOOP OR TO THE GROUNDING BUS BARS AS INDICATED AND IN ACCORDANCE WITH THE CONDUIT AND WIRE SCHEDULE. FOR GROUNDING OF PIPING AND OTHER MISCELLANEOUS ITEMS PROVIDE COMPLETE GROUNDING SYSTEM IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL REGULATIONS

| EQUIPMENT | GROUNDING CONDUIT AND WIRE | QTY. | NOTES |
|---|---|---|---|
| PAD MOUNTED TRANSFORMER | [G11] | TWO | TO GROUNDING LOOP |
| DIESEL GENERATOR GEN.10-1 ENCLOSURE | [G11] | TWO | TO GROUNDING LOOP |
| 2000 AMPS SWITCHBOARD | - | TWO | TO GROUND BUS BAR |
| MOTOR CONTROL CENTER | [G7] | TWO | TO GROUND BUS BAR |
| LESS THAN 300 HP TO 100 HP VFD UNIT | [G5] | ONE | TO GROUND BUS BAR |
| LESS THAN 100 HP TO 50 VFD UNIT | [G4] | ONE | TO GROUND BUS BAR |
| 100 AMPS DISTRIBUTION PANEL | [G3] | ONE | TO GROUND BUS BAR 1 |
| 45 KVA DRY-TYPE TRANSFORMER | [G5] | ONE | TO GROUND BUS BAR |
| 30 KVA DRY-TYPE TRANSFORMER | [G4] | ONE | TO GROUND BUS BAR |
| 480VAC EQUIPMENT LOCAL CONTROL PANELS | [G2] | ONE | TO GROUNDING LOOP |
| FIRE ALARM CONTROL PANELS | [G2] | ONE | TO GROUND BUS BAR |
| PLC CONTROL PANELS | [G3] | ONE | TO GROUNDING LOOP |
| ANTENNA | [G2] | ONE | TO GROUNDING LOOP |
| 100 HP AND LARGER MOTOR FRAMES | [G4] | ONE | RUN GROUND WIRE AND CONDUIT TO THE GROUNDING LOOP OR THE NEAREST GROUND BUS BAR |
| ANY STEEL TANK | [G4] | TWO | RUN GROUND WIRE AND CONDUIT TO THE GROUNDING LOOP OR THE NEAREST GROUND BUS BAR |
| BUILDING STEEL COLUMNS | [G4] | ONE | GROUND EVERY OTHER STEEL COLUMN TO GROUND LOOP OR NEAREST GROUND BUS USING EXOTHERMIC WELD CONNECTIONS. |
| GROUND BUS BAR | [G10] | TWO | TO GROUNDING LOOP |
| OUTDOOR TANKS, PUMP, MOTORS, PANELS OR EQUIPMENT | [G4] | ONE | TO GROUNDING LOOP 1 |
| OUTDOOR LIGHT, CCTV AND UTILITY POLES | [G4] | ONE | TO GROUNDING LOOP |
| OUTDOOR METAL WALKWAYS, HANDRAILS | [G4] | ONE | TO GROUNDING LOOP |

### TABLE OF RESPONSIBILITY - ELECTRICAL, HVAC & PLUMBING

| | ELEMENT | HVAC CONTRACTOR | PLUMBING CONTRACTOR | ELECTRICAL CONTRACTOR |
|---|---|---|---|---|
| 1 | 480VAC, AND 120VAC POWER TO EXHAUST FANS AND PUMPS | | | X |
| 2 | 480VAC, AND 120VAC POWER TO HVAC AND PLUMBING CONTROL PANELS | | | X |
| 3 | HVAC AND PLUMBING CONTROL SYSTEM COMPONENTS (INCLUDING, BUT NOT LIMITED TO PANELS, COMPUTER WORK STATIONS, CONTROLLERS, RELAYS, TRANSFORMERS, SENSORS, SWITCHES, CONTROL VALVES, CONTROL DAMPERS, DAMPER ACTUATORS, ETC.) | X | X | |
| 4 | CONTROL WIRING, CONDUIT AND CONNECTIONS REQUIRED FOR THE CONTROL OF THE HVAC AND PLUMBING SYSTEMS (INCLUDING, BUT NOT LIMITED TO, CONTROL WIRING FOR THERMOSTATS, SENSORS, RELAYS, CONTROL VALVES, CONTROLLERS, SWITCHES, DAMPERS, HVAC NETWORK CABLE, ETC.) | X | X | |
| 5 | POWER WIRING, CONDUIT AND CONNECTIONS REQUIRED FOR POWERING ANCILLARY HVAC, ATC AND PLUMBING DEVICES (INCLUDING, BUT NOT LIMITED TO, DEVICE POWER FOR 120VAC/24VDC DAMPERS, THERMOSTATS, CONTROL VALVES, RELAYS, SENSORS, ETC.) | X | X | |
| 6 | ADJUSTING CONTROL SET POINTS FOR HVAC AND PLUMBING SYSTEM EQUIPMENT | X | X | |
| 7 | ALL SPECIFIED HVAC/PLUMBING CONTROLS TESTING AND REMEDIAL WORK TO MAKE SYSTEMS FULLY FUNCTIONAL AND OPERATE IN ACCORDANCE WITH THE CONTROL SEQUENCES | X | X | |
| 8 | CONTROL WIRING BETWEEN MCC AND SCADA FOR HVAC AND PLUMBING ALARMS | | | X |
| 9 | CONTROL WIRING BETWEEN MCC AND HVAC (ATC) AND PLUMBING CONTROL PANELS | | | X |
| 10 | CONTROL WIRING BETWEEN HVAC (ATC) AND PLUMBING CONTROL PANELS AND PLANT SCADA | | | X |
| 11 | CONTROL WIRING BETWEEN HVAC CONTROL PANELS (ATC) AND FIRE ALARM CONTROL PANEL | | | X |
| 12 | CONTROL WIRING BETWEEN DUCT MOUNTED SMOKE DETECTORS AND ASSOCIATED AIR HANDLING UNIT STARTERS AT MCC AND FIRE ALARM SYSTEM | | | X |
| 13 | CONTROL WIRING BETWEEN SPRINKLER SYSTEM DEVICES AND FIRE ALARM SYSTEM | | | X |
| 14 | MCC LOCATED MOTOR STARTERS AND VFDS FOR 3ϕ HVAC EXHAUST FANS & PLUMBING EQUIPMENT | | | X |
| 15 | STAND ALONE 1ϕ/3ϕ MOTOR STARTERS & VFDS FOR HVAC AND PLUMBING EQUIPMENT | | | X |
| 16 | STAND ALONE VFDS AND CONTROLS FOR BOILER SYSTEM PUMPS | X | | |
| 17 | SAFTEY DISCONNECT SWITCHES AT HVAC AND PLUMBING EQUIPMENT (BESIDES DISCONNECTS FOR CABINET UNIT HEATERS (CUH) THAT SHALL BE SUPPLIED INTEGRAL TO HEATER UNIT) | | | X |
| 18 | PROVIDE DUCT MOUNTED SMOKE DETECTORS | | | X |
| 19 | INSTALL DUCT MOUNTED SMOKE DETECTORS | X | | |

### TABLE OF RESPONSIBILITY - ELECTRICAL, GENERAL, AND SYSTEM INTEGRATOR

| | ELEMENT | GENERAL CONTRACTOR | SYSTEM INTEGRATOR | ELECTRICAL CONTRACTOR |
|---|---|---|---|---|
| 1 | FURNISH, TEST AND CALIBRATE INSTRUMENTS | | X | |
| 2 | INSTALL INSTRUMENTS | X | | |
| 3 | INSTALL FIELD LOCATED DEVICES ASSOCIATED WITH INSTRUMENTS INCLUDING TRANSMITTERS, INDICATORS, CONTROL PANELS, AND ANCIALLARY COMPONENTS THAT ARE NOT LOCATED WITHIN PROCESS PIPING AND TANKS. LOCATIONS SHALL BE AS INDICATED ON THE ELECTRICAL DRAWINGS. | X | | |
| 4 | FURNISH NETWORK EQUIPMENT, SCADA THIN CLIENT WORKSTATIONS/ENCLOSURES | | X | |
| 4 | FURNISH AND INSTALL INTERCONNECTING WIRE, CABLE, CONDUIT, AND CONNECTIONS FOR INSTRUMENTS | | | X |
| 5 | FURNISH AND INSTALL ETHERNET CABLES | | | X |
| 6 | PROVIDE FIBER OPTIC CABLE, PATCH PANELS AND ASSOCIATED HARDWARE | | X | |
| 7 | INSTALL FIBER OPTIC CABLE | | | X |
| 8 | TERMINATE AND TEST FIBER OPTIC CABLE | | X | |
| 9 | FURNISH AND INSTALL GAS MONITORING CONTROL PANELS, HORN STROBES AND ALARM DEVICES | | | X |
| 10 | FURNISH GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | X | | |
| 11 | INSTALL GAS MONITORING ANALYZER SENSORS AND TRANSMITTERS | | | X |


AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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No. 39420
REGISTERED
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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

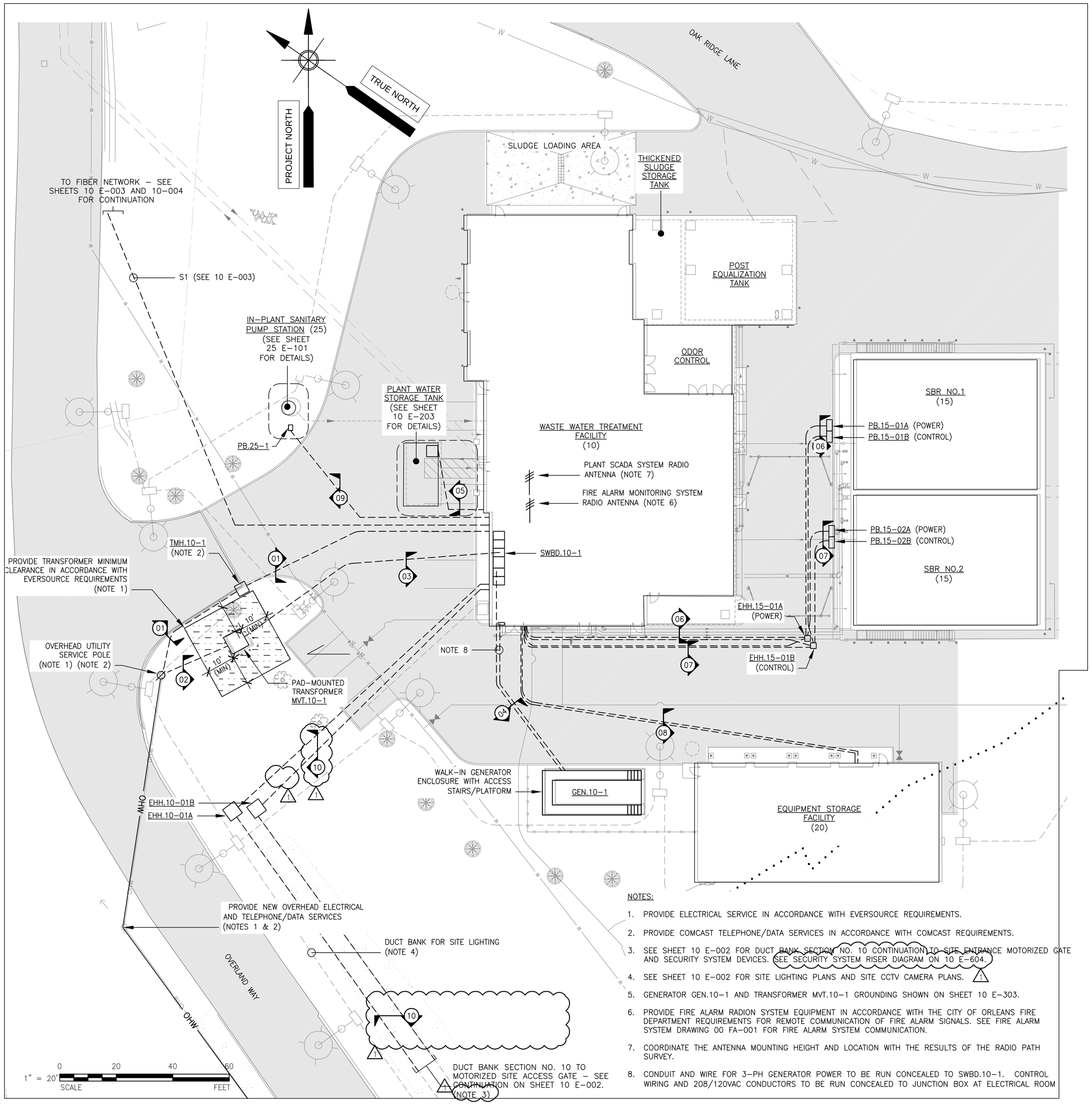
**SHEET TITLE**

**ELECTRICAL SCHEDULES II**

**SHEET NUMBER**

**00 E-602**


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\00 E-602.DWG
LAST UPDATE: Friday, March 20, 2020 2:26:14 PM
PLOT DATE: Tuesday, March 24, 2020 4:11:38 AM

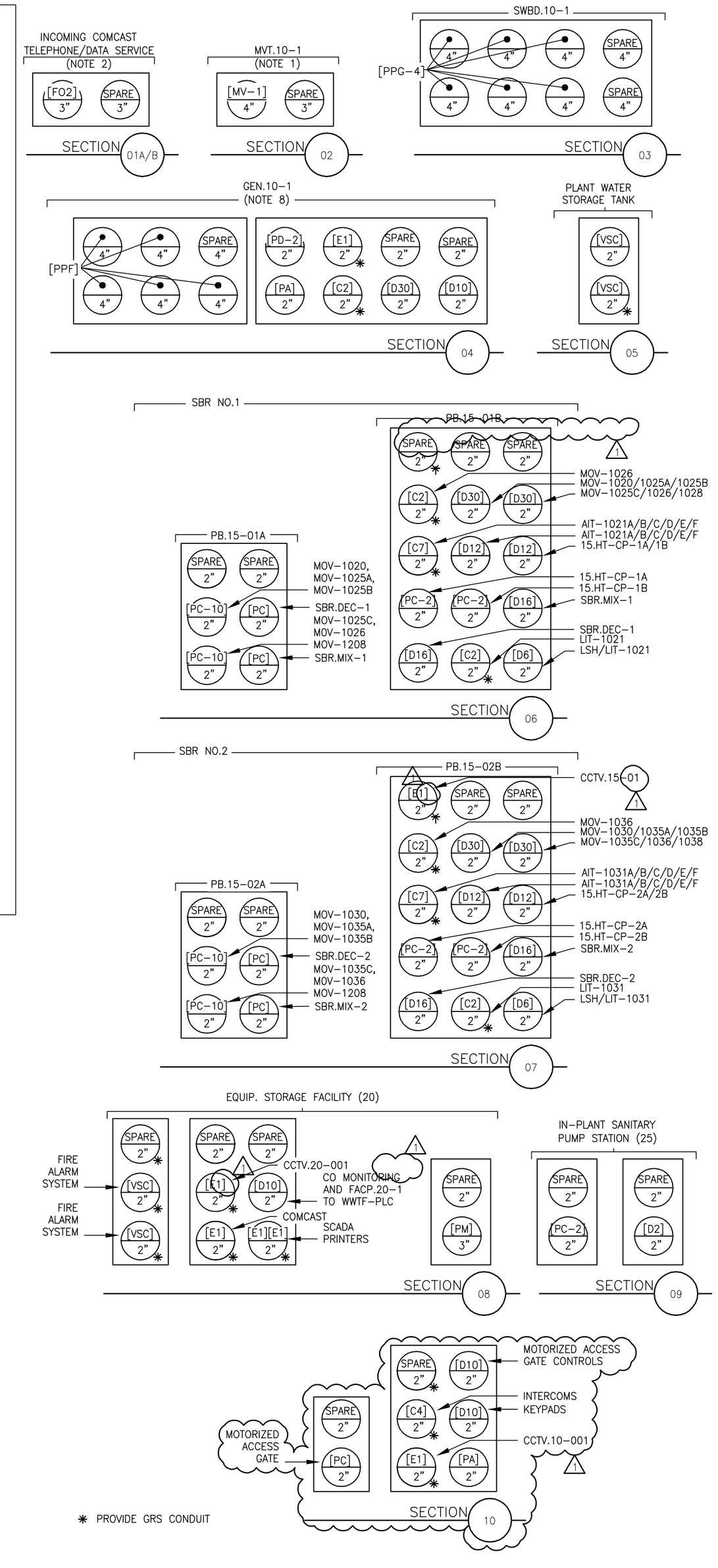



NOTES:

1. PROVIDE ELECTRICAL SERVICE IN ACCORDANCE WITH EVERSOURCE REQUIREMENTS.
2. PROVIDE COMCAST TELEPHONE/DATA SERVICES IN ACCORDANCE WITH COMCAST REQUIREMENTS.
3. SEE SHEET 10 E-002 FOR DUCT BANK SECTION NO. 10 CONTINUATION TO SITE ENTRANCE MOTORIZED GATE AND SECURITY SYSTEM DEVICES. SEE SECURITY SYSTEM RISER DIAGRAM ON 10 E-604.
4. SEE SHEET 10 E-002 FOR SITE LIGHTING PLANS AND SITE CCTV CAMERA PLANS. (1)
5. GENERATOR GEN.10-1 AND TRANSFORMER MVT.10-1 GROUNDING SHOWN ON SHEET 10 E-303.
6. PROVIDE FIRE ALARM RADION SYSTEM EQUIPMENT IN ACCORDANCE WITH THE CITY OF ORLEANS FIRE DEPARTMENT REQUIREMENTS FOR REMOTE COMMUNICATION OF FIRE ALARM SIGNALS. SEE FIRE ALARM SYSTEM DRAWING 00 FA-001 FOR FIRE ALARM SYSTEM COMMUNICATION.
7. COORDINATE THE ANTENNA MOUNTING HEIGHT AND LOCATION WITH THE RESULTS OF THE RADIO PATH SURVEY.
8. CONDUIT AND WIRE FOR 3-PH GENERATOR POWER TO BE RUN CONCEALED TO SWBD.10-1. CONTROL WIRING AND 208/120VAC CONDUCTORS TO BE RUN CONCEALED TO JUNCTION BOX AT ELECTRICAL ROOM

## WASTEWATER TREATMENT FACILITY - ELECTRICAL SITE PLAN I - POWER

(SCALE: 1"= 20'-0")

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**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
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**ENGINEER**

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PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| | | |
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| | | |
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| | | |
| 1 | 3-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

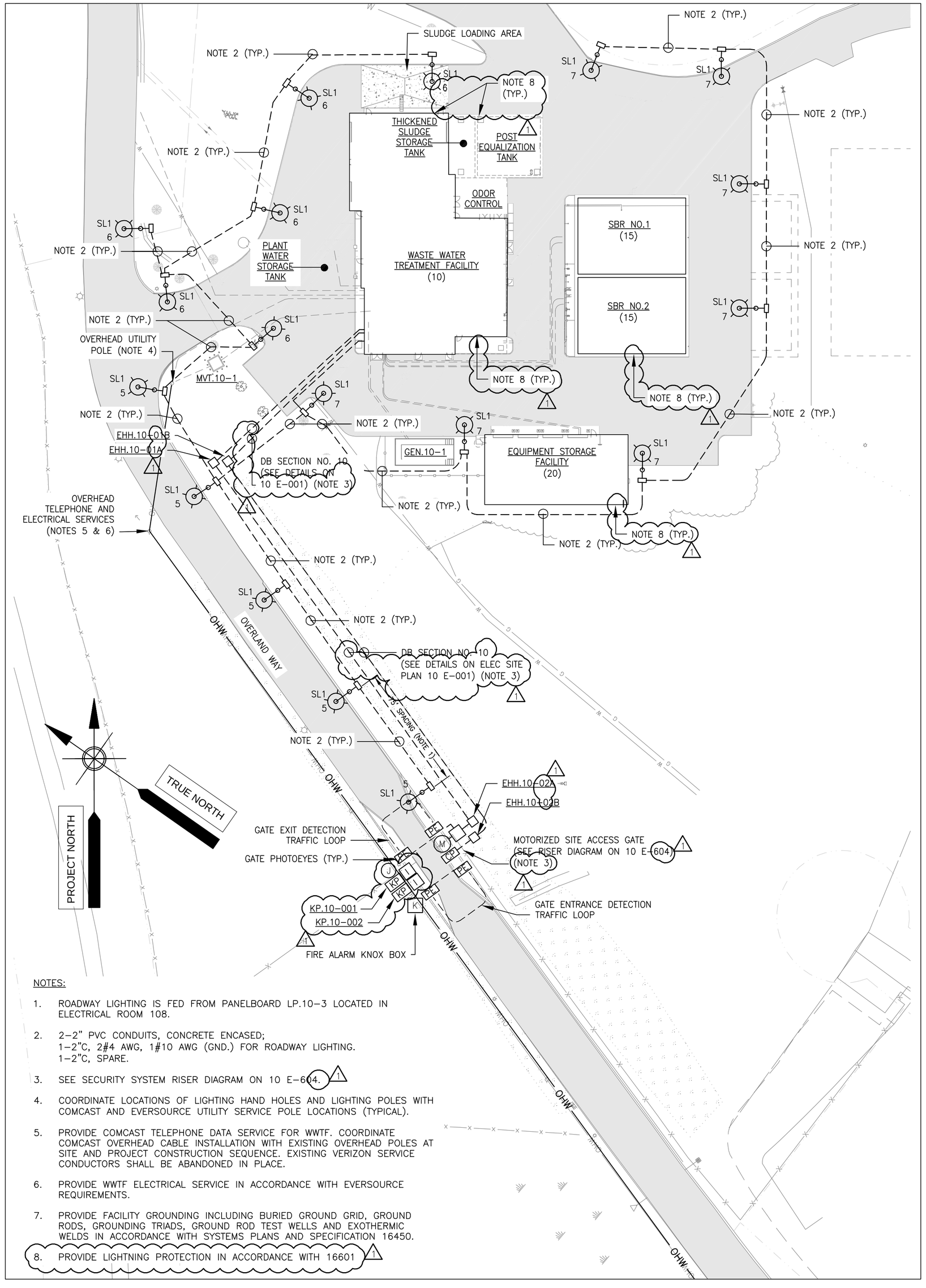
**SHEET TITLE**

**WWTF - ELECTRICAL SITE PLAN - POWER**

**SHEET NUMBER**

**10 E-001**

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-001.DWG
LAST UPDATE: Thursday, March 19, 2020 6:52:46 PM
PLOT DATE: Tuesday, March 24, 2020 4:11:58 AM

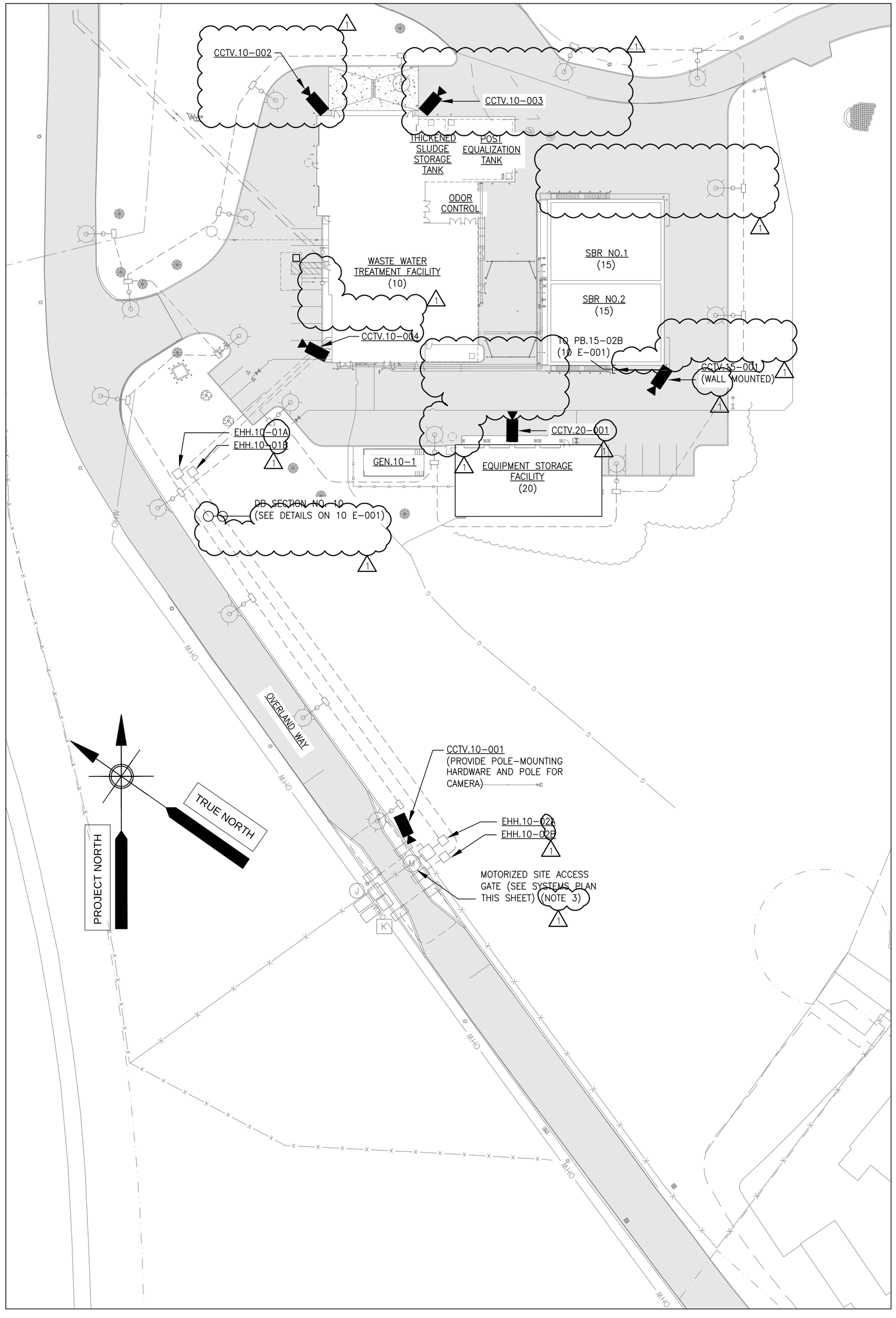



NOTES:

1. ROADWAY LIGHTING IS FED FROM PANELBOARD LP.10–3 LOCATED IN ELECTRICAL ROOM 108.
2. 2–2" PVC CONDUITS, CONCRETE ENCASED; 1–2"C, 2#4 AWG, 1#10 AWG (GND.) FOR ROADWAY LIGHTING. 1–2"C, SPARE.
3. SEE SECURITY SYSTEM RISER DIAGRAM ON 10 E–604.
4. COORDINATE LOCATIONS OF LIGHTING HAND HOLES AND LIGHTING POLES WITH COMCAST AND EVERSOURCE UTILITY SERVICE POLE LOCATIONS (TYPICAL).
5. PROVIDE COMCAST TELEPHONE DATA SERVICE FOR WWTF. COORDINATE COMCAST OVERHEAD CABLE INSTALLATION WITH EXISTING OVERHEAD POLES AT SITE AND PROJECT CONSTRUCTION SEQUENCE. EXISTING VERIZON SERVICE CONDUCTORS SHALL BE ABANDONED IN PLACE.
6. PROVIDE WWTF ELECTRICAL SERVICE IN ACCORDANCE WITH EVERSOURCE REQUIREMENTS.
7. PROVIDE FACILITY GROUNDING INCLUDING BURIED GROUND GRID, GROUND RODS, GROUNDING TRIADS, GROUND ROD TEST WELLS AND EXOTHERMIC WELDS IN ACCORDANCE WITH SYSTEMS PLANS AND SPECIFICATION 16450.
8. PROVIDE LIGHTNING PROTECTION IN ACCORDANCE WITH 16601

## WASTEWATER TREATMENT FACILITY - ELECTRICAL SITE PLAN - SYSTEMS

(SCALE: 1"- 40'-0")




## WASTEWATER TREATMENT FACILITY - ELECTRICAL SITE PLAN - SECURITY

(SCALE: 1"- 40'-0")

0 40 80 120
1" = 40' SCALE FEET

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**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

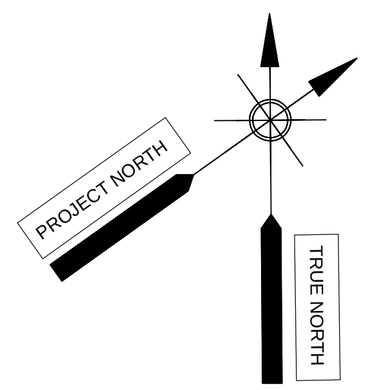
**SHEET TITLE**

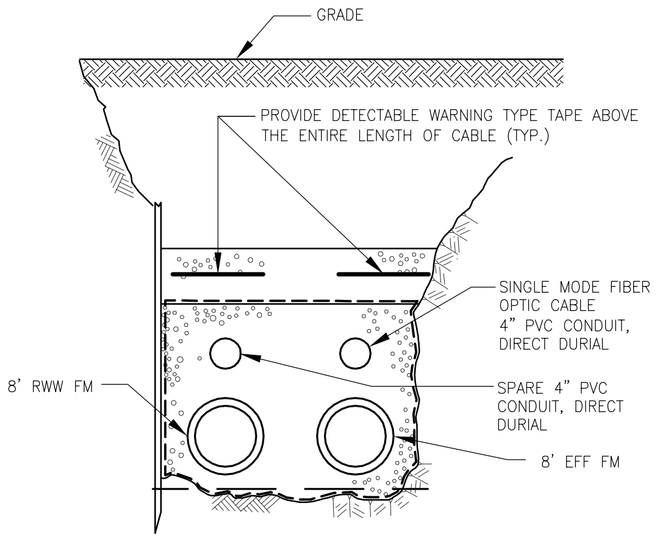
**WWTF - ELECTRICAL SITE PLAN - SYSTEMS**

**SHEET NUMBER**

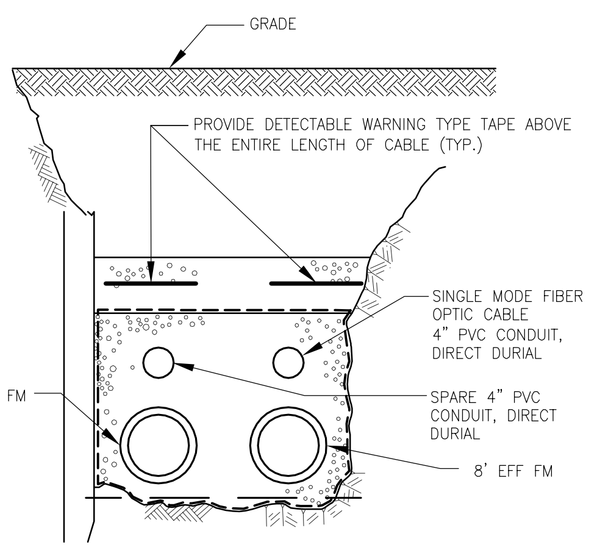
**10 E-002**

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\EL\D E-002.DWG
LAST UPDATE: Tuesday, March 24, 2020 1:49:53 AM
PLOT DATE: Tuesday, March 24, 2020 4:12:19 AM



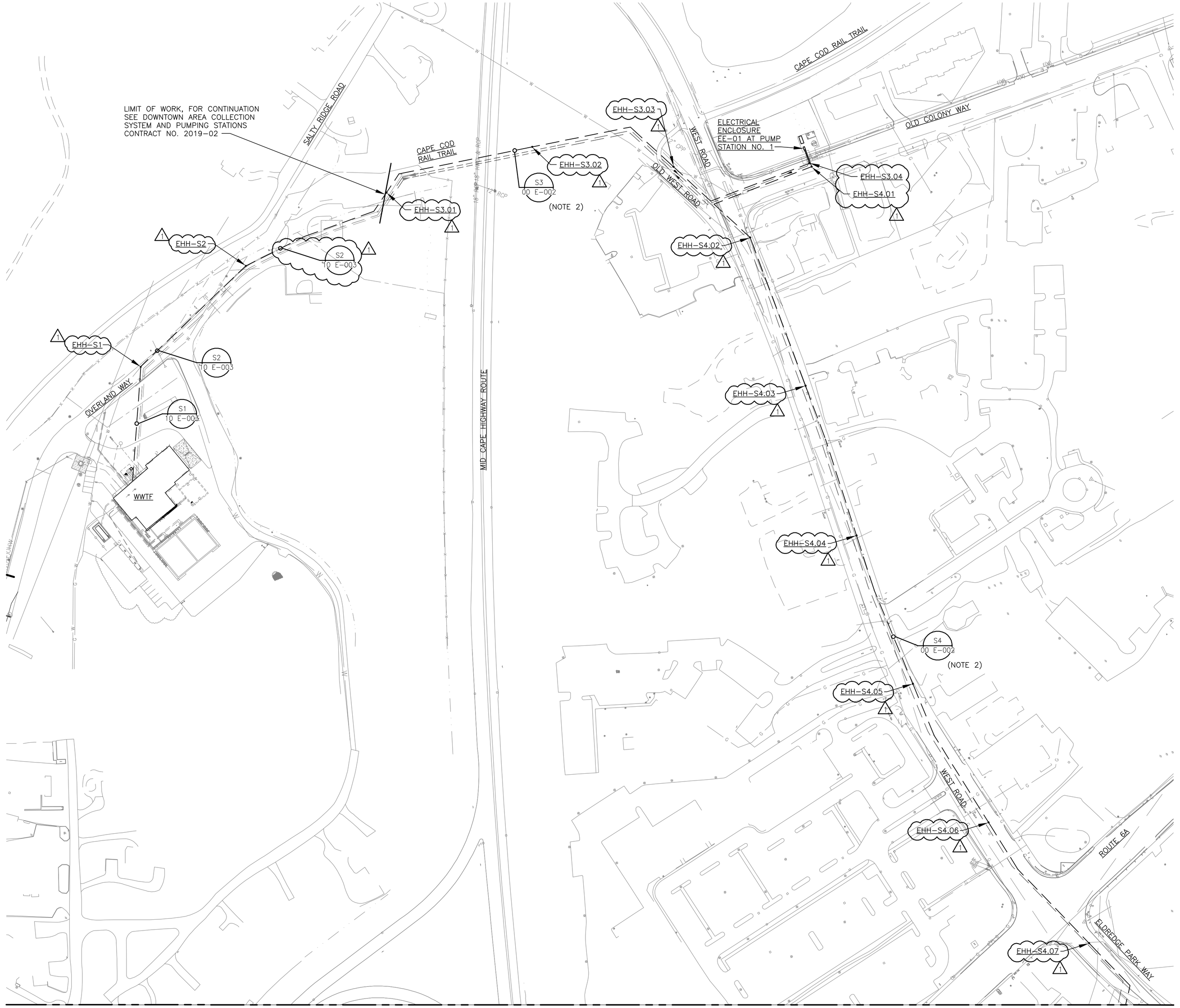

TRENCH DETAIL S1 / 10 E-003
NTS




TRENCH DETAIL S2 / 10 E-003
NTS

NOTES

1. SEE WWTF AND COLLECTION SYSTEM SCOPE DELINEATION TABLE ON SHEET 00 E-601 FOR FIBER NETWORK SCOPE
2. SEE COLLECTION SYSTEMS AND PUMP STATIONS CONTRACT FOR FIBER TRENCH SECTIONS S3, S4




MATCH LINE A - A (FOR CONTINUATION SEE SHEET 10 E-004

WASTEWATER TREATMENT FACILITY - ELECTRICAL SITE PLAN - FIBER NETWORK I

SCALE: 1"=100'-0"

1" = 100 SCALE 0 100 200 300 FEET

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-003.DWG
LAST UPDATE: Thursday, March 19, 2020 8:33:05 AM
PLOT DATE: Tuesday, March 24, 2020 4:12:32 AM

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**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 3-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | B. DESOUZA |
| Dept Check: | Y. RISK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

WWTF - ELECTRICAL SITE PLAN - FIBER NETWORK I

**SHEET NUMBER**

10 E-003

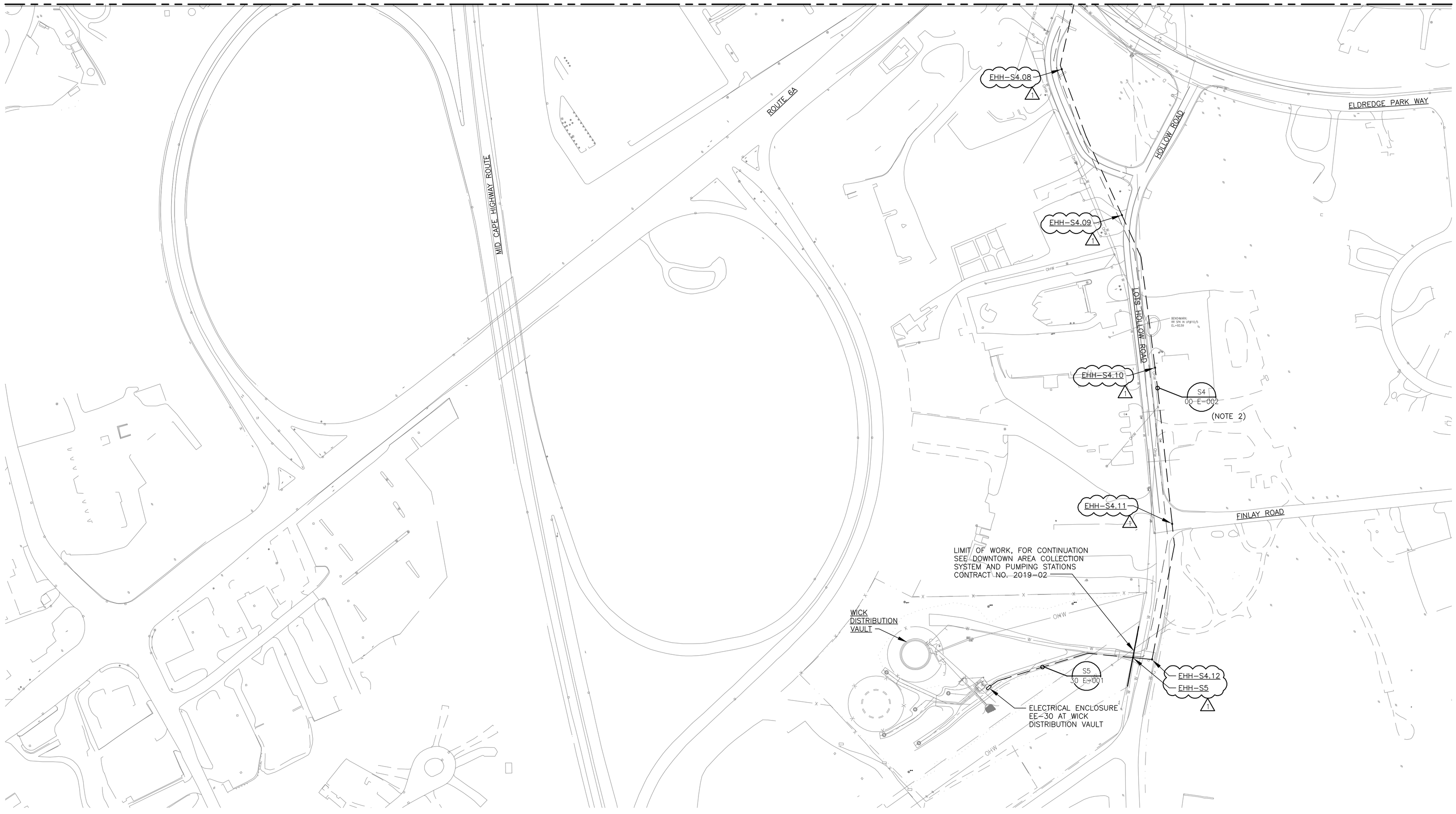
NOTES

1. SEE WWTF AND COLLECTION SYSTEM SCOPE DELINEATION TABLE ON SHEET 00 E-601 FOR FIBER NETWORK SCOPE
2. SEE COLLECTION SYSTEMS AND PUMP STATIONS CONTRACT FOR FIBER TRENCH SECTION S4

PROJECT NORTH

TRUE NORTH

MATCH LINE A - A (FOR CONTINUATION SEE SHEET 10 E-003)




WASTEWATER TREATMENT FACILITY - ELECTRICAL SITE PLAN - FIBER NETWORK II

SCALE: 1'=100'-0"

1" = 100' SCALE 0 100 200 300 FEET

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-004.DWG
LAST UPDATE: Thursday, March 19, 2020 8:33:16 AM
PLOT DATE: Tuesday, March 24, 2020 4:12:41 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 3-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | B. DESOUZA |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

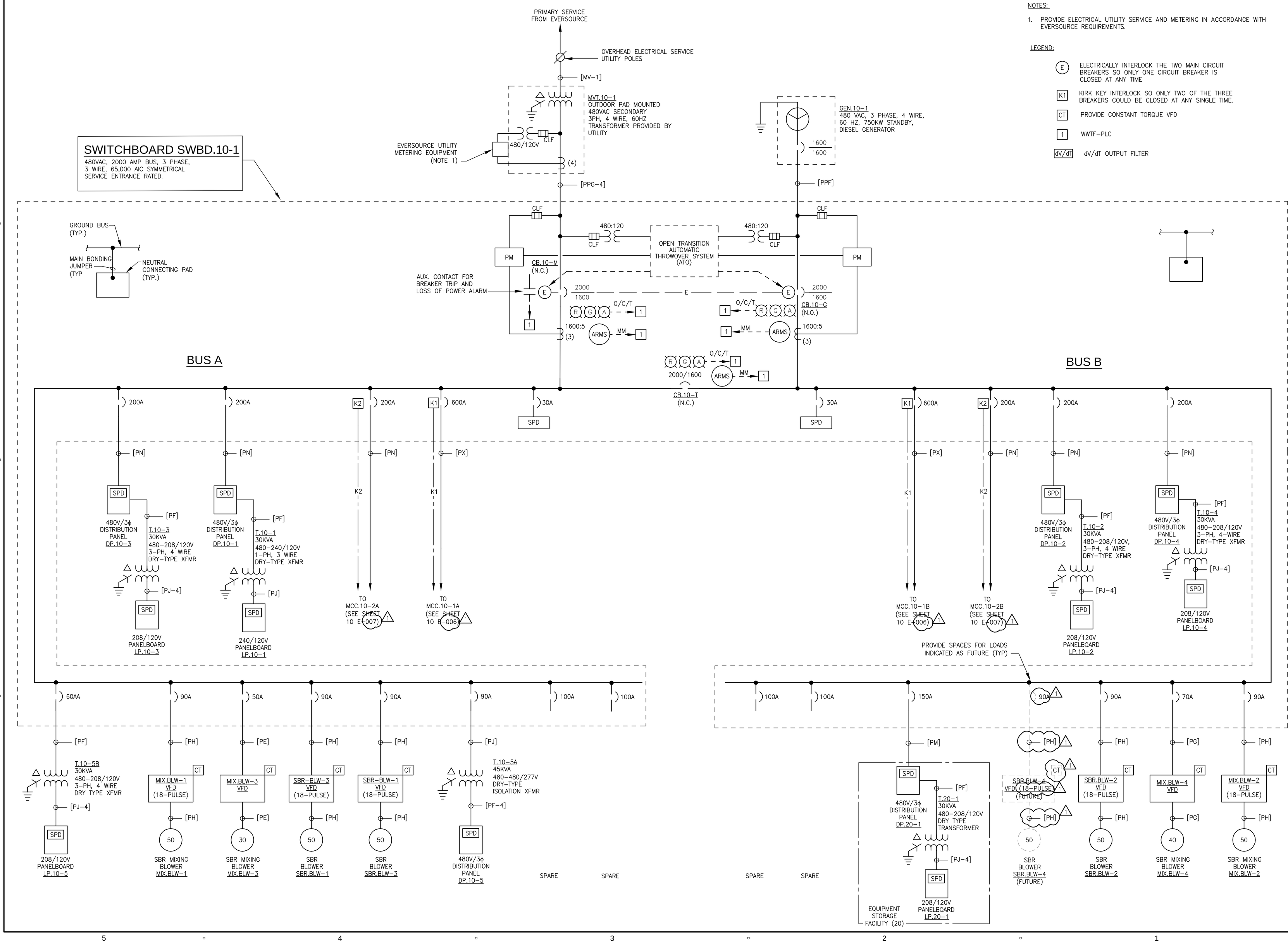
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL SITE PLAN - FIBER NETWORK II

**SHEET NUMBER**

# 10 E-004




NOTES:

1. PROVIDE ELECTRICAL UTILITY SERVICE AND METERING IN ACCORDANCE WITH EVERSOURCE REQUIREMENTS.

LEGEND:

- (E) ELECTRICALLY INTERLOCK THE TWO MAIN CIRCUIT BREAKERS SO ONLY ONE CIRCUIT BREAKER IS CLOSED AT ANY TIME
- [K1] KIRK KEY INTERLOCK SO ONLY TWO OF THE THREE BREAKERS COULD BE CLOSED AT ANY SINGLE TIME.
- [CT] PROVIDE CONSTANT TORQUE VFD
- [1] WWTF-PLC
- [dV/dT] dV/dT OUTPUT FILTER

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

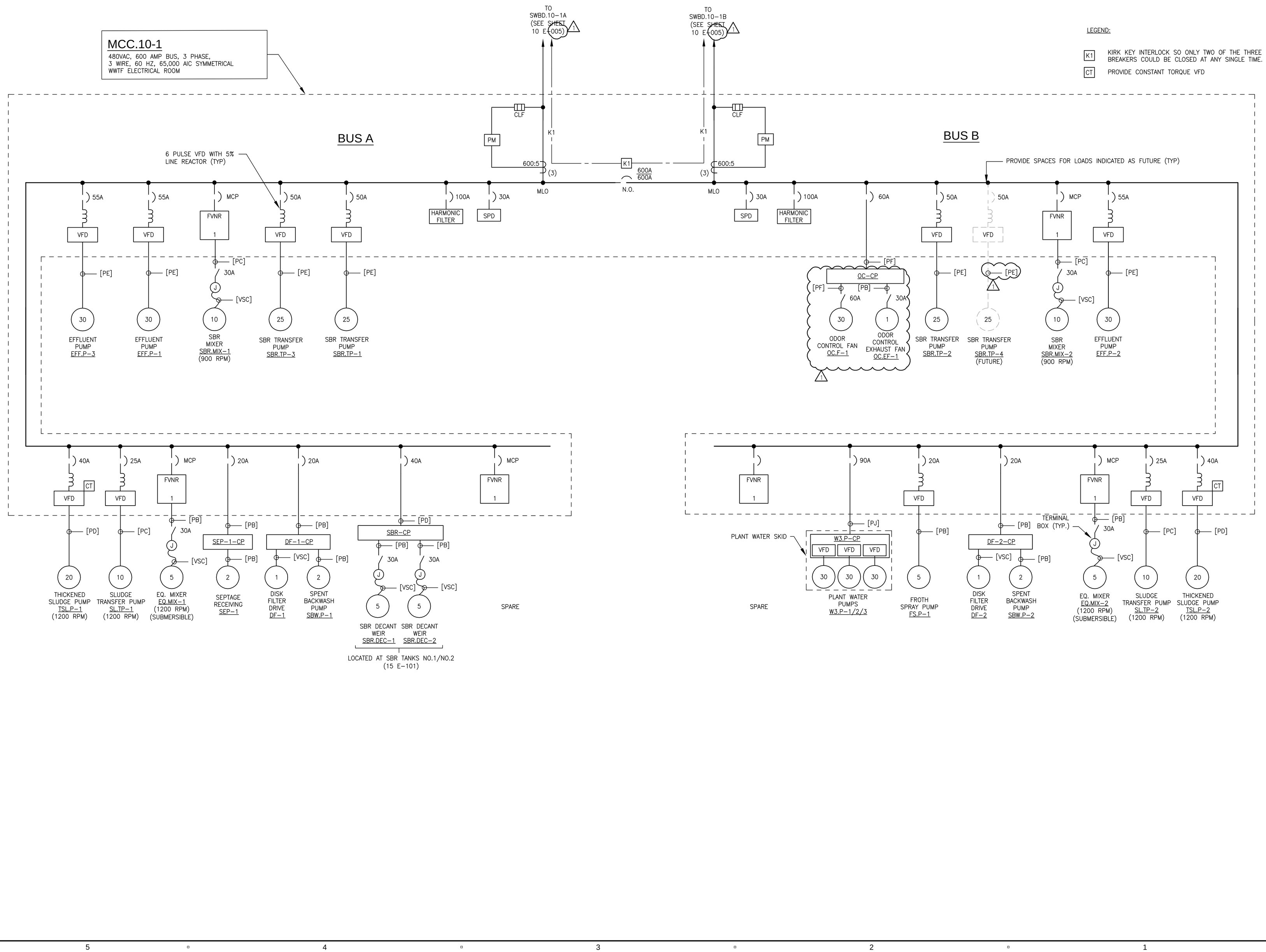
**SHEET TITLE**

# WWTF - ELECTRICAL SINGLE LINE DIAGRAM I - SWBD.10-1

**SHEET NUMBER**

# 10 E-005

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\EL10 E-005.DWG
LAST UPDATE: Tuesday, March 24, 2020 2:18:21 AM
PLOT DATE: Tuesday, March 24, 2020 4:12:49 AM

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LAST UPDATE: Tuesday, March 24, 2020 2:18:06 AM
PLOT DATE: Tuesday, March 24, 2020 4:12:59 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
No. 52462
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

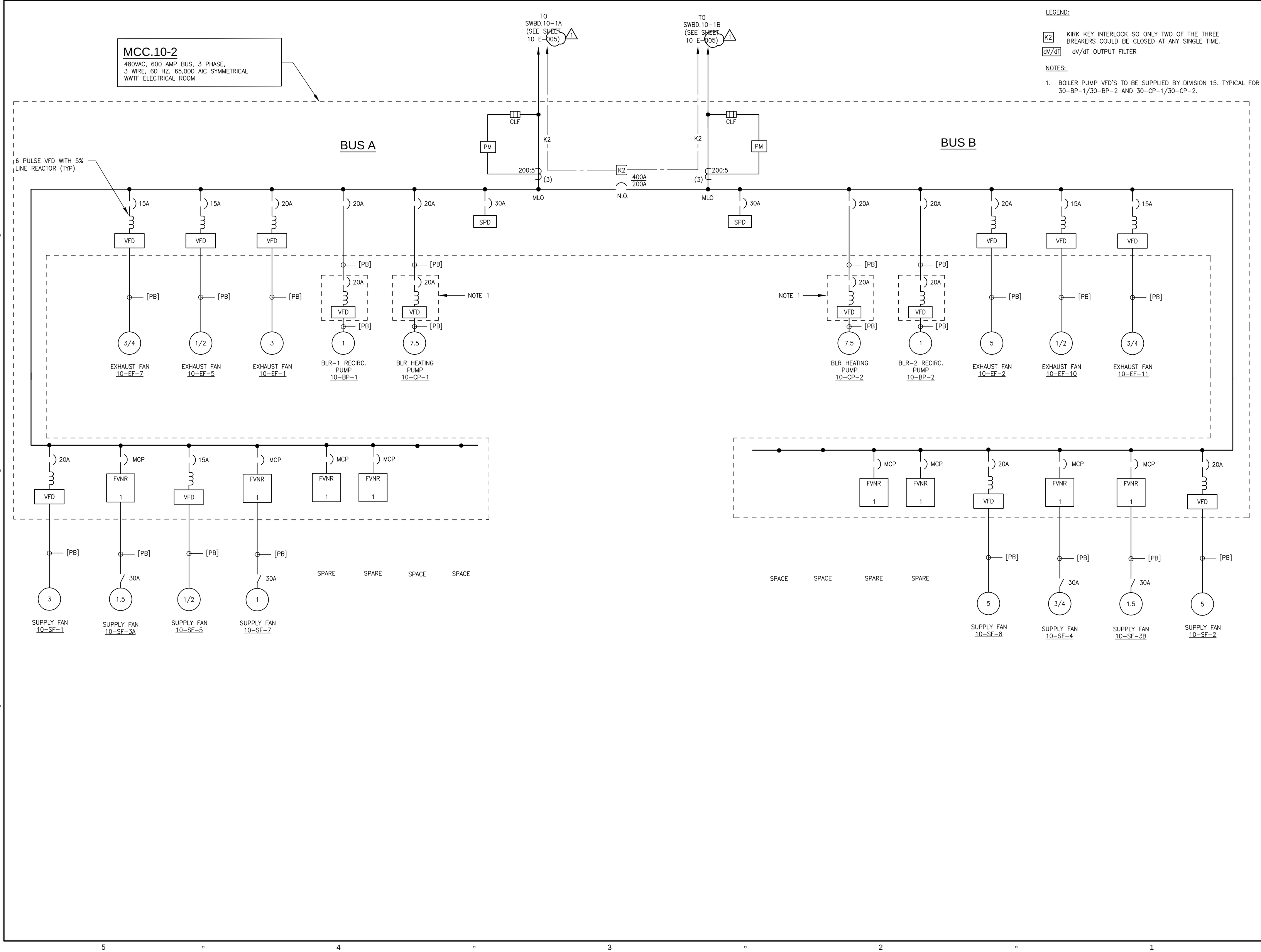
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL SINGLE LINE DIAGRAM II - MCC.10-1

**SHEET NUMBER**

# 10 E-006




PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-007.DWG
LAST UPDATE: Tuesday, March 24, 2020 2:17:54 AM
PLOT DATE: Tuesday, March 24, 2020 4:13:10 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
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**ENGINEER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
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ELECTRICAL
No. 45421
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

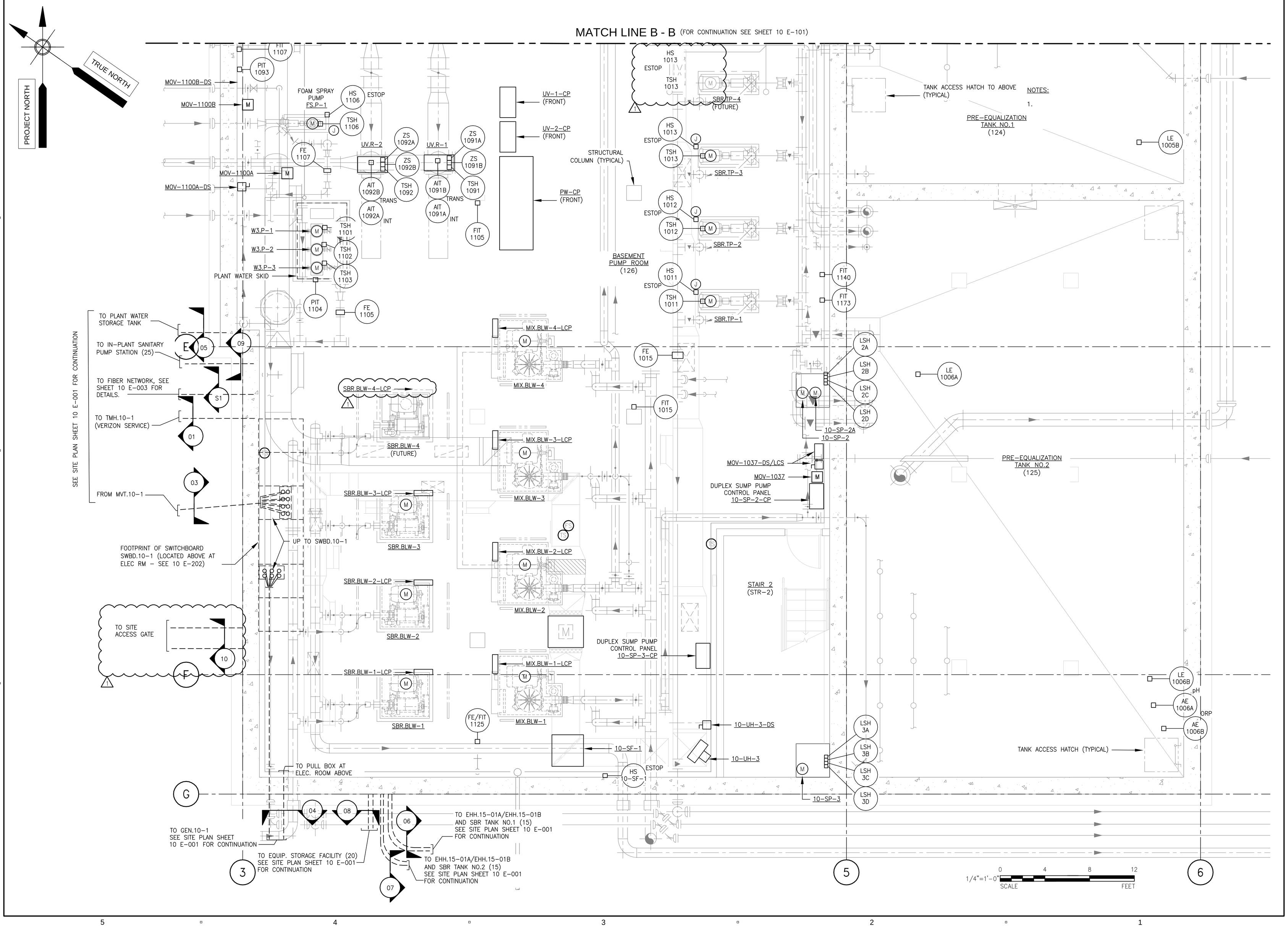
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL SINGLE LINE DIAGRAM III - MCC.10-2

**SHEET NUMBER**

# 10 E-007





AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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**ENGINEER**

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**REGISTRATION**

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03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

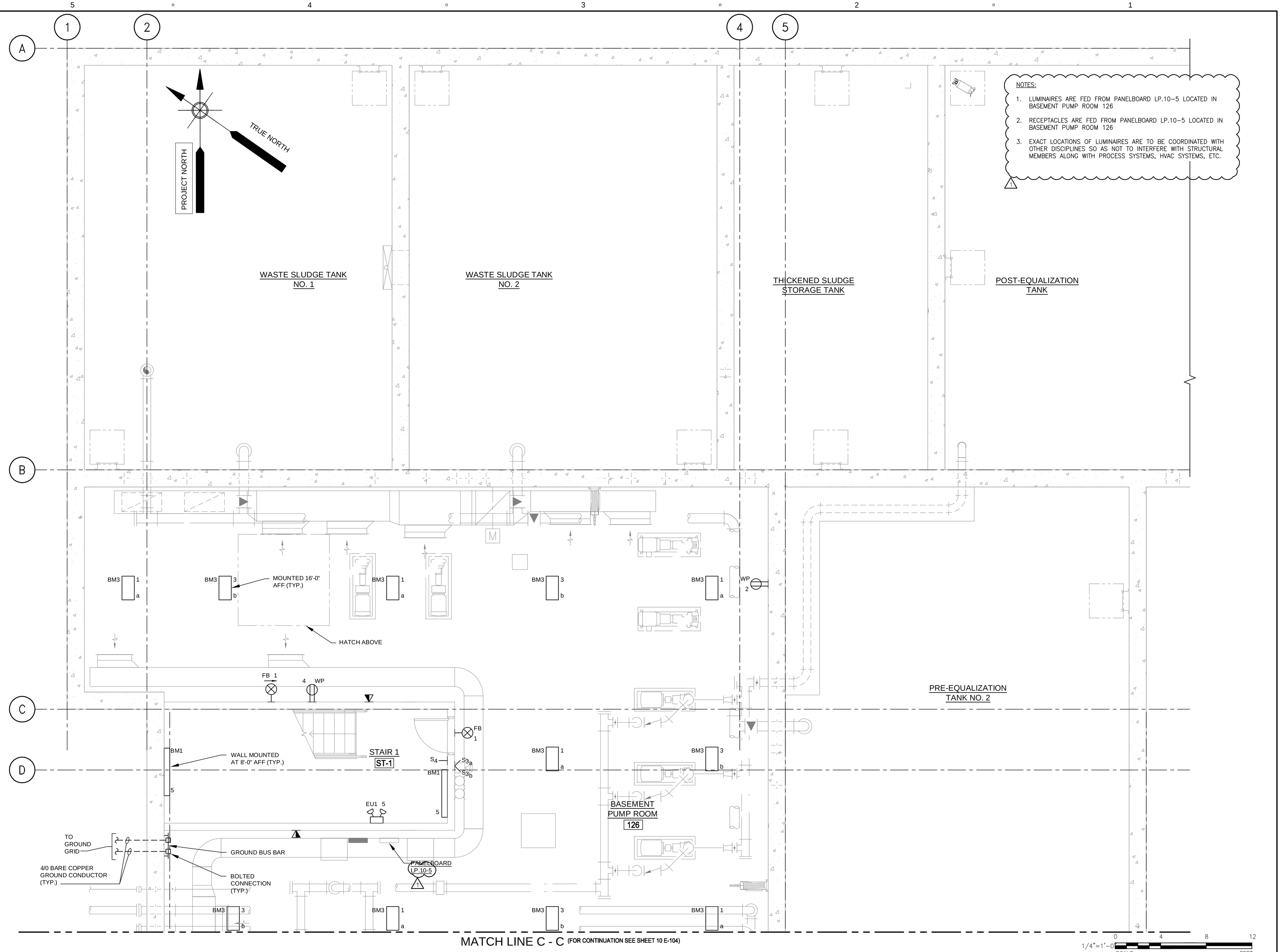
**SHEET TITLE**

# WWTF - LOWER LEVEL - POWER PLAN II

**SHEET NUMBER**

# 10 E-102


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-102.DWG
LAST UPDATE: Tuesday, March 24, 2020 2:12:03 AM
PLOT DATE: Tuesday, March 24, 2020 4:13:32 AM

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LAST UPDATE: Tuesday, March 24, 2020 2:15:23 AM
PLOT DATE: Tuesday, March 24, 2020 4:13:43 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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**ENGINEER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
No. 39462
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - LOWER LEVEL - SYSTEMS PLAN I

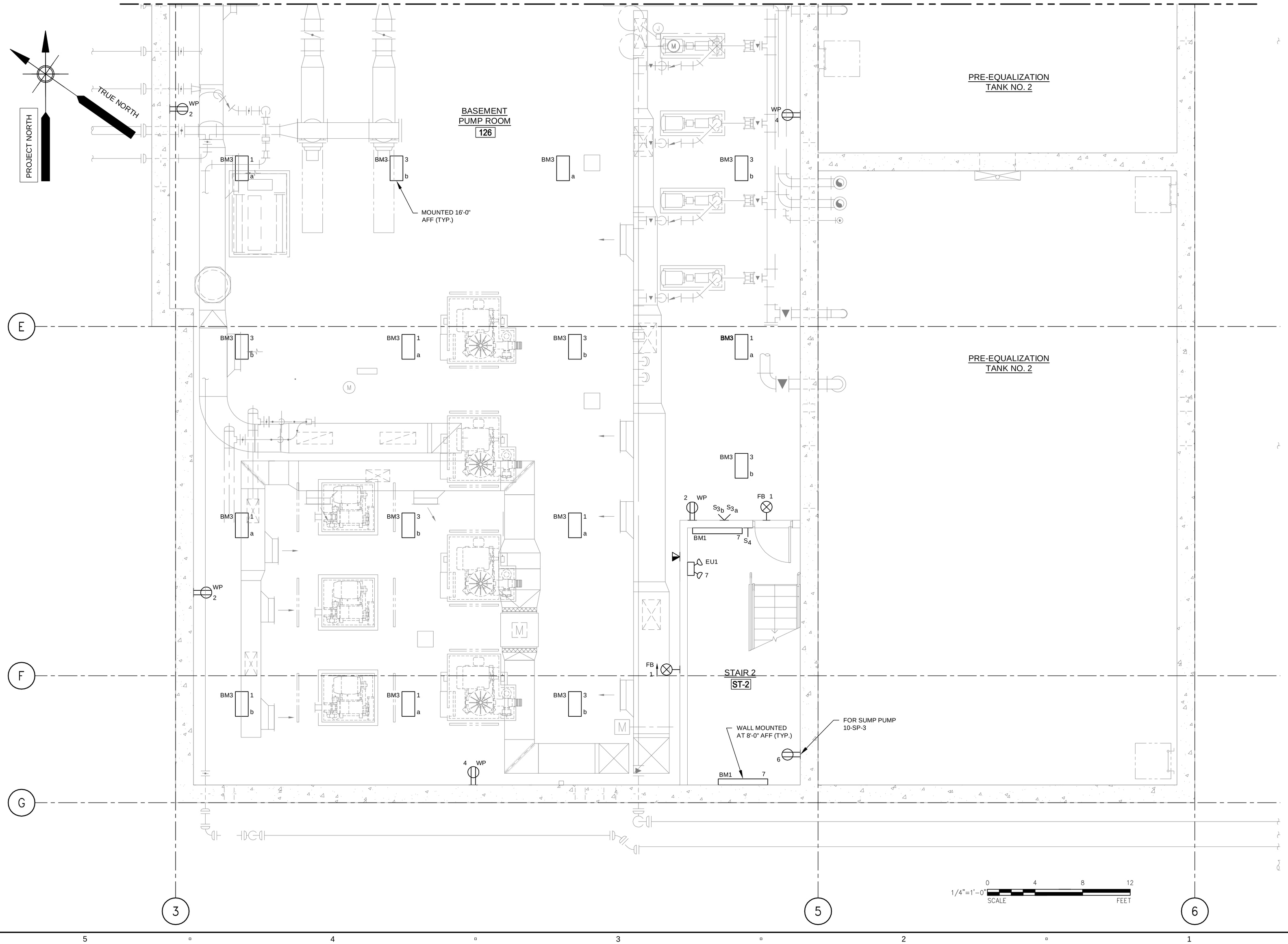
**SHEET NUMBER**

# 10 E-103

NOTES:

1. LUMINAIRES ARE FED FROM PANELBOARD LP.10-5 LOCATED THE BASEMENT PUMP ROOM 126 .
2. RECEPTACLES ARE FED FROM PANELBOARD LP.10-5 LOCATED IN BASEMENT PUMP ROOM 126 .
3. EXACT LOCATIONS OF LUMINAIRES ARE TO BE COORDINATED WITH OTHER DISCIPLINES SO AS NOT TO INTERFERE WITH STRUCTURAL MEMBERS ALONG WITH PROCESS SYSTEMS, HVAC SYSTEMS, ETC.

MATCH LINE C - C (FOR CONTINUATION SEE SHEET 10 E-103)




1/4"=1'-0" SCALE 0 4 8 12 FEET

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-104.DWG
LAST UPDATE: Tuesday, March 24, 2020 2:14:49 AM
PLOT DATE: Tuesday, March 24, 2020 4:13:58 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
No. 39462
REGISTERED
PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

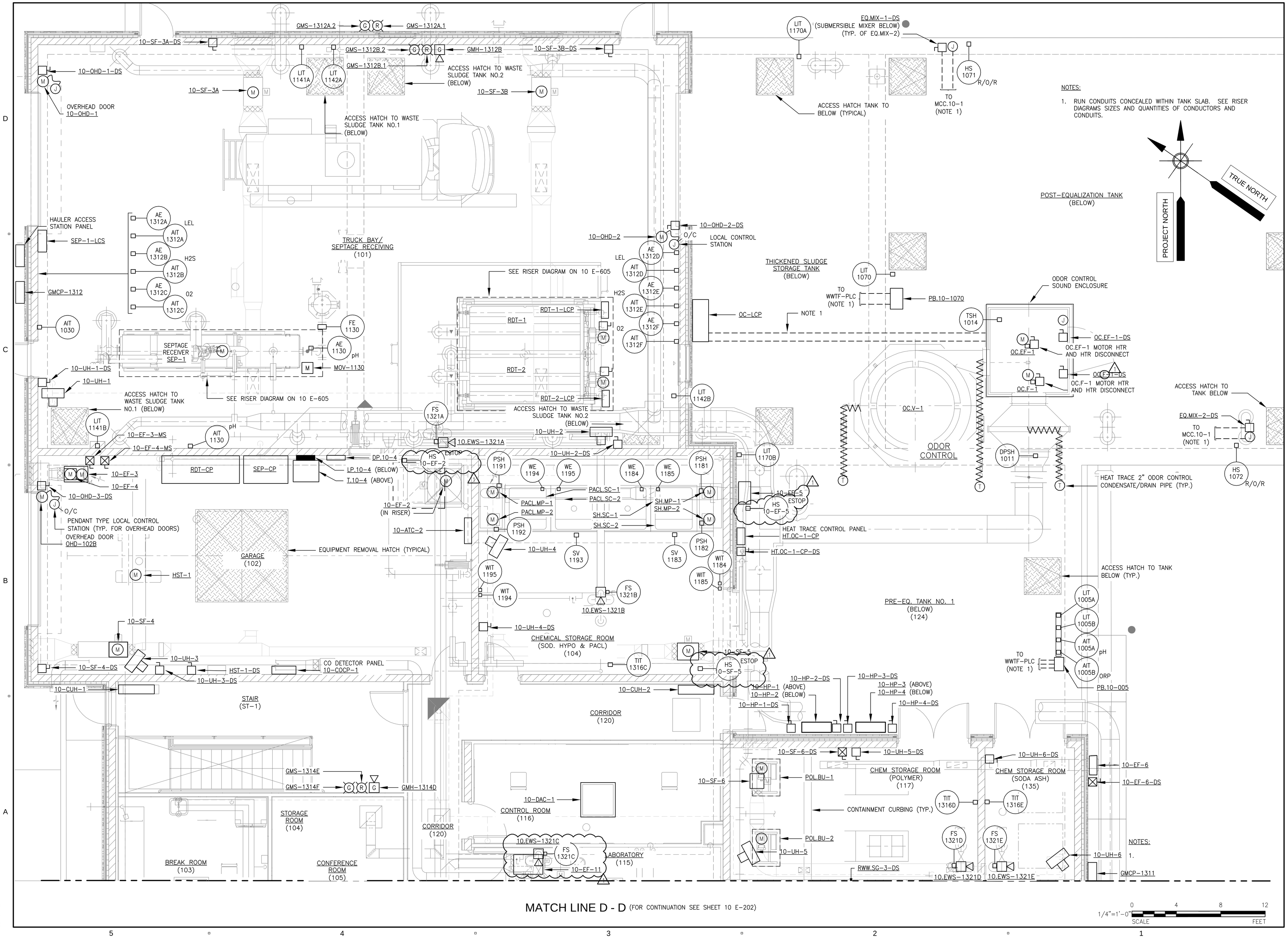
ELECTRICAL

**SHEET TITLE**

# WWTF - LOWER LEVEL - SYSTEMS PLAN II

**SHEET NUMBER**

# 10 E-104




MATCH LINE D - D (FOR CONTINUATION SEE SHEET 10 E-202)

1/4"=1'-0" SCALE 0 4 8 12 FEET

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\EL\D E-201.DWG
LAST UPDATE: Tuesday, March 24, 2020 4:07:28 AM
PLOT DATE: Tuesday, March 24, 2020 4:14:25 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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(508) 240-3700

**ENGINEER**

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9 JONATHAN BOURNE DRIVE
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PHONE: (508) 833-6950
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
No. 39621
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - GRADE LEVEL - POWER PLAN I

**SHEET NUMBER**

# 10 E-201

MATCH LINE D - D (FOR CONTINUATION SEE SHEET 10 E-201)

TRUE NORTH

PROJECT NORTH

BREAK ROOM (103)

CONFERENCE ROOM (105)

HS 10-EF-10 ESTOP

HS 10-EF-11 ESTOP

10-EF-11

LABORATORY (115)

RWW.SG-1-DS

GMS-1311B

GMH-1311

GMS-1311A

10-SF-7-DS

10-SF-7

ACCESS HATCH TO TANK BELOW (TYPICAL)

HEADWORKS (118)

RWW.SG-1

RWW.SG-3

LE 1001A

LE 1001B

RWW.SCRN-1-LCP

VESTIBULE (VEST-1)

CORRIDOR (120)

CORRIDOR (120)

MENS SHOWER ROOM (112)

WOMENS SHOWER ROOM (114)

WSH 1001

TSH 1001

AN 1002 (SAMPLER)

INFLUENT SCREEN RWW.SCR-1

10-CUH-3

CLOSET (130)

SV 1001

RWW.SG-2

ACCESS HATCH TO TANK BELOW (TYP.)

LEL H2S O2

AIT 1311A AIT 1311B AIT 1311C

AE 1311A AE 1311B AE 1311C

RWW.SG-4

RWW.SG-2-DS

RWW.SG-4-DS

10-UH-7

10-UH-7-DS

10-UH-8-DS

10-UH-8

SUPER. OFFICE (106)

COPY ROOM (107)

MENS ROOM (111)

WOMENS ROOM (113)

TURB TURB

AIT 1056 AIT 1050

RWW.SCR-1-CP

10-EF-7

FS 1321F

HS 10-EF-7 ESTOP

10.EWS-1321F

TO PLANT WATER STORAGE TANK

TO IN-PLANT SANITARY PUMP STATION (25)

05 LIT 1100 09

GROUND BUS BAR

PV EQUIP. (FUTURE)

SCADA SERVER RACK

WWTF-PLC

STORAGE (110)

TO EHH-S1

COMCAST TELEPHONE/DATA BACKBOARD

S1

TIT 1316B

10-EF-1 (IN VERTICAL RISER)

10-EF-8

10-EF-8-DS

HS 10-EF-1 ESTOP

SERVICE SINK (120A)

LAUNDRY (120B)

SEE RISER DIAGRAM ON SHEET 10 E-606

DF-1-CP

SBW.P-1

AE 1056 TURB

DISK FILTER NO. 1 DF-1

AE 1050 TURB

FE 1050

FIT 1050

FIT 1060

MOV-1050

DISK FILTER ROOM (109)

MOV-1060

SEE RISER DIAGRAM ON SHEET 10 E-606

AE 1066 TURB

DISK FILTER NO. 2 DF-2

AE 1060 TURB

FE 1060

SBW.P-2

DF-2-CP

TO TMH.10-1 (VERIZON SERVICE)

01

03

FROM MVT.10-1

SEE ELECTRICAL PLAN 10 E-102 FOR LOCATIONS OF BELOW GRADE CONDUITS ENTERING BUILDING (TYPICAL)

SWBD.10-1

MCC.10-1

MIX.BLW-4 VFD

MIX.BLW-3 VFD

MIX.BLW-2 VFD

MIX.BLW-1 VFD

SBR.BLW-3 VFD

SBR.BLW-2 VFD

LP.10-1 (BELOW)(TYP.) T.10-1 (ABOVE)(TYP.)

DP.10-1 LP.10-2 T.10-2

DP.10-2

LP.10-3 T.10-3

DP.10-3

10-CP-1 10-CP-2

10-BLR-1

10-BLR-1-DS

10-BP-1

10-BP-1-VFD

10-CP-2-VFD

10-CP-1-VFD

10-BLR-2

10-BLR-2-DS

10-DH-2

10-PP-2-DS

10-BP-2

10-BP-2-VFD

10-PP-2

10-DH-1

10-PP-1

MECHANICAL ROOM (109)

10-BLR-2-DS

STAIR (ST-2)

10-SF-2 (IN VERTICAL RISER)

10-UH-10-DS

10-ATC-1

10-UH-10

HS 10-SF-2 ESTOP

10-DH-1-DS

10-DH-2-DS

10-CUH-4

10-UH-9

10-UH-9-DS

10-COND-2-DS

10-COND-2-DS

PRE-EQ. TANK NO. 2 (BELOW) (125)

NOTE 1

NOTE 1

10-COND-1

10-COND-2

TO WWTF-PLC (NOTE 1)

PB.10-006

LIT 1006A

LIT 1006B

AIT 1006A pH

AIT 1006B ORP

ACCESS HATCH TO PRE-EQ. TANK NO. 2 BELOW

TO SITE ACCESS GATE

10

MCC.10-2

10-ACCU-1-DS

DIRECT BURIAL CONDUIT

10-ACCU-1

10-EUH-1

SBR-CP

SBR.BLW-1 VFD

SBR.BLW-4 VFD (FUTURE)

ELECTRICAL ROOM (108)

10-AC-1 (CEILING SUSPENDED)

FACP.10-1

SSCP.10-1

GEN. ANNUNCIATOR GACP.10-1

PULL BOX FROM GEN.10-1 FOR CONTROL AND 208/120VAC CONDUCTORS

CCTV-CP.10-1

08

04

05

TO GEN.10-1 SEE SITE PLAN SHEET 10 E-001 FOR CONTINUATION

TO EQUIP. STORAGE FACILITY (20) SEE SITE PLAN SHEET 10 E-001 FOR CONTINUATION

TO EHH.15-01A/EHH.15-01B AND SBR TANKS NO.1 & NO.2 (15) SEE SITE PLAN SHEET 10 E-001 FOR CONTINUATION

SEE SITE PLAN SHEET 10 E-001 FOR CONTINUATION

NOTES:

1. RUN CONDUITS CONCEALED WITHIN TANK SLAB. SEE RISER DIAGRAMS SIZES AND QUANTITIES OF CONDUCTORS AND CONDUITS.

1/4"=1'-0" SCALE 0 4 8 12 FEET

3 5 6

D C B A F G E

5 4 3 2 1

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\EUD E-202.DWG
LAST UPDATE: Tuesday, March 24, 2020 4:03:50 AM
PLOT DATE: Tuesday, March 24, 2020 4:14:51 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS ANDREA ABRAHAM ELECTRICAL No. 45564 REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

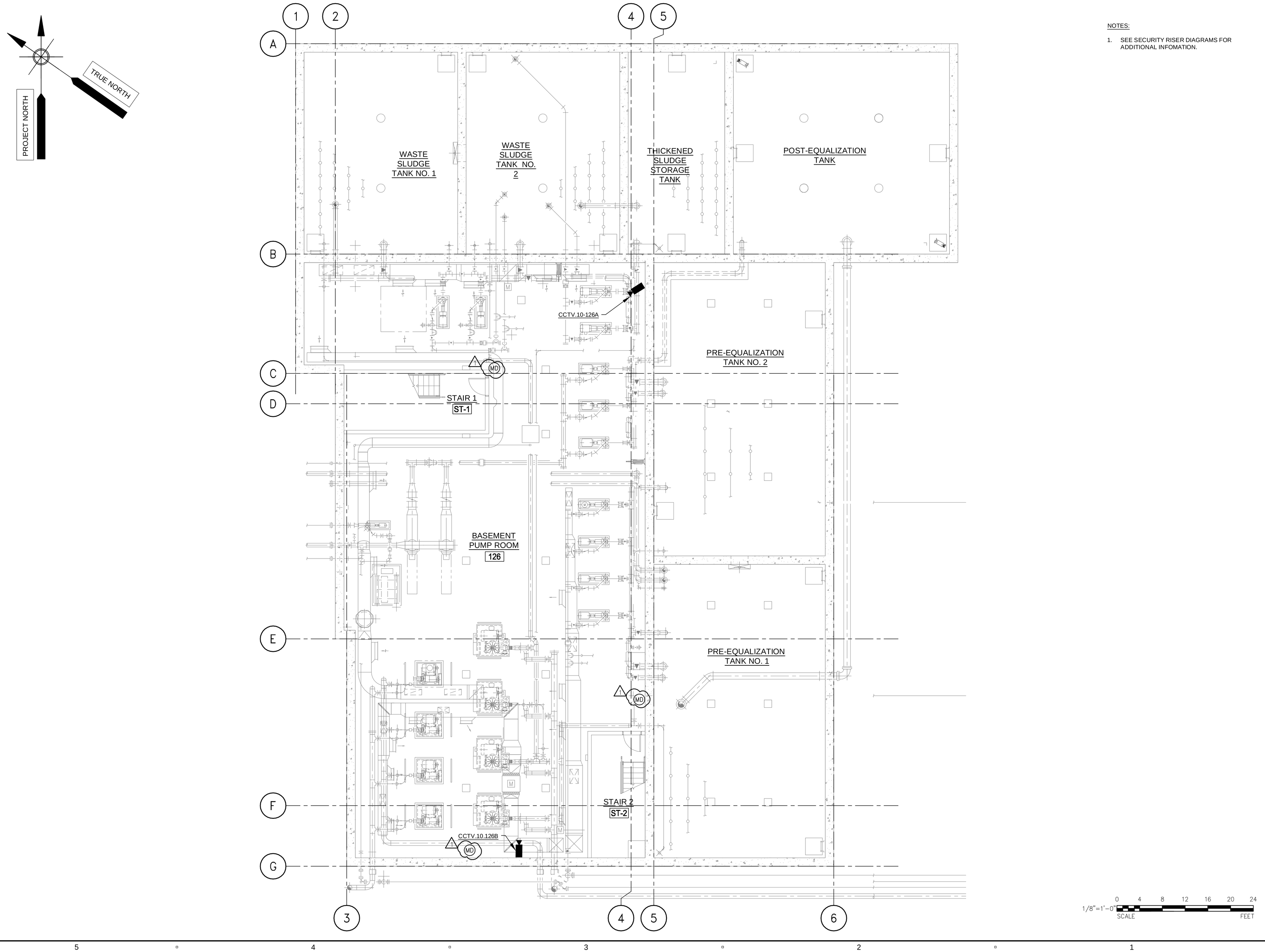
ELECTRICAL

**SHEET TITLE**

# WWTF - GRADE LEVEL - POWER PLAN II

**SHEET NUMBER**

# 10 E-202




NOTES:

1. SEE SECURITY RISER DIAGRAMS FOR ADDITIONAL INFOMATION.

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
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PROFESSIONAL ENGINEER

03-24-2020

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| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

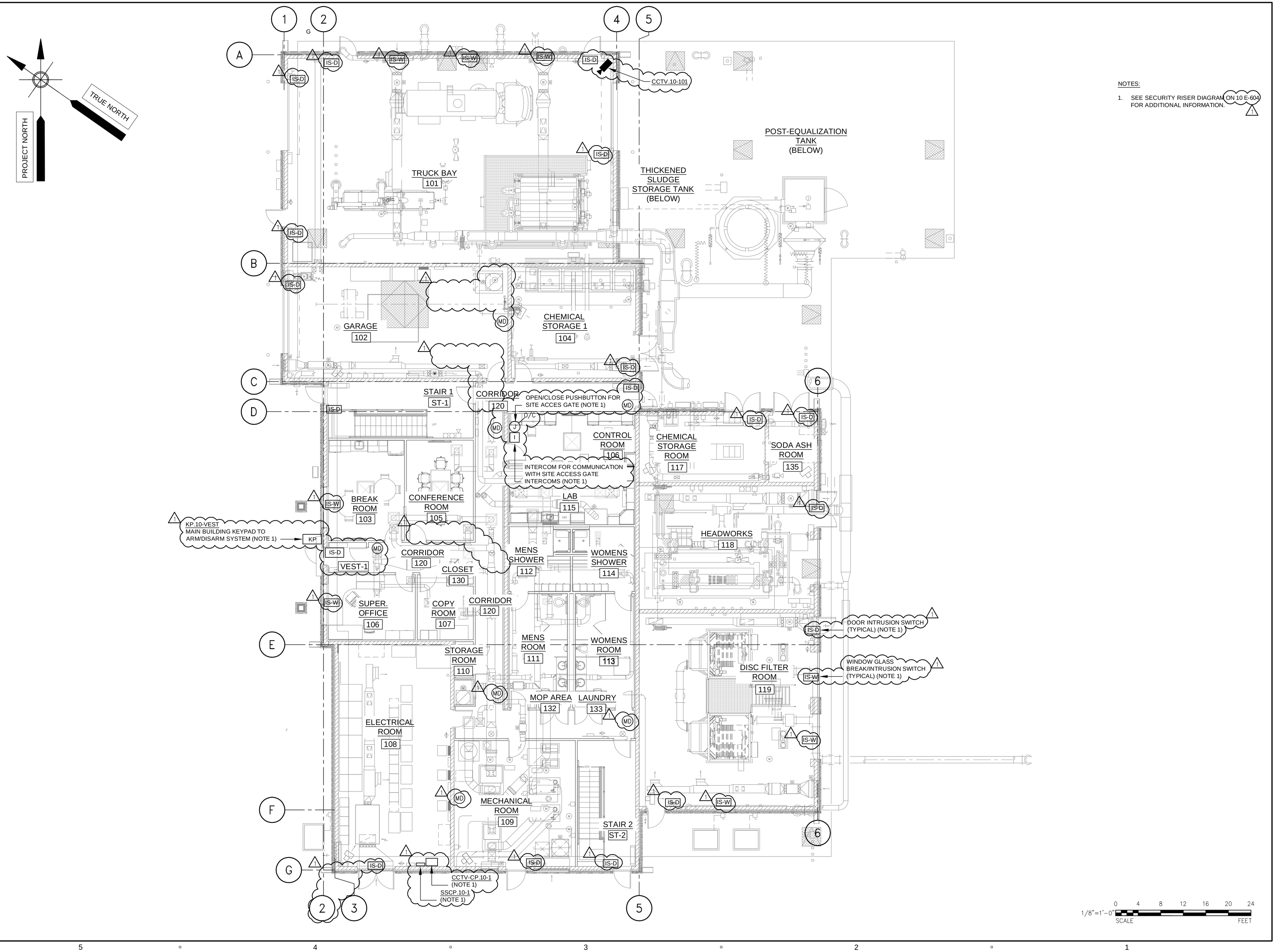
**SHEET TITLE**

# WWTF - LOWER LEVEL - SECURITY PLAN I

**SHEET NUMBER**

# 10 E-301

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-301.DWG
LAST UPDATE: Monday, March 23, 2020 8:04:59 PM
PLOT DATE: Tuesday, March 24, 2020 4:15:01 AM




NOTES:

1. SEE SECURITY RISER DIAGRAM ON 10 E-604 FOR ADDITIONAL INFORMATION.

1/8"=1'-0" SCALE 0 4 8 12 16 20 24 FEET

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
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ELECTRICAL
No. 43962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

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| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
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| Date: | JANUARY 2020 |
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**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - GRADE LEVEL - SECURITY PLAN I

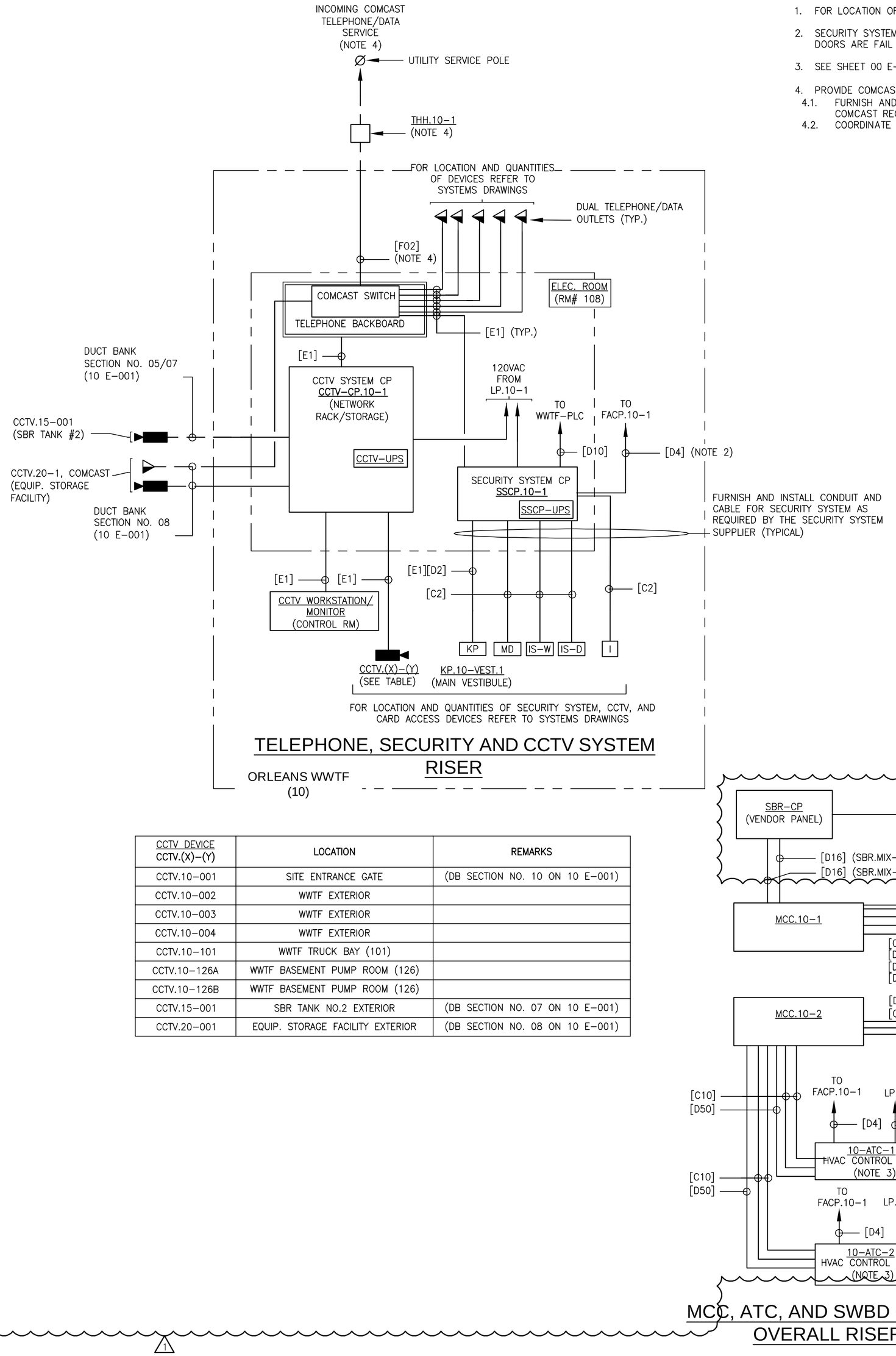
**SHEET NUMBER**

# 10 E-302

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-302.DWG
LAST UPDATE: Monday, March 23, 2020 9:13:13 PM
PLOT DATE: Tuesday, March 24, 2020 4:15:15 AM

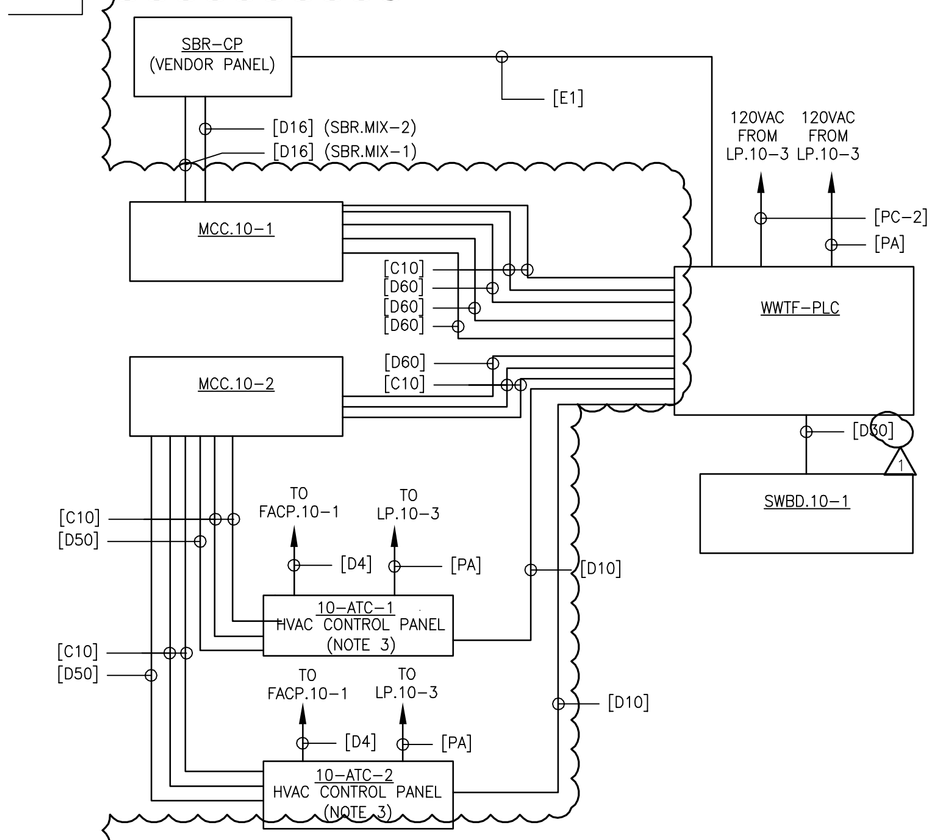
NOTES:

1. FOR LOCATION OF DEVICES SEE POWER AND SYSTEMS PLANS.
2. SECURITY SYSTEMS SHALL BE INTERLOCKED WITH THE MAIN FIRE ALARM CONTROL PANEL SUCH THAT IN THE EVENT OF A FIRE THE DOORS ARE FAIL OPEN.
3. SEE SHEET 00 E-602 TABLE OF RESPONSIBILITY FOR ELECTRICAL AND HVAC SCOPE OF SUPPLY.
4. PROVIDE COMCAST TELEPHONE AND DATA SERVICE(S) IN ACCORDANCE WITH COMCAST REQUIREMENTS.
   - 4.1. FURNISH AND INSTALL TELEPHONE MANHOLES, CONDUIT AND CABLE FOR TELEPHONE/DATA SERVICE(S) IN ACCORDANCE WITH COMCAST REQUIREMENTS.
   - 4.2. COORDINATE TELEPHONE BACKBOARD, SWITCHES, AND SYSTEM HARDWARE WITH COMCAST REQUIREMENTS.

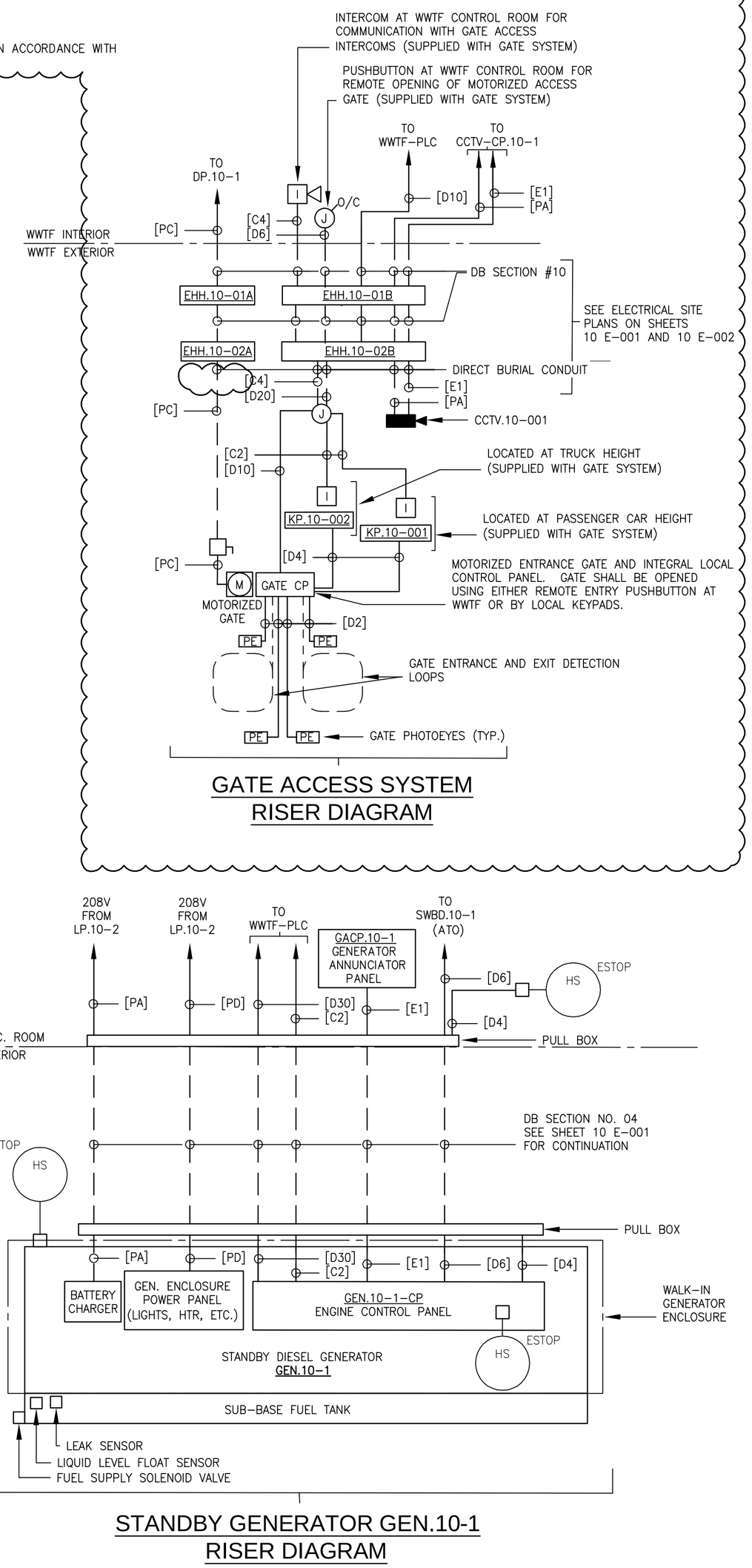



## TELEPHONE, SECURITY AND CCTV SYSTEM RISER

| CCTV DEVICE CCTV.(X)-(Y) | LOCATION | REMARKS |
|---|---|---|
| CCTV.10-001 | SITE ENTRANCE GATE | (DB SECTION NO. 10 ON 10 E-001) |
| CCTV.10-002 | WWTF EXTERIOR | |
| CCTV.10-003 | WWTF EXTERIOR | |
| CCTV.10-004 | WWTF EXTERIOR | |
| CCTV.10-101 | WWTF TRUCK BAY (101) | |
| CCTV.10-126A | WWTF BASEMENT PUMP ROOM (126) | |
| CCTV.10-126B | WWTF BASEMENT PUMP ROOM (126) | |
| CCTV.15-001 | SBR TANK NO.2 EXTERIOR | (DB SECTION NO. 07 ON 10 E-001) |
| CCTV.20-001 | EQUIP. STORAGE FACILITY EXTERIOR | (DB SECTION NO. 08 ON 10 E-001) |




## MCC, ATC, AND SWBD CONTROL WIRING OVERALL RISER DIAGRAM




## GATE ACCESS SYSTEM RISER DIAGRAM




## STANDBY GENERATOR GEN.10-1 RISER DIAGRAM

## WWTF- GENERAL RISER DIAGRAMS

NTS


AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
No. 43962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

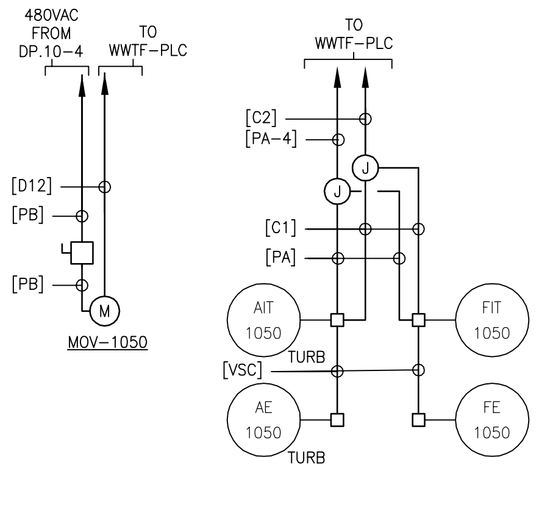
**SHEET TITLE**

**WWTF - ELECTRICAL RISER DIAGRAMS I**

**SHEET NUMBER**

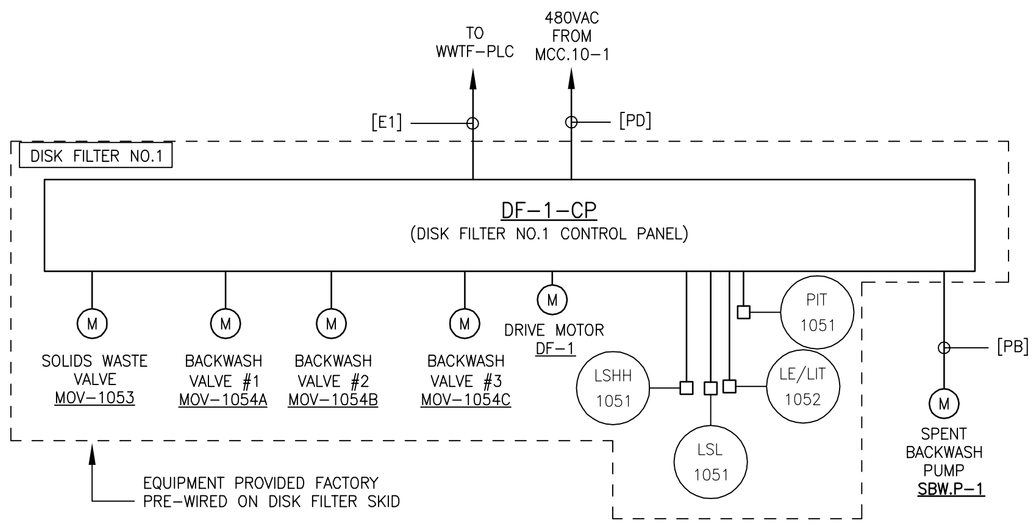
**10 E-604**


PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-604.DWG
LAST UPDATE: Monday, March 23, 2020 11:45:26 PM
PLOT DATE: Tuesday, March 24, 2020 4:15:25 AM

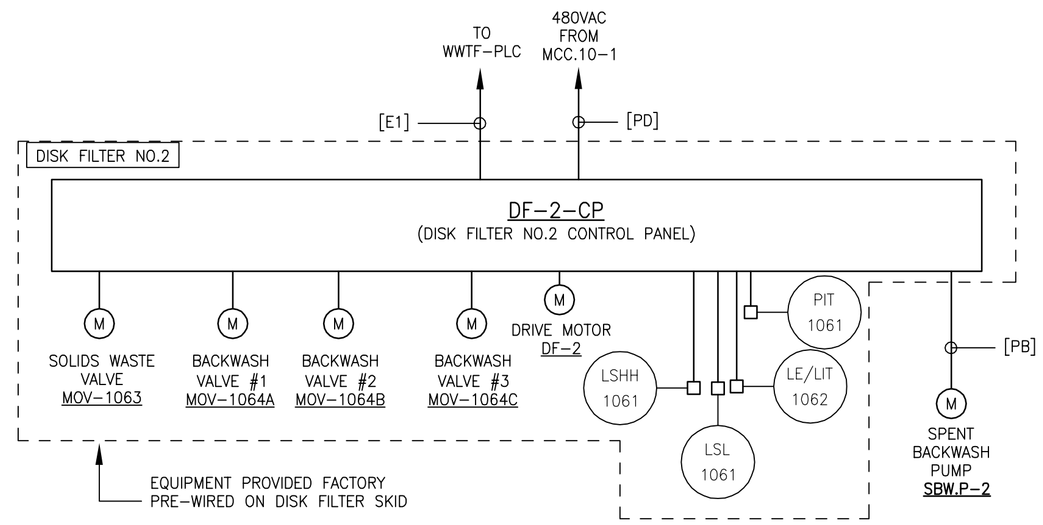


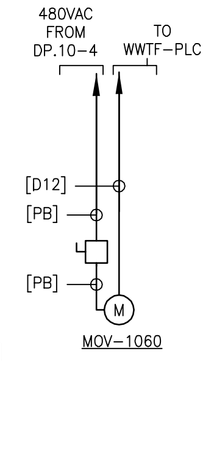


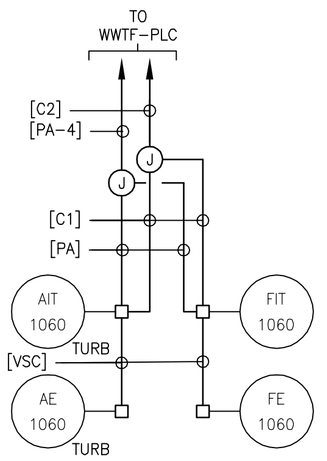





DISK FILTER NO.1 - RISER DIAGRAM



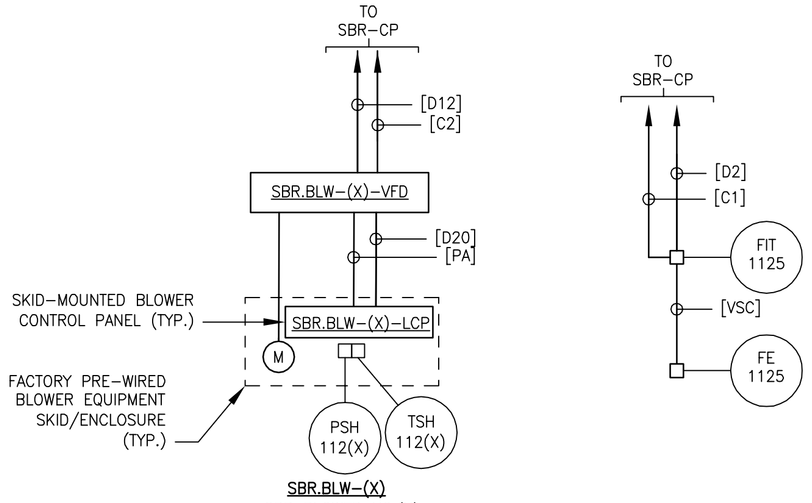




DISK FILTER NO.2 - RISER DIAGRAM

# DISK FILTERS - RISER DIAGRAMS

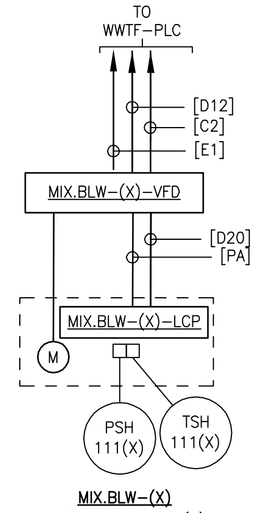
NTS




SBR.BLW–(X)
SBR BLOWER NO.(X)

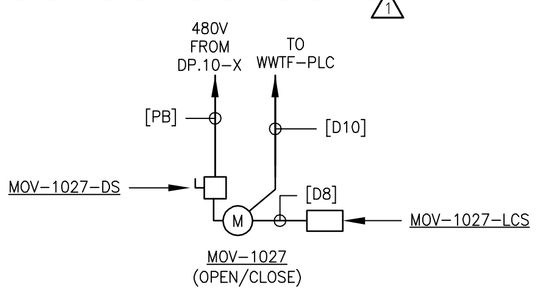
| SBR BLOWER SBR.BLW–(X) | SBR BLOWER VFD SBR.BLW–(X)–VFD | LOCAL CONTROL PANEL SBR.BLW–(X)–LCP | TSH–112(X), PSH–112(X) | ESTOP HS–112(X) |
|---|---|---|---|---|
| SBR.BLW–1 | SBR.BLW–1–VFD | SBR.BLW–1–LCP | 1121 | 1121 |
| SBR.BLW–2 | SBR.BLW–2–VFD | SBR.BLW–2–LCP | 1122 | 1122 |
| SBR.BLW–3 | SBR.BLW–3–VFD | SBR.BLW–3–LCP | 1123 | 1123 |
| SBR.BLW–4 (FUTURE) | SBR.BLW–4–VFD | SBR.BLW–4–LCP | 1124 | 1124 |

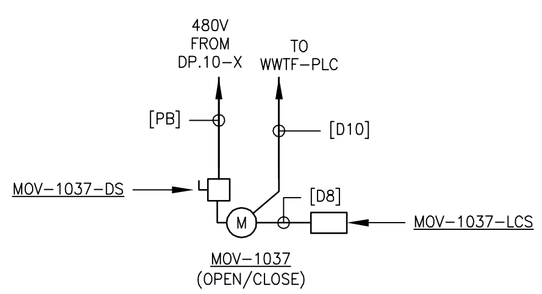



MIX.BLW–(X)
MIX BLOWER NO.(X)

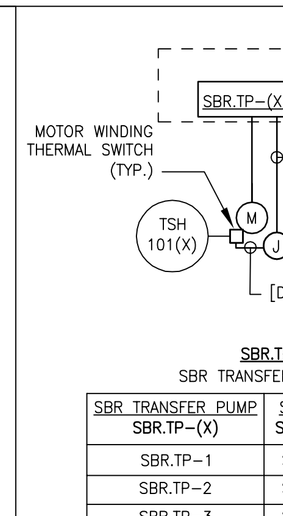
| MIX BLOWER MIX.BLW–(X) | MIX BLOWER VFD MIX.BLW–(X) | LOCAL CONTROL PANEL MIX.BLW–(X)–LCP | TSH–111(X), PSH–111(X) | ESTOP HS–111(X) |
|---|---|---|---|---|
| MIX.BLW–1 | MIX.BLW–1–VFD | MIX.BLW–1–LCP | 1111 | 1111 |
| MIX.BLW–2 | MIX.BLW–2–VFD | MIX.BLW–2–LCP | 1112 | 1112 |
| MIX.BLW–3 | MIX.BLW–3–VFD | MIX.BLW–3–LCP | 1113 | 1113 |
| MIX.BLW–4 | MIX.BLW–4–VFD | MIX.BLW–4–LCP | 1114 | 1114 |

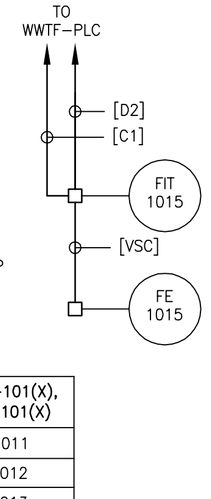



## WWTF BLOWERS - RISER DIAGRAMS

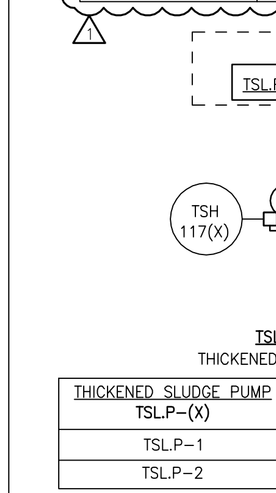
NTS

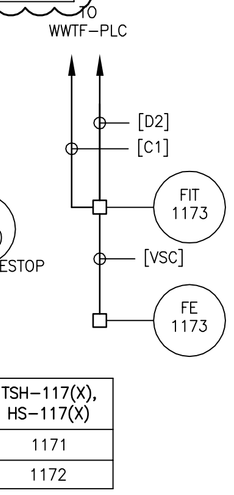



SBR.TP–(X)
SBR TRANSFER PUMP NO.(X)

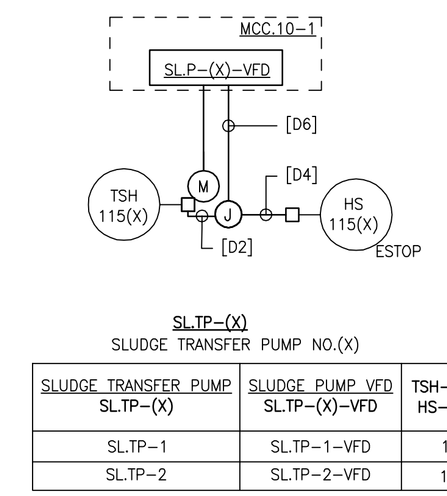
| SBR TRANSFER PUMP SBR.TP–(X) | SBR PUMP VFD SBR.TP–(X)–VFD | TSH–101(X), HS–101(X) |
|---|---|---|
| SBR.TP–1 | SBR.TP–1–VFD | 1011 |
| SBR.TP–2 | SBR.TP–2–VFD | 1012 |
| SBR.TP–3 | SBR.TP–3–VFD | 1013 |
| SBR.TP–4 (FUTURE) | SBR.TP–4–VFD | 1014 |



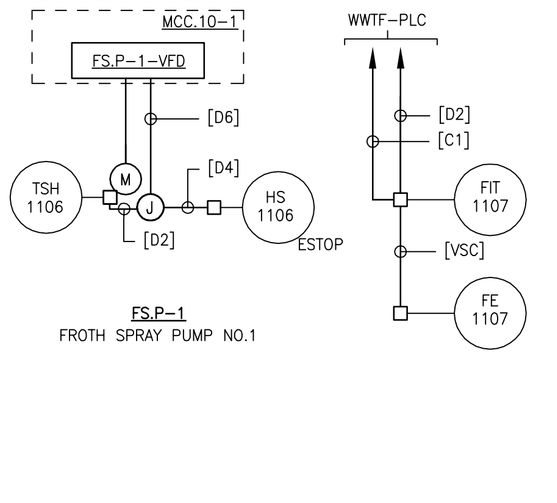

TSL.P–(X)
THICKENED SLUDGE PUMP NO.(X)

| THICKENED SLUDGE PUMP TSL.P–(X) | TSL PUMP VFD TSL.P–(X)–VFD | TSH–117(X), HS–117(X) |
|---|---|---|
| TSL.P–1 | TSL.P–1–VFD | 1171 |
| TSL.P–2 | TSL.P–2–VFD | 1172 |

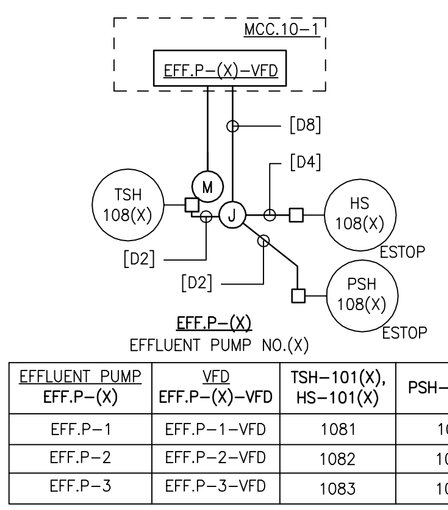



SL.TP–(X)
SLUDGE TRANSFER PUMP NO.(X)

| SLUDGE TRANSFER PUMP SL.TP–(X) | SLUDGE PUMP VFD SL.TP–(X)–VFD | TSH–115(X), HS–115(X) |
|---|---|---|
| SL.TP–1 | SL.TP–1–VFD | 1151 |
| SL.TP–2 | SL.TP–2–VFD | 1152 |

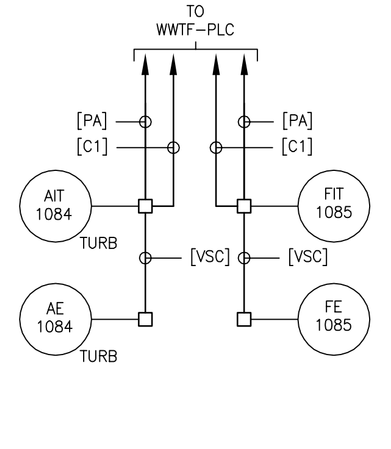



FS.P–1
FROTH SPRAY PUMP NO.1




EFF.P–(X)
EFFLUENT PUMP NO.(X)

| EFFLUENT PUMP EFF.P–(X) | VFD EFF.P–(X)–VFD | TSH–101(X), HS–101(X) | PSH–101(X) |
|---|---|---|---|
| EFF.P–1 | EFF.P–1–VFD | 1081 | 1081 |
| EFF.P–2 | EFF.P–2–VFD | 1082 | 1082 |
| EFF.P–3 | EFF.P–3–VFD | 1083 | 1083 |




## WWTF PUMPS - RISER DIAGRAMS

NTS


AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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9 JONATHAN BOURNE DRIVE
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PHONE: (508) 833-6950
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
No. 43962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

**WWTF - ELECTRICAL RISER DIAGRAMS IV**

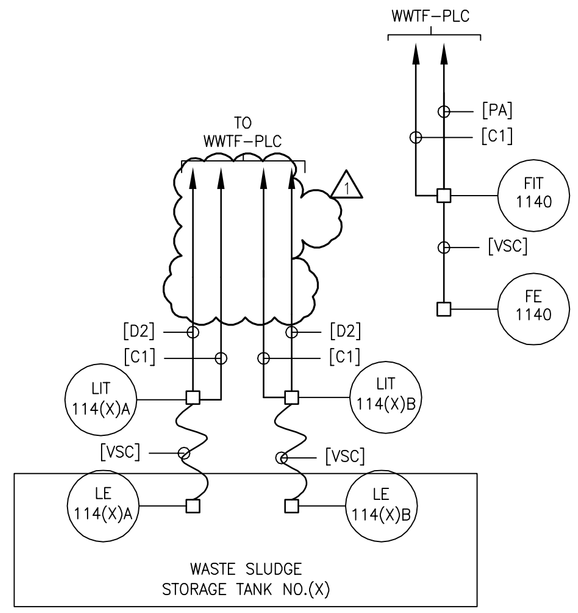
**SHEET NUMBER**

**10 E-607**


PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-607.DWG
LAST UPDATE: Tuesday, March 24, 2020 4:08:06 AM
PLOT DATE: Tuesday, March 24, 2020 4:15:34 AM

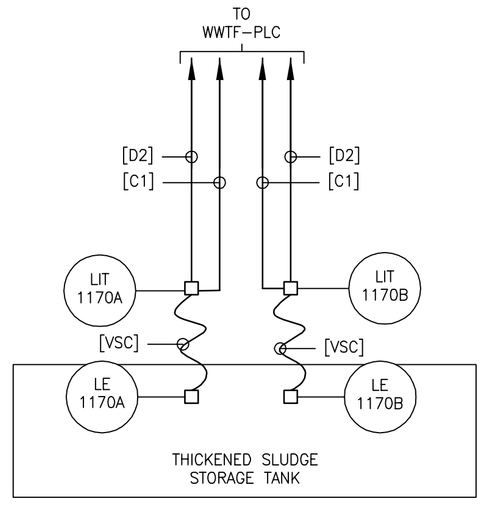
NOTES:

1. RUN CONDUITS INDICATED AS CONCEALED WITHIN TANK SLAB.
2. PROVIDE TERMINAL BOX AS INDICATED. INSTALL VENDOR SUPPLIED MOISTURE/TEMPERATURE DETECTION RELAYS WITHIN TERMINAL BOX.

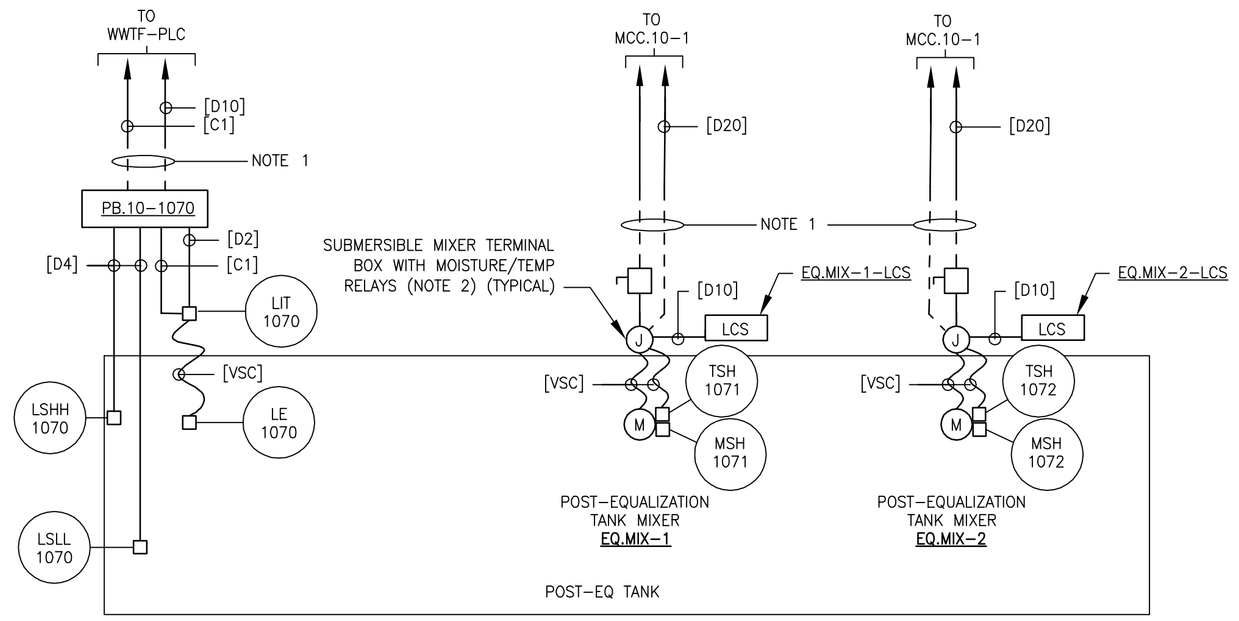



| LEVEL LE/LIT–(X) | LOCATION |
|---|---|
| LE/LIT–1141A | WASTE SLUDGE STORAGE TANK NO.1 |
| LE/LIT–1141B | |
| LE/LIT–1142A | WASTE SLUDGE STORAGE TANK NO.2 |
| LE/LIT–1142B | |

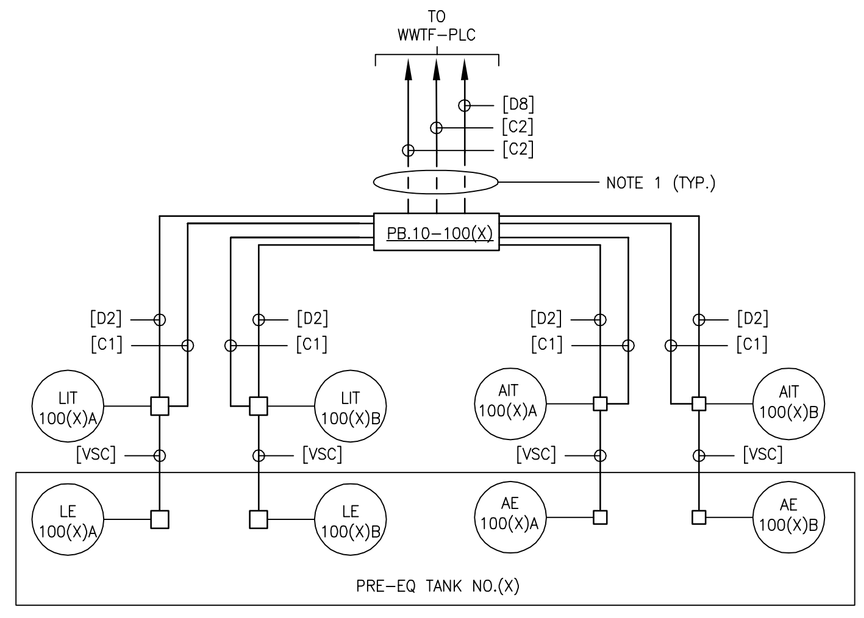
WASTE SLUDGE STORAGE TANKS NO.1 & NO.2 – RISER DIAGRAMS




THICKENED SLUDGE STORAGE TANK – RISER DIAGRAMS




POST–EQUALIZATION TANK – RISER DIAGRAMS




| LEVEL LE/LIT–(X) | ANALYZER AE/AIT–(X) | PULL BOX PB.10–00(X) | LOCATION |
|---|---|---|---|
| LE/LIT–1005A | AE/AIT–1005A (pH) | PB.10–1005 | PRE–EQUALIZATION TANK NO.1 |
| LE/LIT–1005B | AE/AIT–1005B (ORP) | | |
| LE/LIT–1006A | AE/AIT–1006A (pH) | PB.10–1006 | PRE–EQUALIZATION TANK NO.2 |
| LE/LIT–1006B | AE/AIT–1006B (ORP) | | |

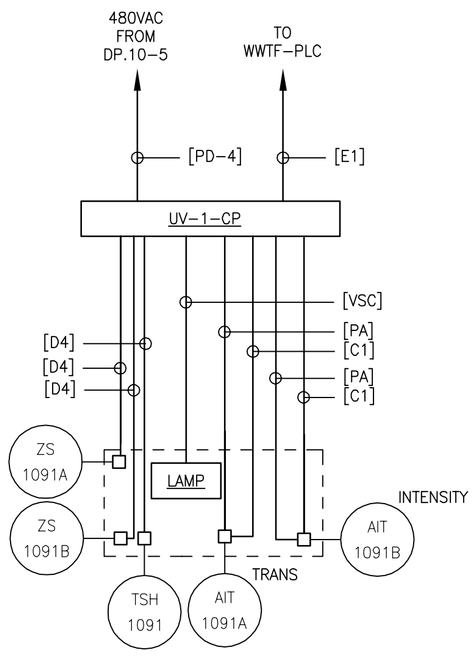
PRE–EQUALIZATION TANKS NO.1 & NO.2 – RISER DIAGRAMS

# PRE-EQ, POST-EQ, WASTE SLUDGE AND THICKENED SLUDGE STORAGE TANKS - RISER DIAGRAMS

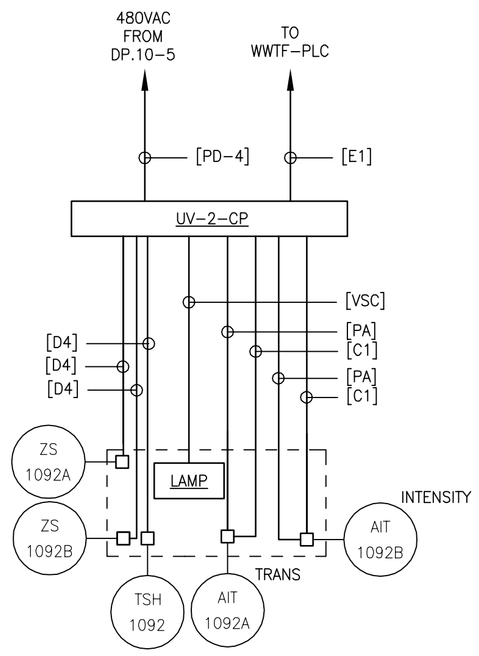
NTS

## UV SYSTEM - RISER DIAGRAMS

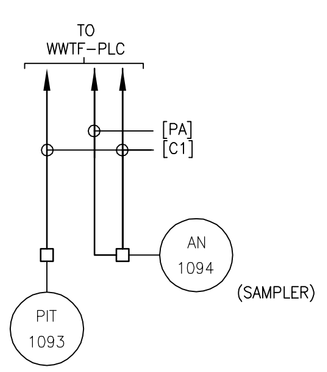
NTS




IN–LINE UV REACTOR NO.1
UVR–1

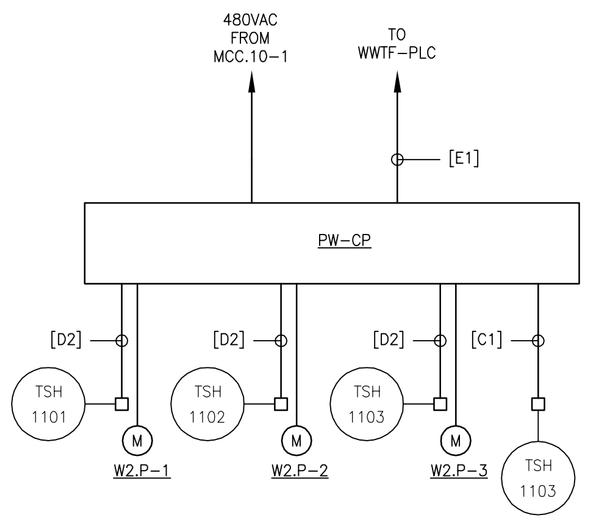



IN–LINE UV REACTOR NO.2
UVR–2

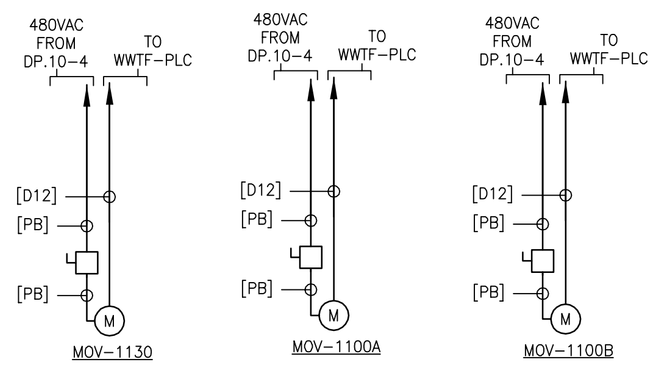



## PLANT WATER SYSTEM - RISER DIAGRAMS

NTS




PLANT WATER PUMPS/CONTROL PANEL





AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
No. 43962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

**WWTF - ELECTRICAL RISER DIAGRAMS V**

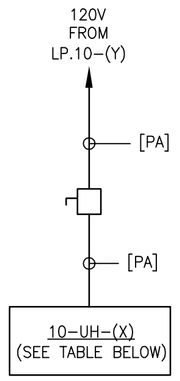
**SHEET NUMBER**

**10 E-608**


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E10 E-608.DWG
LAST UPDATE: Tuesday, March 24, 2020 3:47:22 AM
PLOT DATE: Tuesday, March 24, 2020 4:15:45 AM

NOTES:

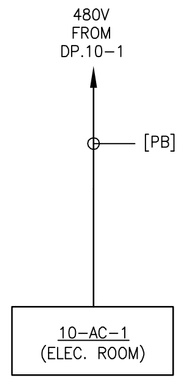
1. FOR LOCATION OF DEVICES SEE POWER PLAN AND SYSTEMS PLAN DRAWINGS.



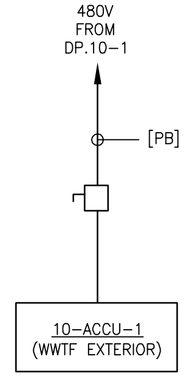

UNIT HEATERS

| 10-UH-(X) | LP.10-(Y) |
|---|---|
| 10-UH-1 | LP.10-X |
| 10-UH-2 | LP.10-X |
| 10-UH-3 | LP.10-X |
| 10-UH-4 | LP.10-X |
| 10-UH-5 | LP.10-X |
| 10-UH-6 | LP.10-X |
| 10-UH-7 | LP.10-X |
| 10-UH-8 | LP.10-X |
| 10-UH-9 | LP.10-X |
| 10-GUH-1 | LP.10-X |
| 10-GUH-2 | LP.10-X |
| 10-GUH-3 | LP.10-X |
| 10-GUH-4 | LP.10-X |
| 10-CUH-1* | LP.10-X |
| 10-CUH-2* | LP.10-X |
| 10-CUH-3* | LP.10-X |
| 10-CUH-4* | LP.10-X |

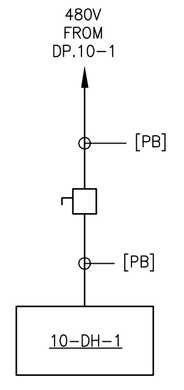
* DISCONNECT SUPPLIED INTEGRAL TO CABINET UNIT HEATERS



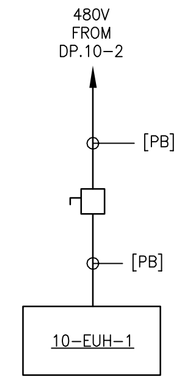

AIR CONDITIONING UNIT



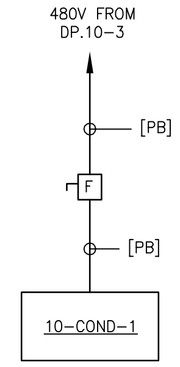

AIR CONDITIONING UNIT



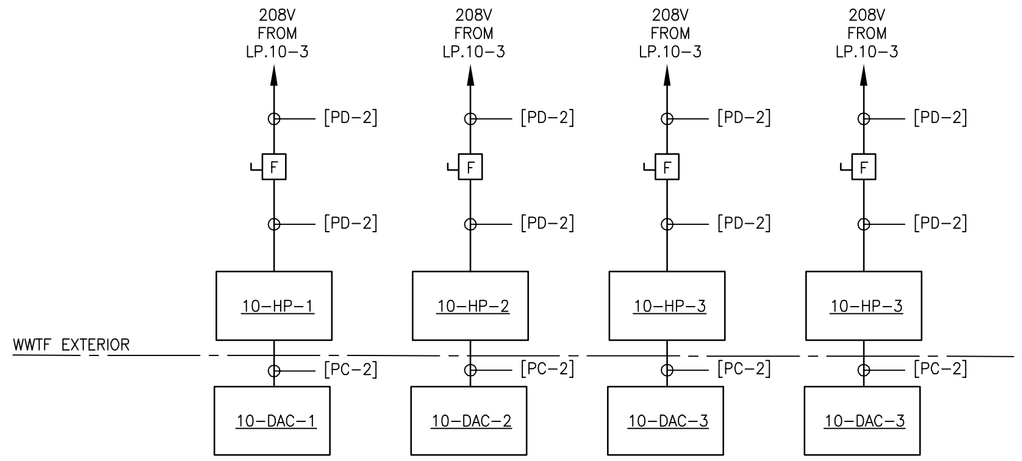

DEHUMIDIFIER
(TYPICAL OF 10-DH-2)



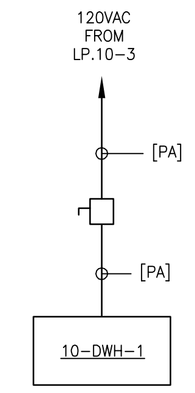

ELECTRIC UNIT HEATER



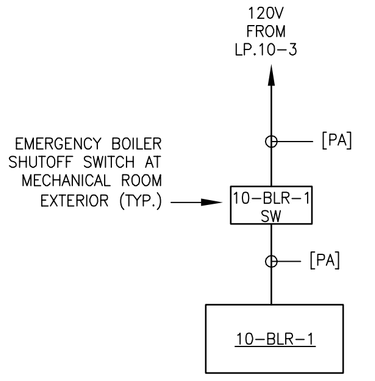

CONDENSING UNIT
(TYP. OF 10-COND-2)



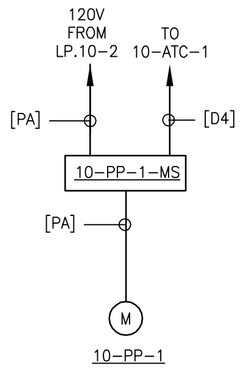

DUCTLESS SPLIT AIR CONDITIONERS



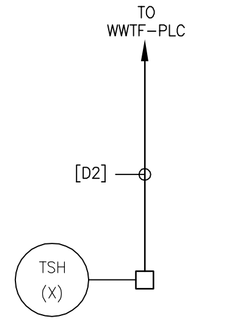

DOMESTIC WATER HEATER




BOILER
(TYP. OF 10-BLR-2)

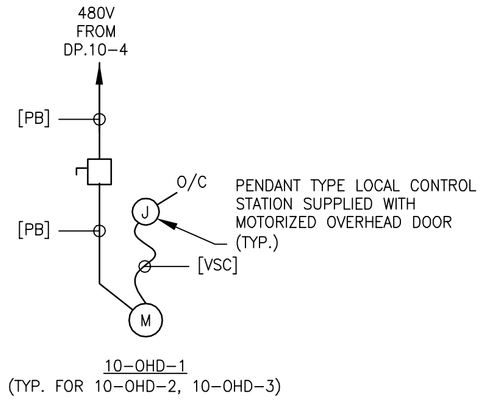



HOT WATER RECIRC. PUMP
(TYPICAL OF 10-PP-2)

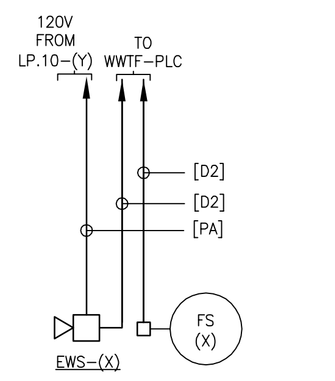



| TEMP. SWITCHES TSH-(X) | LOCATION |
|---|---|
| TSH-01 | ELEC ROOM |
| TSH-02 | ELEC ROOM |

ELECTRICAL ROOM TEMP. SWITCHES

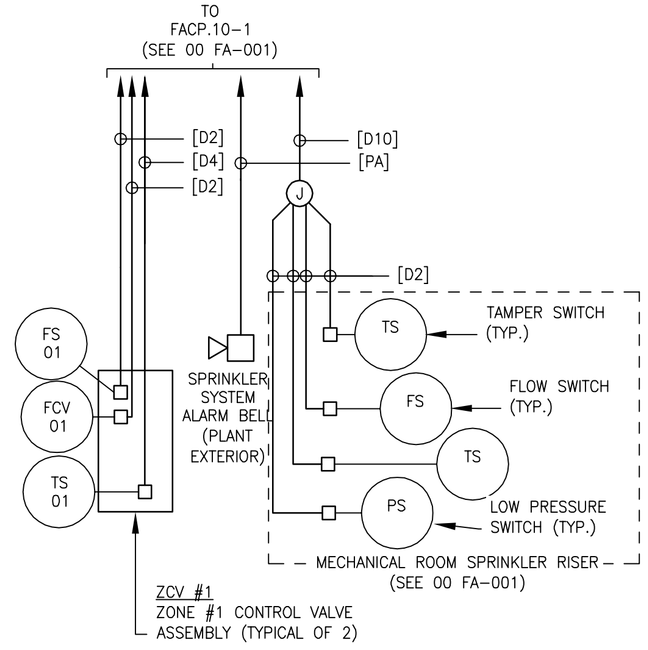



MOTORIZED OVERHEAD DOOR

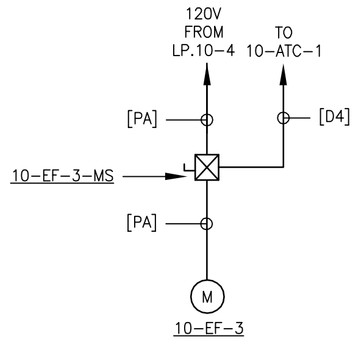



EMERGENCY EYEWASH SHOWER
ALARM HORNS & FLOW SWITCHES

| EYEWASH SHOWER EWS-(X) | FLOW SWITCH FS-(X) | LP.10-(Y) |
|---|---|---|
| EWS-01 | FS-01 | LP.10-4 |
| EWS-02 | FS-02 | |
| EWS-03 | FS-03 | |
| EWS-04 | FS-04 | |
| EWS-05 | FS-05 | |

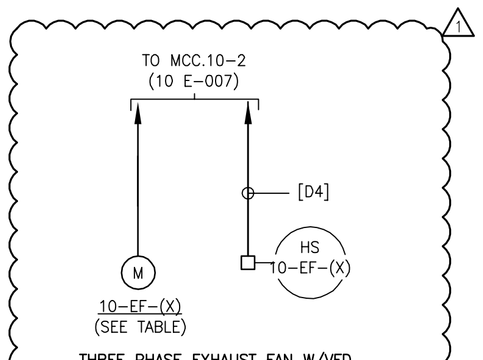



| SPRINKLER ZONE CONTROL VALVE ASSEMBLY | | |
|---|---|---|
| ZONE CONTROL VAVE ASSEMBLY ZCV #(X) | FS-(XX) FCV-(XX) TS-(XX) | LOCATION |
| ZCV #1 | FS/FCV/TS-01 | - |
| ZCV #2 | FS/FCV/TS-02 | - |



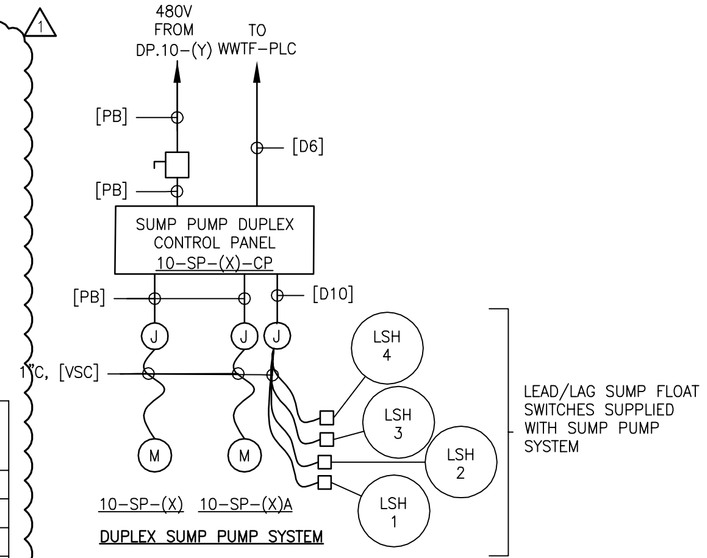

SINGLE PHASE EXHAUST FAN

| SINGLE PHASE EXHAUST FAN 10-EF-(X) | 120VAC POWER FROM LP.10-(X) |
|---|---|
| 10-EF-3 | LP.10-4 |
| 10-EF-4 | LP.10-4 |
| 10-EF-6 | LP.10-4 |
| 10-EF-8 | LP.10-3 |
| 10-EF-9 | LP.10-3 |
| 10-SF-6 | LP.10-4 |

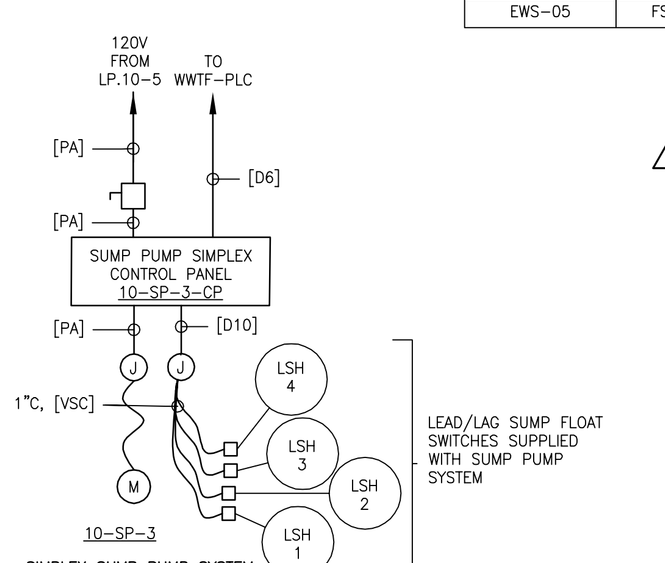


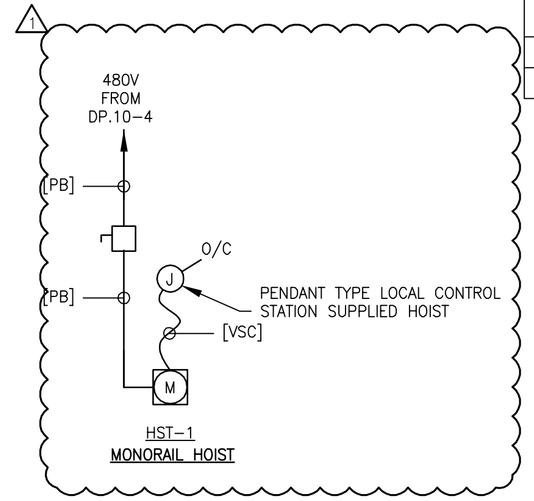

THREE PHASE EXHAUST FAN W/VFD

| THREE PHASE EXHAUST FAN W/VFD 10-EF-(X) | ESTOP HS-10-EF-(X) |
|---|---|
| 10-EF-1 | HS-10-EF-1 |
| 10-EF-2 | HS-10-EF-2 |
| 10-EF-5 | HS-10-EF-5 |
| 10-EF-7 | HS-10-EF-7 |
| 10-EF-10 | HS-10-EF-10 |
| 10-EF-11 | HS-10-EF-11 |
| 10-SF-1 | HS-10-SF-1 |
| 10-SF-2 | HS-10-SF-2 |
| 10-SF-5 | HS-10-SF-5 |
| 10-SF-8 | HS-10-SF-8 |




| SUMP PUMP CONTROL PANEL 10-SP-(X)-CP | SUMP PUMPS 10-SP-(X) | LOCATION | DP.10-(Y) |
|---|---|---|---|
| 10-SP-1-CP | 10-SP-1 | WWTF BASEMENT PUMP ROOM | DP.10-5 |
| | 10-SP-1A | | |
| 10-SP-1-CP | 10-SP-2 | | DP.10-5 |
| | 10-SP-2A | | |




## WWTF - HVAC, PLUMBING, MISC. RISER DIAGRAMS

NTS

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-610.DWG
LAST UPDATE: Tuesday, March 24, 2020 3:56:35 AM
PLOT DATE: Tuesday, March 24, 2020 4:15:54 AM

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**


AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
No. 35547
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

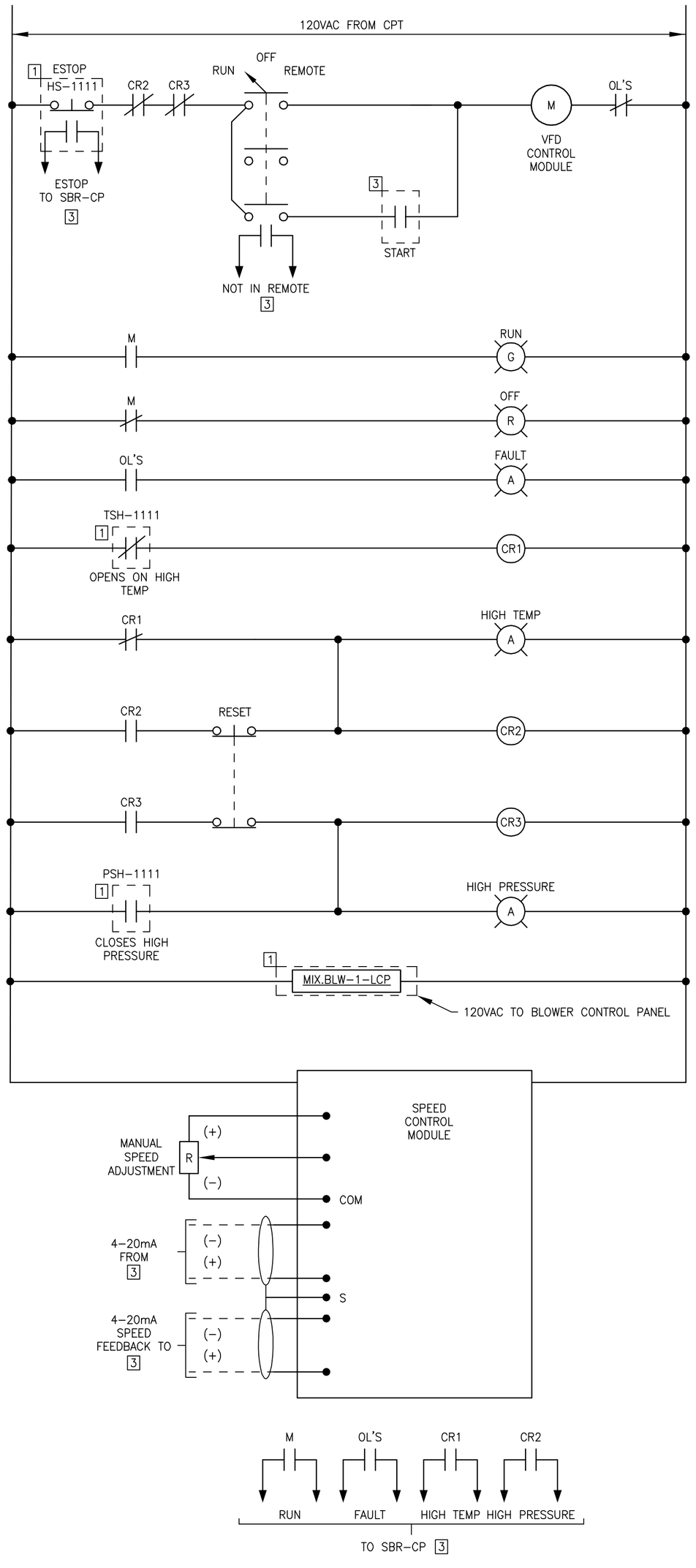
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL RISER DIAGRAMS VII

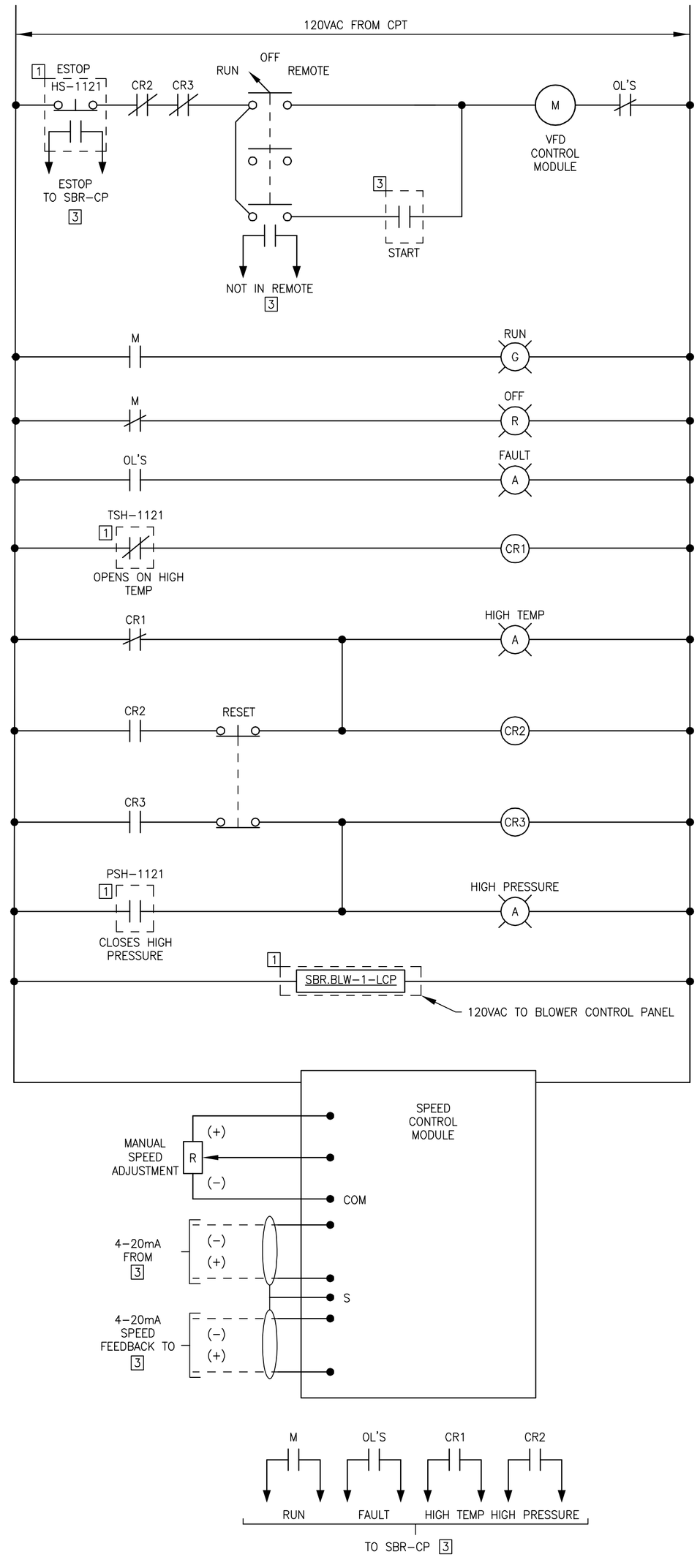
**SHEET NUMBER**

# 10 E-610




## MIXING BLOWER VFD WIRING DIAGRAM MIX.BLW-1-VFD

(TYPICAL OF MIX.BLW-2/3/4)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)




## SBR BLOWER VFD WIRING DIAGRAM SBR.BLW-1-VFD

(TYPICAL OF SBR.BLW-2/3/4) 1
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)

LEGEND

1 DEVICE LOCATED AT EQUIPMENT
2 FROM/TO WWTF-PLC
3 FROM/TO SBR-CP


AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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(508) 240-3700

**ENGINEER**

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**REGISTRATION**

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ANDREA ABRAHAM
ELECTRICAL
NO. 34962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL WIRING SCHEMATICS I

**SHEET NUMBER**

# 10 E-613


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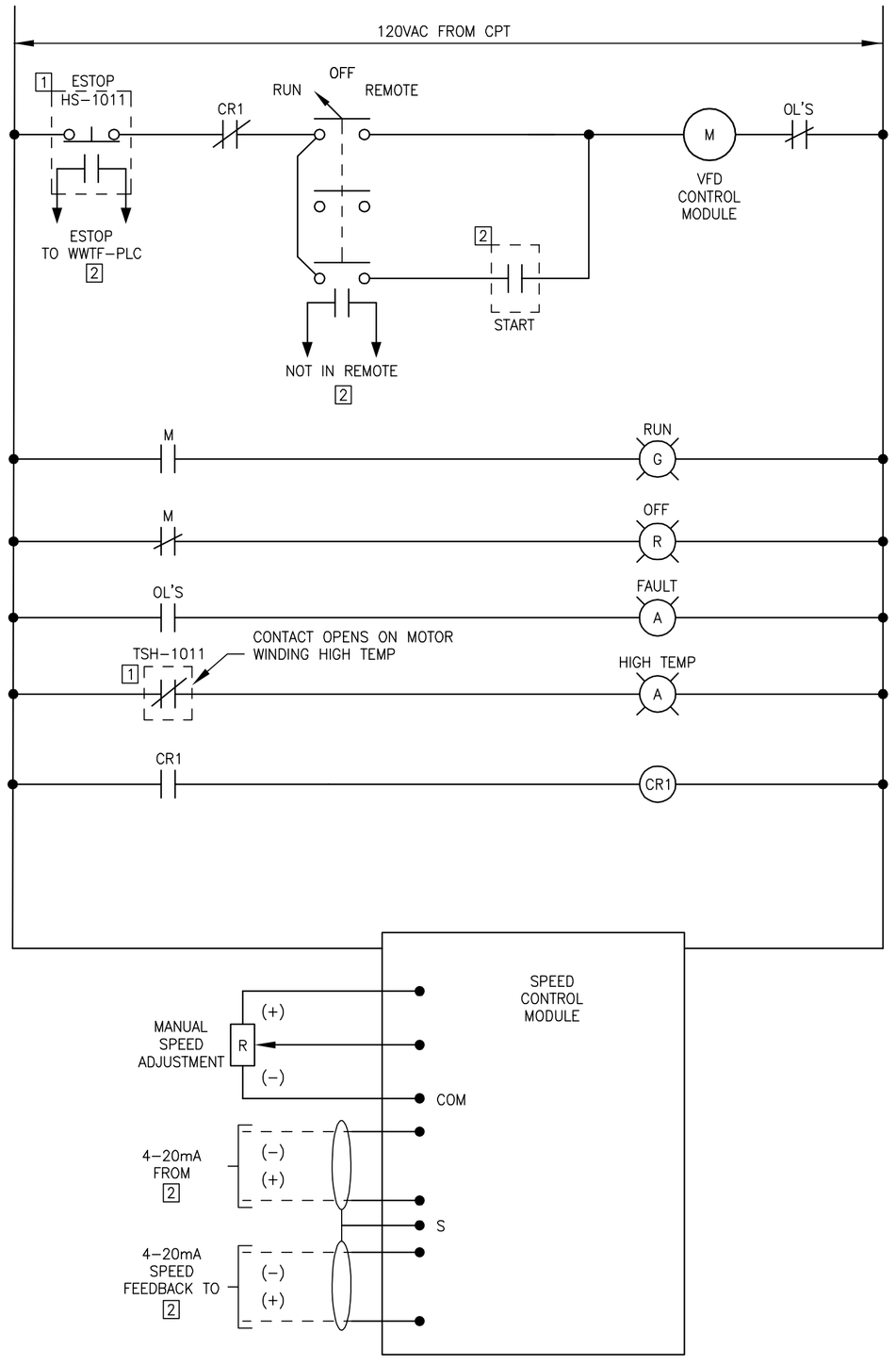
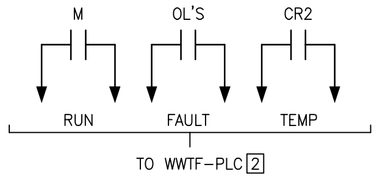
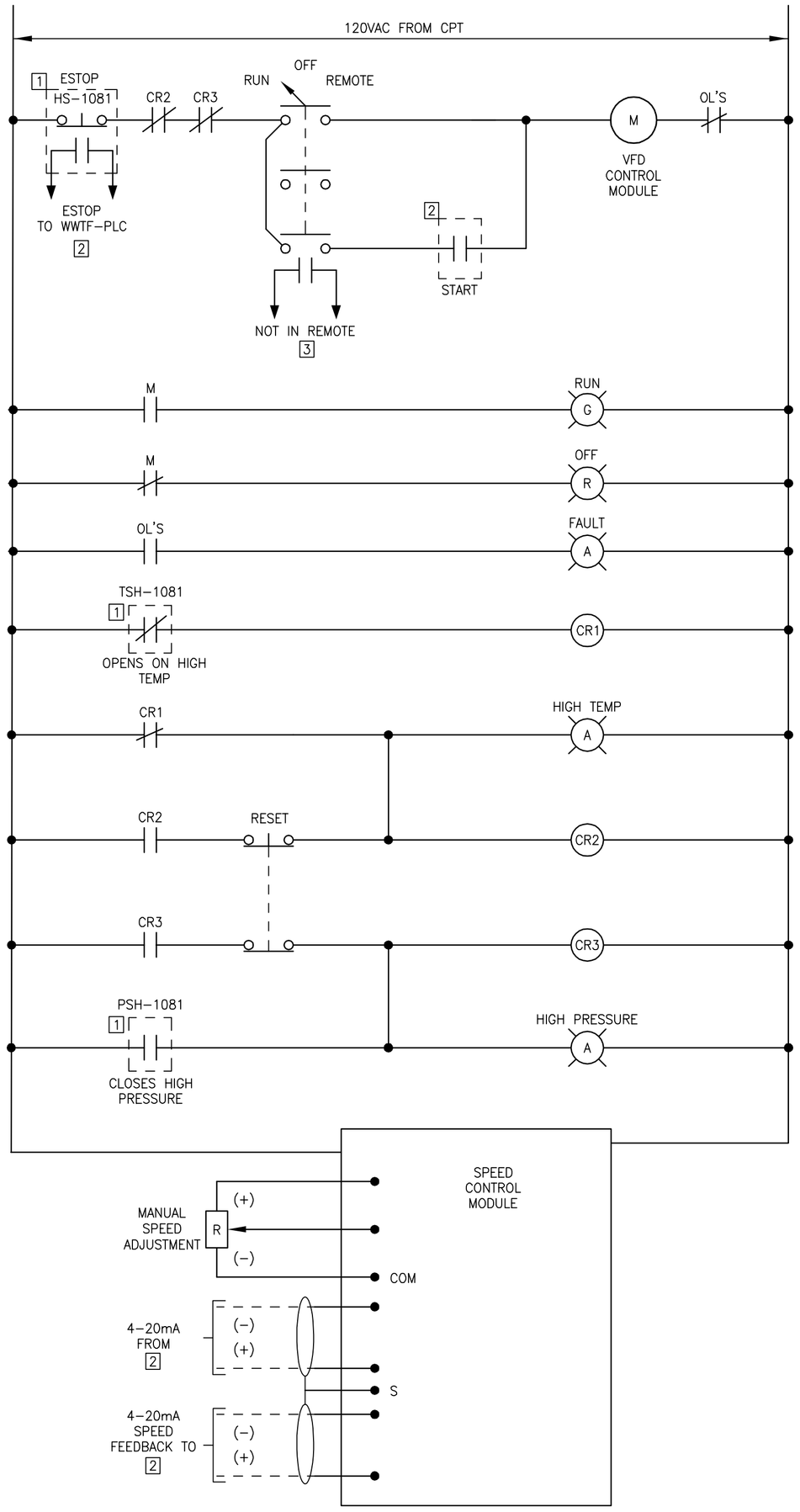
PLOT DATE: Tuesday, March 24, 2020 4:16:04 AM

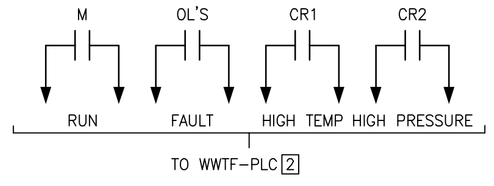



## SBR TRANSFER PUMP VFD WIRING DIAGRAM SBR.TP-1-VFD

(TYPICAL FOR SBR.TP-2, SBR.TP-3, AND SBR.TP-4)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)




## EFFLUENT PUMP VFD WIRING DIAGRAM EFF.P-1-VFD

(TYPICAL OF EFF.P-2/3)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)

LEGEND

| | |
|---|---|
| 1 | DEVICE LOCATED AT EQUIPMENT |
| 2 | FROM/TO WWTF-PLC |
| 3 | FROM/TO SBR-CP |
| 4 | FROM/TO 10-ATC-1 |
| 5 | FROM/TO 20-ATC-1 |

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\ELD E-614.DWG
LAST UPDATE: Monday, March 23, 2020 11:22:52 PM
PLOT DATE: Tuesday, March 24, 2020 4:16:14 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREW ABRAHAM
ELECTRICAL
NO. 43962
REGISTERED
PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

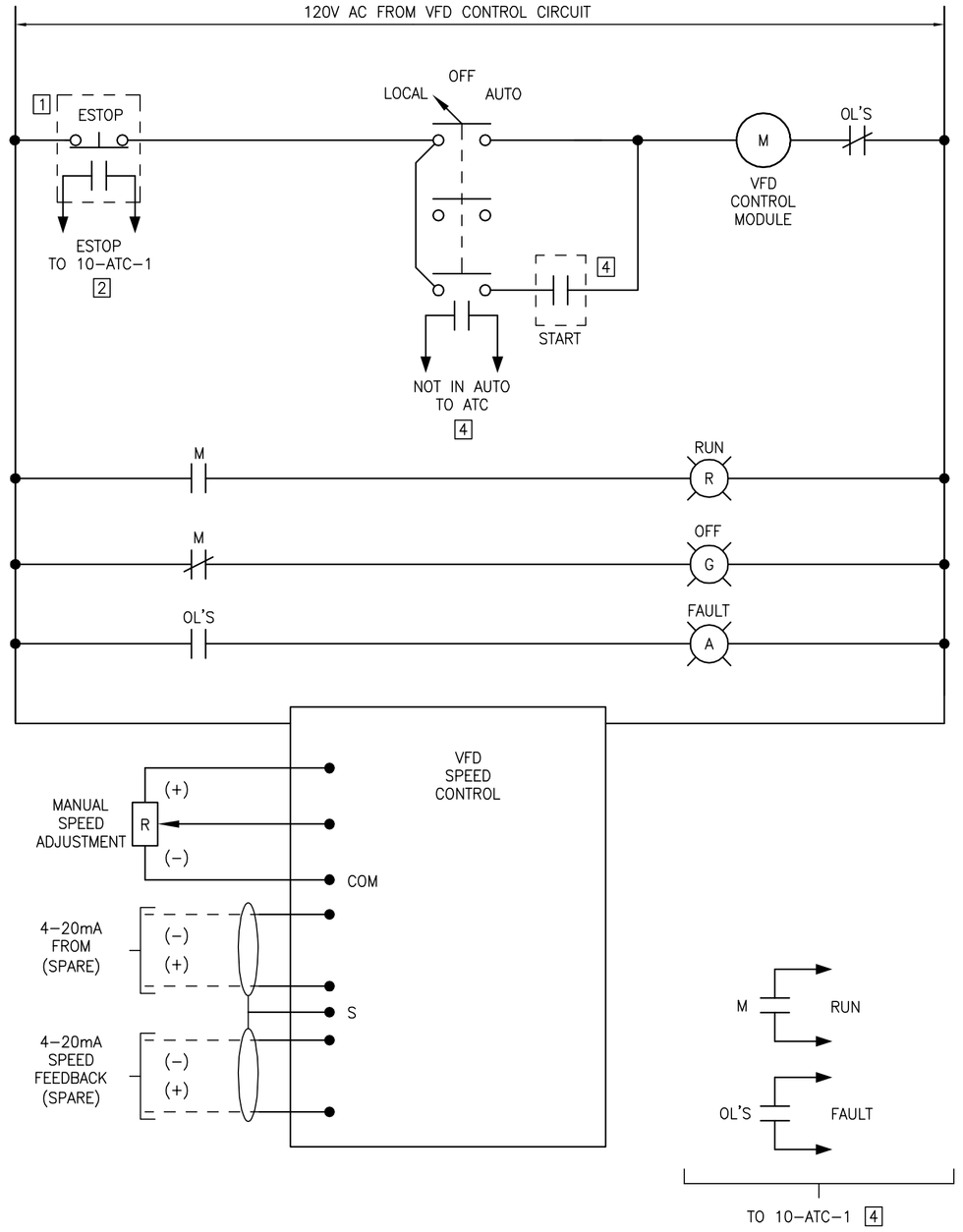
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL WIRING SCHEMATICS II

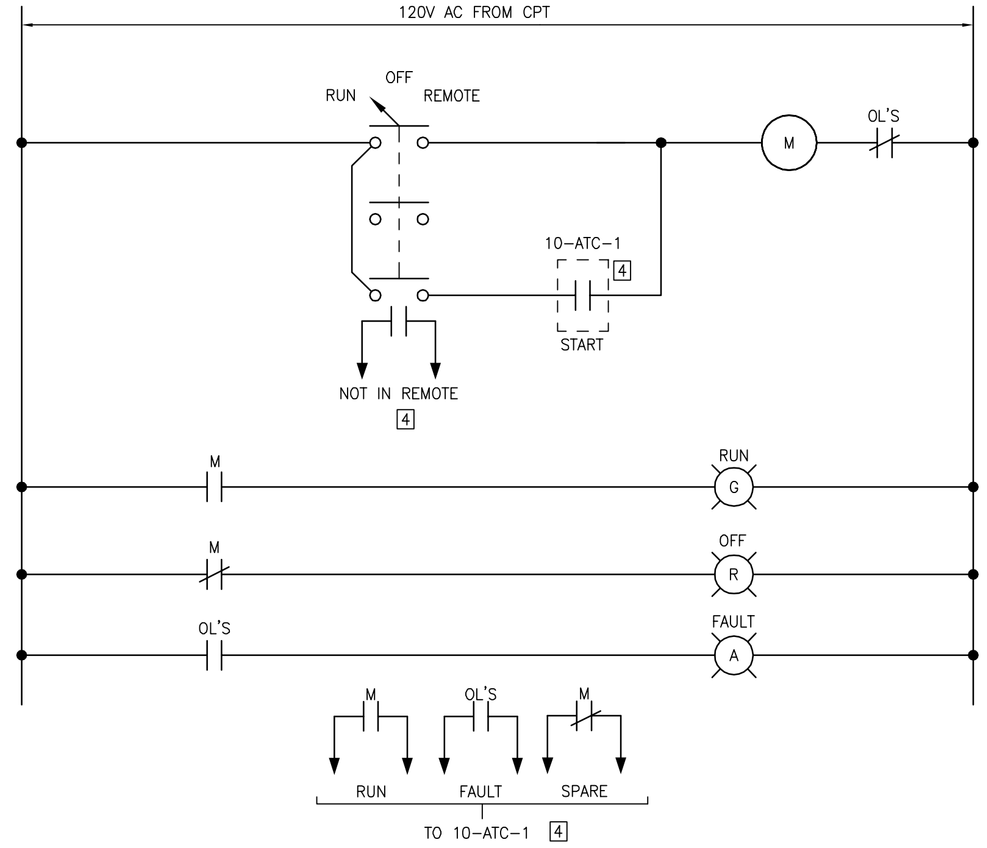
**SHEET NUMBER**

# 10 E-614



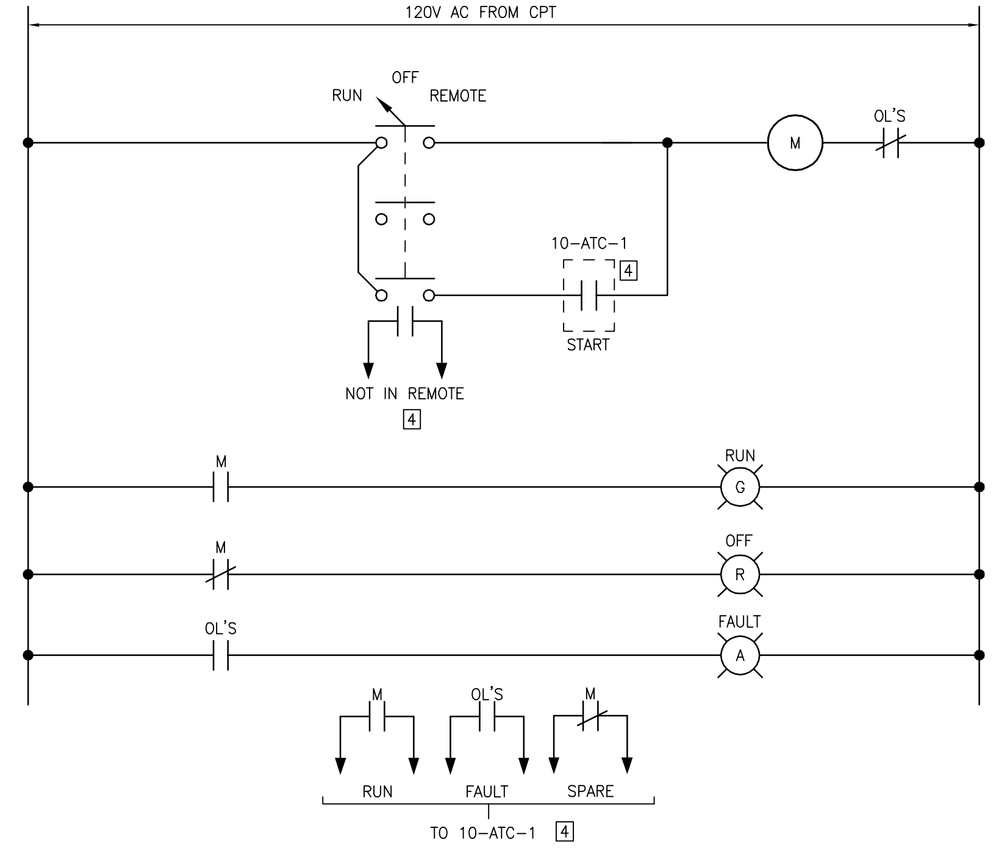

## TYPICAL HVAC EQUIPMENT VFD WIRING DIAGRAM

(TYPICAL FOR 10-EF-1, 10-EF-2, 10-EF-5, 10-EF-7, 10-EF-10, 10-EF-11, 10-SF-1, 10-SF-2, 10-SF-5, 10-SF-8) (1)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)




## HVAC EXHAUST FAN MOTOR STARTER WIRING DIAGRAM

(TYPICAL FOR 10-SF-3A, 10-SF-3B, 10-SF-4, 10-SF-7)
(ALL COMPONENTS LOCATED AT STARTER UNLESS OTHERWISE NOTED)




## TYPICAL 1-PHASE HVAC/PLUMBING PUMP MOTOR STARTER WIRING DIAGRAM

(TYPICAL FOR 10-PP-1, 10-PP-2)
(ALL COMPONENTS LOCATED AT STARTER UNLESS OTHERWISE NOTED)

LEGEND

1 DEVICE LOCATED AT EQUIPMENT
2 FROM/TO WWTF-PLC
3 FROM/TO SBR-CP
4 FROM/TO 10-ATC-1
5 FROM/TO 20-ATC-1


AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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**REGISTRATION**

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

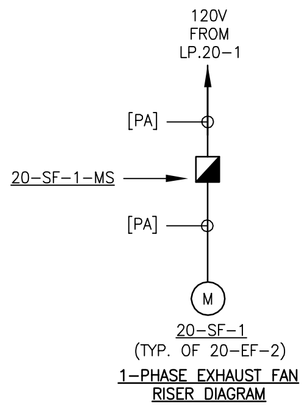
**SHEET TITLE**

**WWTF - ELECTRICAL WIRING SCHEMATICS V**

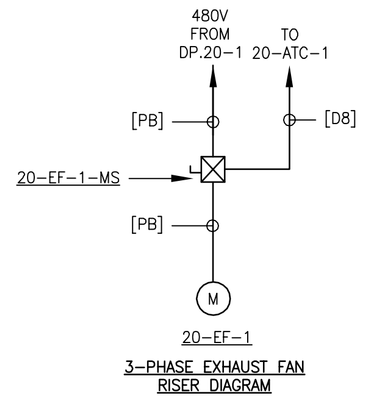
**SHEET NUMBER**

**10 E-617**

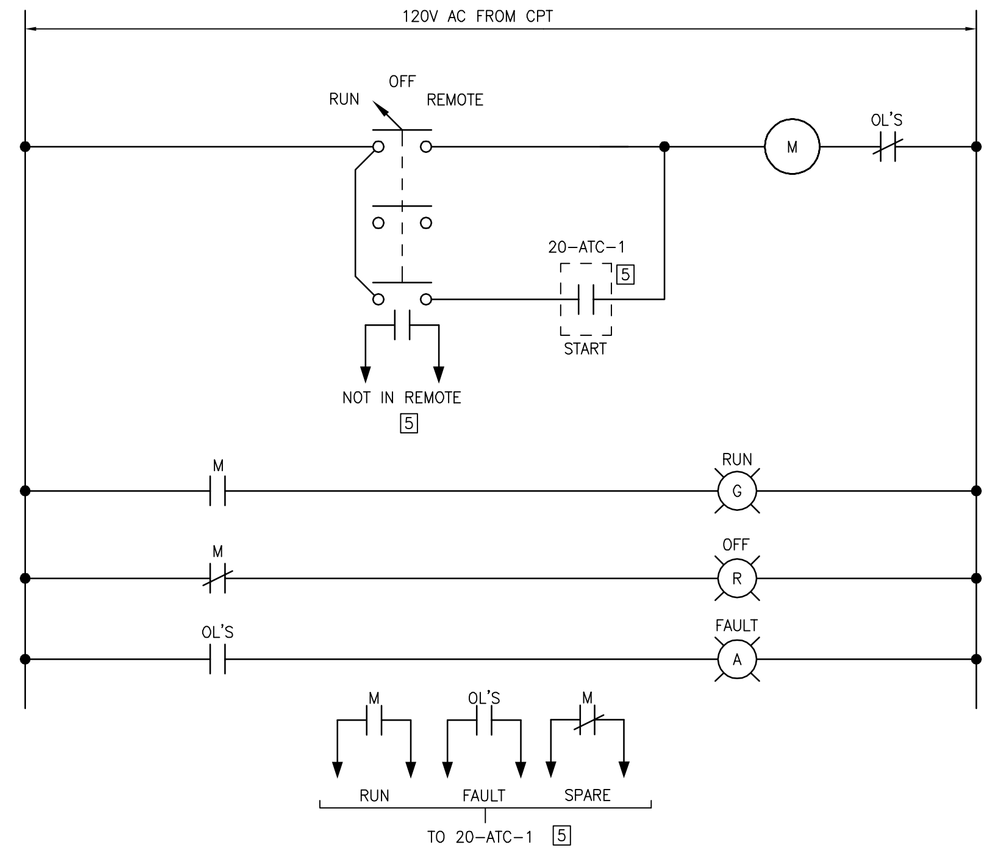

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\EL\10 E-617.DWG
LAST UPDATE: Tuesday, March 24, 2020 4:03:20 AM
PLOT DATE: Tuesday, March 24, 2020 4:16:24 AM




1-PHASE EXHAUST FAN
RISER DIAGRAM

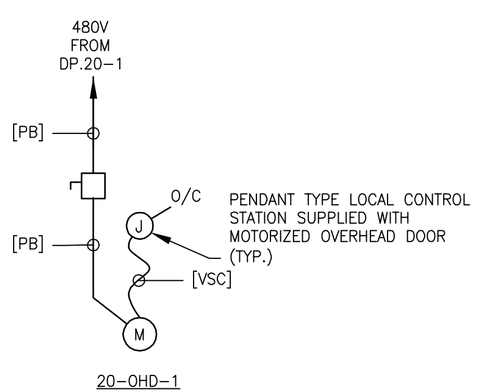



3-PHASE EXHAUST FAN
RISER DIAGRAM



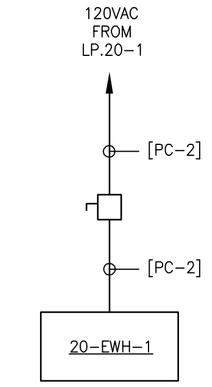

## HVAC EXHAUST FAN MOTOR STARTER WIRING DIAGRAM

(TYPICAL FOR 20-SF-1, 20-EF-1, AND 20-EF-2)
(ALL COMPONENTS LOCATED AT STARTER UNLESS OTHERWISE NOTED)




PENDANT TYPE LOCAL CONTROL STATION SUPPLIED WITH MOTORIZED OVERHEAD DOOR (TYP.)

MOTORIZED OVERHEAD DOOR




ELECTRIC WATER HEATER

LEGEND

| | |
|---|---|
| 1 | DEVICE LOCATED AT EQUIPMENT |
| 2 | FROM/TO WWTF-PLC |
| 3 | FROM/TO SBR-CP |
| 4 | FROM/TO 10-ATC-1 |
| 5 | FROM/TO 20-ATC-1 |

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
NO. 43962
REGISTERED
PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

**EQUIPMENT STORAGE FACILITY - WIRING SCHEMATICS**

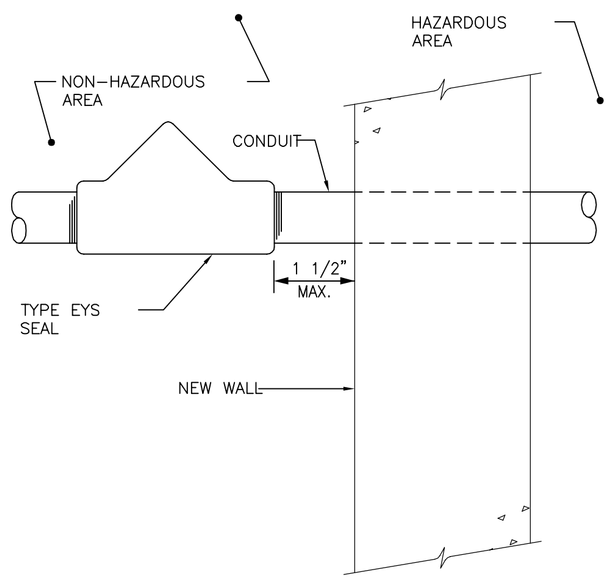
**SHEET NUMBER**

**20 E-602**

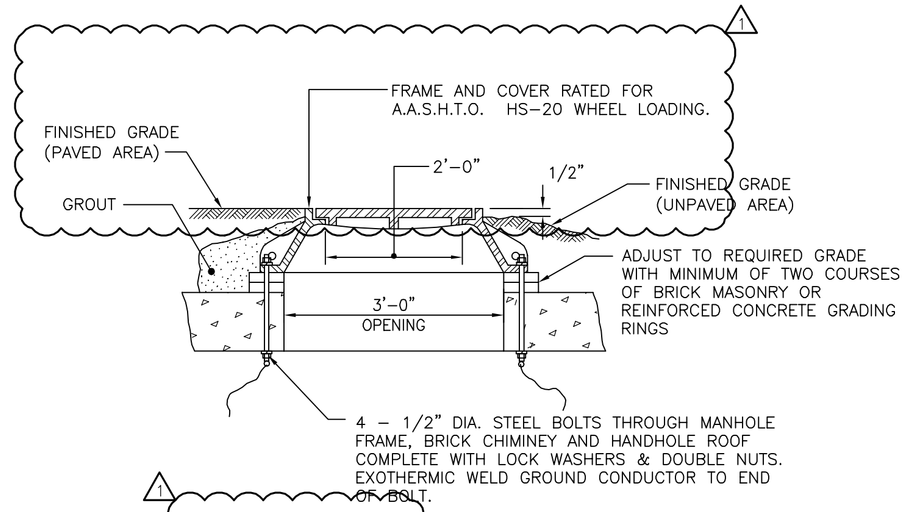
PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\ECD\E-602.DWG
LAST UPDATE: Wednesday, October 09, 2019 11:27:30 AM
PLOT DATE: Tuesday, March 24, 2020 4:16:34 AM

## HANDHOLE AND DUCT BANK NOTES

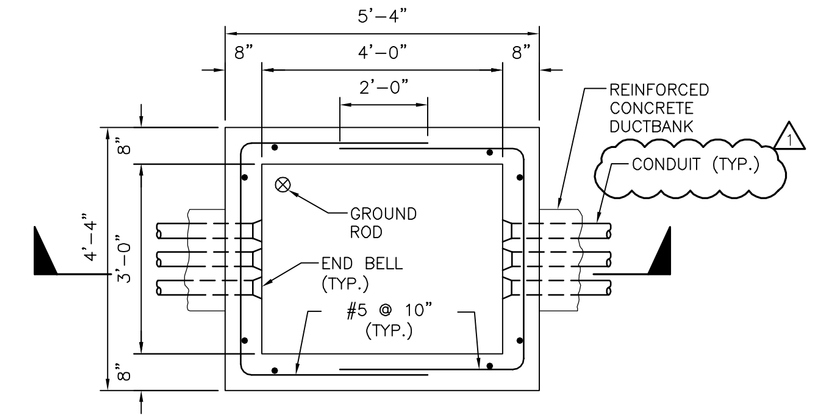
1. ALL CONCRETE INSERTS, FITTINGS AND ACCESSORIES ARE TO BE FABRICATED FROM HEAVY–DUTY STAINLESS STEEL.
2. ALL CONCRETE FOR HANDHOLES AND DUCT RUNS TO BE CLASS "A" (4000 PSI) AS PER THE STRUCTURAL SPECIFICATIONS.
3. ALL CONDUIT AND OTHER EQUIPMENT IN HANDHOLES SHALL BE BONDED WITH A NO. 4, STRANDED COPPER CABLE (MINIMUM).
4. ALL 4" OR LARGER STEEL CONDUIT BENDS SHALL HAVE A 36" RADIUS (MINIMUM).
5. ALL CABLES SHALL BE TAGGED WITH A PROTECTED PLASTIC TAG OF DISTINCTIVE COLOR AND MARKING FOR EACH VOLTAGE. THE TAGS WILL GIVE VOLTAGE AND CIRCUIT NUMBER ASSIGNED BY THE CONTRACT DRAWING CONDUIT AND WIRE SCHEDULE.
6. CONTRACTOR TO SIZE THE CIRCULAR OPENINGS IN THE HANDHOLE ROOF FROM FRAMES ACTUALLY FURNISHED.
7. PLASTIC DUCT SPACERS SHALL BE INSTALLED ON 4 FT. CENTERS. JOINTS ARE TO BE STAGGERED BETWEEN TIERS TO PROVIDE NOT LESS THAN 12 INCH LONGITUDINAL SEPARATION BETWEEN JOINTS SEPARATION BETWEEN JOINTS IN ANY TWO ADJOINING CONDUITS.
8. THE SIZE OF A HANDHOLE WINDOW DEPENDS ON THE NUMBER OF CONDUITS IN THE INCOMING DUCTLINE. TO DETERMINE THE ACTUAL WINDOW SIZE AND LOCATION, SEE THE DUCT SECTION. THE WINDOW OPENING MUST ALSO BE A MINIMUM OF ONE FOOT ABOVE HANDHOLE FLOOR AND / OR ONE FOOT BELOW HANDHOLE ROOF. EACH MANHOLE WINDOW SHOULD BE OFFSET FROM THE CENTER OF THE WALL SO THAT ONE VERTICAL EDGE IS CLOSE TO THE INTERSECTION OF TWO WALLS.
9. ALL STEEL CONDUIT SHALL BE TERMINATED IN HANDHOLES WITH CONDUIT GROUNDING BUSHINGS.
10. HANDHOLE COVER SHALL HAVE THE WORD "ELECTRIC" CAST ON THE COVER.
11. INSTALL TWO PULLING–IN IRONS OPPOSITE CENTER OF EACH ENTERING DUCT RUN. ONE 6" BELOW ROOF AND ONE 6" ABOVE FLOOR.
12. ALL DUCTS SHALL DRAIN FROM HIGH POINT TO HANDHOLE WITH A SLOPE OF NOT LESS THAN 4" PER 100 FEET.



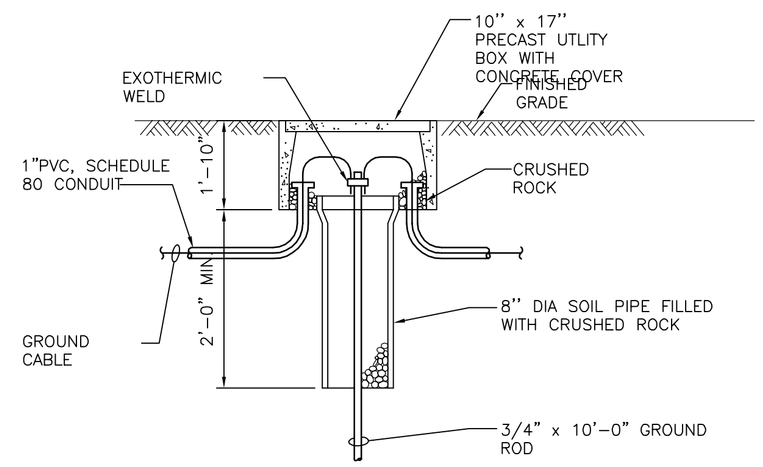

HAZARDOUS AREA ENTRANCE SEAL
NTS




HANDHOLE FRAME AND COVER
NTS




3'-0" X 4'-0" HANDHOLE
NTS




GROUND ROD AND TEST WELL
NTS


AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
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**REGISTRATION**

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ANDREA ABRAHAM
ELECTRICAL
NO. 34962
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

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|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

**ELECTRICAL DETAILS III**

**SHEET NUMBER**

**99 E-503**


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\99 E-503.DWG
LAST UPDATE: Tuesday, March 24, 2020 1:24:38 AM
PLOT DATE: Tuesday, March 24, 2020 4:16:42 AM

## FIRE ALARM

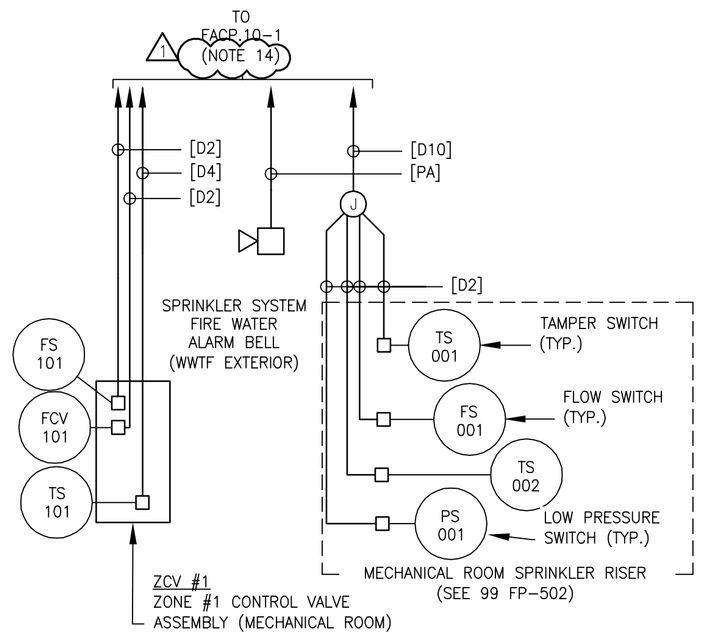
| | |
|---|---|
| —FOC— | CONDUIT FOR FIBER OPTIC CABLE |
| F | FIRE ALARM MASTER BOX |
| F | MANUAL FIRE ALARM PULL STATION; WP – WEATHERPROOF. |
| F 110cd | FIRE ALARM HORN WITH STROBE 110cd INDICATOR CANDELA RATING |
| F | FIRE ALARM STROBE |
| H | FIRE ALARM HORN |
| K | KNOX BOX |
| FACP | FIRE ALARM CONTROL PANEL |
| FB | WEATHERPROOF FIRE ALARM BEACON |
| FAA | FIRE ALARM REMOTE ANNUNCIATOR |
| H | HEAT DETECTOR COMBINATION FIXED TEMPERATURE AND RATE OF RISE. |
| FD | FLAME DETECTOR, ULTRAVIOLET TYPE |
| SD | SMOKE DETECTOR |
| CO | CARBON MONOXIDE |
| RI | REMOTE ALARM INDICATOR |
| RTS | REMOTE TEST STATION WITH LIGHTS |
| FS | MONITORING MODULE WITH CONNECTION TO FLOW SWITCH ON FIRE PROTECTION PIPING (FLOW SWITCH FURNISHED AND INSTALLED BY OTHERS) |
| PS | MONITORING MODULE WITH CONNECTION TO PRESSURE SWITCH ON FIRE PROTECTION PIPING (PRESSURE SWITCH FURNISHED AND INSTALLED BY OTHERS) |
| TS | MONITORING MODULE WITH CONNECTION TO TEMPERATURE SWITCH ON FIRE PROTECTION PIPING (TEMPERATURE SWITCH FURNISHED AND INSTALLED BY OTHERS) |
| B | FIRE ALARM SPRINKLER BELL |
| FSD | FIRE SMOKE DAMPER |
| SD | DUCT SMOKE DETECTOR |
| CM | CONTROL MODULE |
| MM | MONITORING MODULE |
| 1 Z | ADDRESSABLE MODULE |

## ABBREVIATIONS

| | |
|---|---|
| AFF | ABOVE FINISH FLOOR |
| AHU | AIR HANDLING UNIT |
| AL | ALARM |
| ATS | AUTOMATIC TRANSFER SWITCH |
| EHH | ELECTRICAL HAND HOLE |
| EL | ELEVATION |
| EMH | ELECTRICAL MANHOLE |
| FACP | FIRE ALARM CONTROL PANEL |
| FOC | FIBER OPTIC CABLE |
| G | GROUND |
| HH | HAND HOLE |
| MCC | MOTOR CONTROL CENTER |
| MH | MANHOLE |
| NO | NORMALLY OPEN |
| NC | NORMALLY CLOSED |
| OC | OPEN–CLOSE |
| RGS | RIGID GALVANIZED STEEL CONDUIT |
| W | DENOTES WATERTIGHT EQUIPMENT |
| WP | DENOTES WEATHERPROOF EQUIPMENT |
| XP | DENOTES EXPLOSION PROOF EQUIPMENT |

## GENERAL NOTES

1. CONDUIT INSTALLATIONS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURAL CONDITIONS. EXPOSED CONDUITS SHALL BE INSTALLED PARALLEL TO BEAMS AND WALLS.
2. ITEMS SHALL BE PROVIDED WITH NEMA ENCLOSURE AS INDICATED ON THE EQUIPMENT ENCLOSURE SCHEDULE.
3. ALL DEVICES SHALL COMPLY WITH THE LATEST VERSION OF THE ADA (AMERICANS WITH DISABILITIES ACT).
4. THE CONTRACTOR SHALL FURNISH, MATERIALS, TOOLS AND OTHER EQUIPMENT REQUIRED TO INSTALL THE WORK SHOWN AND SPECIFIED. THE CONTRACTOR SHALL FURNISH AND INSTALL ALL ITEMS NECESSARY FOR A COMPLETE ELECTRICAL SYSTEM MATERIALS SHALL BE NEW AND SHALL BEAR THE REGISTERED UL MARK. WORK SHALL CONFORM WITH THE NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 70 (NEC) AND APPLICABLE FEDERAL, STATE AND LOCAL CODES. CONTRACTOR SHALL SECURE PERMITS AND PAY THE FEES REQUIRED TO CARRY OUT HIS WORK. THE CONTRACTOR SHALL FURNISH COPIES OF CERTIFICATES AND PERMITS TO THE OWNER.
5. THE DRAWINGS AND SPECIFICATIONS INDICATE THE INTENT OF THE DESIGN AND SHALL BE CONSIDERED AS DIAGRAMMATIC ONLY. EXACT LOCATIONS FOR DEVICES AND EQUIPMENT SHALL BE DETERMINED AT THE SITE, AS WORK PROGRESSES DIMENSIONS AND CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE. FINAL WORK SHALL BE DOCUMENTED ON AS BUILT RECORD DRAWINGS.
6. PULL STATIONS, HORN/STROBES, SMOKE DETECTORS, ETC INDICATE QUANTITY, EXACT LOCATIONS OF DEVICES SHALL BE DETERMINED IN THE FIELD AND COORDINATED WITH ARCHITECTURAL DRAWINGS.
7. CONTRACTOR SHALL VERIFY ALL DOORS SWINGS BEFORE INSTALLING BACK BOXES.
8. ALL FIRE ALARM STROBES SHALL BE FIELD ADJUSTABLE AND THE POWER SUPPLY SHALL BE SIZED BASED ON ALL THE STROBES HIGHEST SETTING.
9. ITEMS SHALL BE PROVIDED WITH MINIMUM NEMA ENCLOSURE RATING AS INDICATED ON THE AREA CLASSIFICATION SCHEDULE.
10. DUCT BANK CONDUIT SIZES ARE GIVEN IN THE DUCT BANK SECTION CALLOUTS. WHERE THE SAME CONDUIT NUMBER IS USED BOTH IN THE DUCT BANK AND IN A BUILDING, THE CONDUIT SIZE GIVEN IN THE CONDUIT SCHEDULE APPLIES TO THE CONDUIT IN THE BUILDING ONLY.
11. PROVIDE SCHEDULE 40 POLYVINYL CHLORIDE (PVC) CONDUITS FOR POWER AND CONTROL CIRCUITS WITHIN CONCRETE ENCASED DUCT BANK SYSTEM. PROVIDE RIGID GALVANIZED STEEL CONDUITS FOR 50 VOLTS AND BELOW CIRCUITS, INSTRUMENTATION, COMMUNICATIONS I/O, DATA HIGHWAY, FIRE ALARM AND COMMUNICATIONS NETWORKS WITHIN CONCRETE ENCASED DUCT BANK.
12. CONSOLIDATION OF CONDUITS IS NOT ACCEPTABLE WITHOUT ENGINEERS APPROVAL.
13. SEE SPECIFICATION 01015 FOR SEQUENCE OF WORK LIMITATIONS.
14. SEE FIRE PROTECTION SHEET 99 FP–502 SPRINKLER SYSTEM RISER DIAGRAM FOR SPRINKLER SYSTEM FIRE PROTECTION DEVICES AND ZONE CONTROL VALVES.
15. PROVIDE FIRE ALARM RADIO SYSTEM FOR REMOTE COMMUNICATION WITH THE CITY OF ORLEANS FIRE DEPARTMENT IN ACCORDNACE WITH THE CITY OF ORLEANS FIRE DEPARTMENT REQUIREMENTS. FIRE ALARM ANTENNA SHOWN AT WWTF ROOF ON ELECTRICAL SITE PLAN 10 E–001.
16. PROVIDE DRY CONTACTS FOR REMOTE INDICATION OF FIRE ALARM CONDITION TO HVAC AUTOMATIC TEMPERATURE CONTROL PANEL 10–ATC–1/20–ATC–1.




## SPRINKLER SYSTEM - FIRE ALARM RISER DIAGRAM

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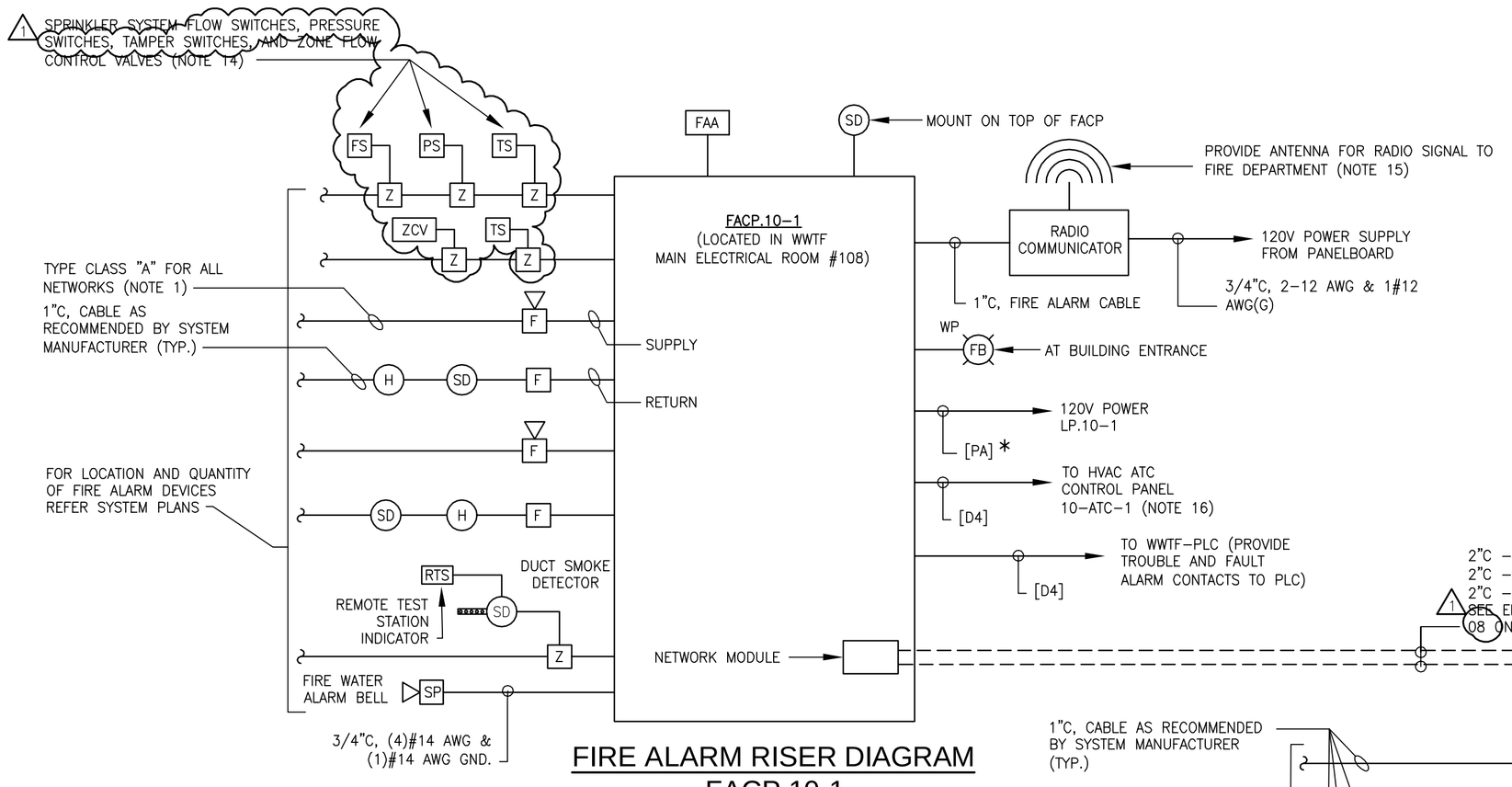
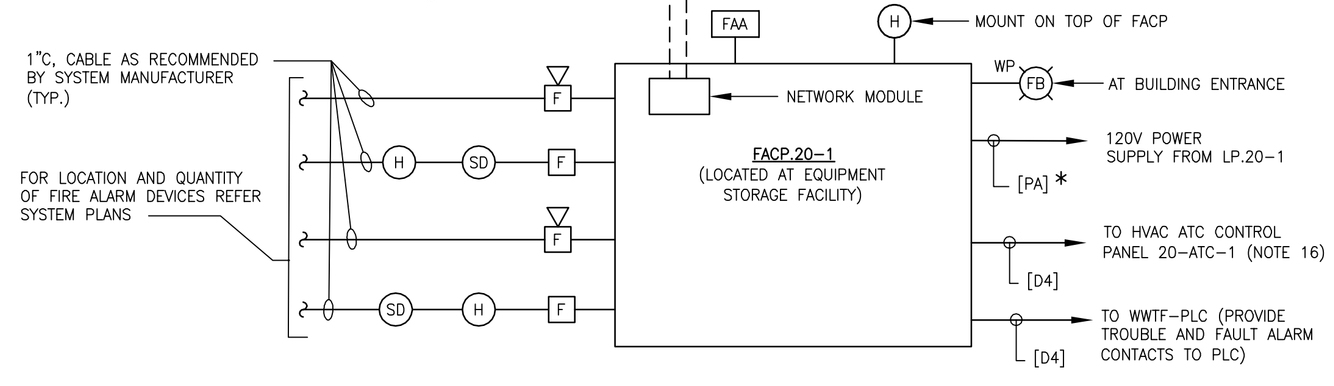



## FIRE ALARM RISER DIAGRAM FACP.10-1

NTS

* LABEL CONDUIT "FIRE PANEL POWER SUPPLY"




## FIRE ALARM RISER DIAGRAM FACP.20-1

NTS

* LABEL CONDUIT "FIRE PANEL POWER SUPPLY"

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**


AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
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No. 49542
REGISTERED PROFESSIONAL ENGINEER

03-24-2020

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

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|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# FIRE ALARM LEGEND, ABBREVIATIONS AND GENERAL NOTES

**SHEET NUMBER**

# 00 FA-001


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\00 FA-001.DWG
LAST UPDATE: Friday, March 20, 2020 9:36:24 AM
PLOT DATE: Tuesday, March 24, 2020 4:16:47 AM

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April 10, 2020

**ADDENDUM NO. 8**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 8 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 10 pages and 36 pages of attachments for a total of 46 pages.

## ATTACHMENTS

1. Orleans_MA-2019-01-Bid Form_Add_8-04-10-20
2. MassDEP Groundwater Discharge Permit 993-0
3. Drawing 10 E-006, WWTF – Electrical Single Line Diagram II – MCC.10-1
4. Drawing 10 E-302, WWTF – Grade Level – Security Plan I

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. GENERAL
   - A. Sub-Bid Opening – May 6, 2020 at 11:00 a.m.
   - B. General Bid Opening – May 13, 2020 at 2:00 pm.
   - C. The Bid and Sub-bid Forms in Excel Format may be downloaded from the Tighe & Bond website. You must click on the "pre-qualified" button to access the Forms. Once obtained, in most cases a yellow bar will appear on the top of the screen labeled as "Security Warning". If this occurs, you must select the "Enable Content" button in order to properly utilize the file.
2. ADDENDUM NO. 4
   - A. Page AD.4-9 Item No.14, Delete "DRAWING 10 DI-603, SLUDGE TRANSFER PUMPS P&ID" and replace with "DRAWING 10 P-106, FACILITY UPPER PLAN II WATER AND GAS".

3. ADDENDUM NO. 5

   A. Page AD.5-12 Item No.4A, Delete "9. The PIs for (SBR.TP-1 thru 3) shall be provided by the Contractor as specified in SECTION 11308, RECESSED IMPELLER PUMPS AND APPURTENANCES." and replace with "1. The PIs for (SBR.TP-1 thru 3) shall be provided by the Contractor as specified in SECTION 11308, RECESSED IMPELLER PUMPS AND APPURTENANCES".

4. ADDENDUM NO. 7

   A. Attachment: SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS, Footnote, delete "Addendum No. 5" and replace with "Addendum No. 7".

5. SECTION 00100, ADVERTISEMENT FOR BIDS

   A. Page 00100-1, Paragraph 3.a, first subparagraph, delete the words "…until 2:00 p.m. prevailing time, on April 29, 2020 at which time and place…" and replace with the words "…until 2:00 p.m. prevailing time, on May 13, 2020 at which time and place…".

   B. Page 00100-1, Paragraph 3.b, first subparagraph, delete the words "…until 11:00 a.m. prevailing time, on April 22, 2020 at which time and place…" and replace with the words "…until 11:00 a.m. prevailing time, on May 6, 2020 at which time and place…".

6. SECTION 00410, FORM OF GENERAL BID

   A. Delete "Orleans_MA-2019-01-Bid Form_Add_6-03-12-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_8-04-10-20" in both hard copy and Microsoft Excel format.

7. DOCUMENT 00858, SPECIAL CONDITIONS - PERMITS AND LICENSES

   A. Page 00858-1, ARTICLE 1.01 - LIST OF PERMITS AND/OR LICENSES, Paragraph A, add the following new subparagraph:

      7. Massachusetts Department of Environmental Protection – Groundwater Discharge Permit

   B. Page 00858-1, ARTICLE 1.01 - LIST OF PERMITS AND/OR LICENSES, delete Paragraph B in its entirety and replace with the following new paragraph:

      B. Not Used.

8. SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS

   A. Page 01650-2, ARTICLE 1.02 - MEASUREMENT AND PAYMENT, add the following new paragraph:

      B. An allowance has been identified in SECTION 01020, ALLOWANCES for the Contractor to perform Performance Testing following Substantial Completion. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials, supplies, manufacturer's services, and the like, in order to perform Performance Testing as specified herein and in other sections. Detailed expenditures shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

   B. Page 01650-11, ARTICLE 1.14 - OPERATIONAL EXPENSES, Paragraph C., delete the paragraph in its entirety and replace with the following new paragraph:

      C. During Performance Testing, the Contractor shall bear the costs for Contractor and manufacturer/suppliers, including but not limited to labor, equipment, tools, supplies, manufacturer's services and the like, as approved by the Engineer. The manufacturer of the following equipment shall perform an equipment check-out and complete any repairs necessary within one month of the Contractor conducting Performance Testing:

         1. SECTION 11333, SEPTAGE RECEIVING STATION
         2. SECTION 11365, ROTARY DRUM THICKENERS
         3. SECTION 11399, EFFLUENT DISK FILTERS
         4. SECTION 11600, SEQUENCING BATCH REACTORS

         The allowance specified in SECTION 01020, ALLOWANCES shall be used to cover these costs.

9. SECTION 01020, ALLOWANCES

   A. Page 01020-2, ARTICLE 1.05 - ALLOWANCES FOR PRODUCTS, Paragraph C., add Item No. 9 as follows:

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 9 | Performance Testing | $50,000 | 2.R. |

   Notes:

   9. Item No. 9 - The allowance is for the cost of the Performance Testing in accordance with SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

10. SECTION 02520, WICK CONSTRUCTION AND TESTING

   A. Page 02520-2, ARTICLE 1.01 - SCOPE, Paragraph E., add the following Specialty Contractors:

      O. E. Dube & Son, Inc
      769 Daniel Webster Highway
      Merrimack, NH 03054
      Phone: 603-669-4810

   B. Page 02520-2, ARTICLE 1.01 - SCOPE, add the following as new Paragraph G.:

      G. Wick Design

         1) The Wick design is different from a typical water-well design. The Wicks are not intended for the extraction of water for drinking water supply. In fact, the bottom of the Wicks are located in unsaturated soils above the water table. MassDEP does not allow a Wick to be designed like a typical water supply well using a well screen. Therefore, the typical water-well design does not apply.

         2) The gravel within the Wick must be installed against the natural formation. The bottom of the Wicks will be installed above the water table. The WWTF effluent will be discharged above the center of the Wick and will flow to the base of the Wick, where it will discharge out of the Wick, flowing into the natural formation. Flow from the Wick should always flow into the formation.

         3) Similarly designed Wicks have been online since 2004 with no apparent plugging from surrounding soils.

         4) The stainless-steel well screen referenced in the specifications applies to the three 6-inch diameter Wick access wells that will be installed in each Wick. These access wells will be used to observe Wick performance, once the Wicks become operational and for maintenance purposes.

   C. Page 02520-2, ARTICLE 1.01 - SCOPE, add the following as new Paragraph H.:

      H. Wick Drilling

         1) The proposed drilling method is to be submitted by the Contractor for review and approval by the ENGINEER. Preferred methods of drilling are caisson drilling and dual rotary drilling, or other means suitable to the Engineer.

         2) The specified plumbness criterion for the Wicks is a critical component for proper operation and maintenance.

11. SECTION 02620, INSULATION AND JACKETING

   A. Delete the section in its entirety.

12. SECTION 02645, MONITORING WELL INSTALLATION AND DEVELOPMENT

A. Page 02645-1, ARTICLE 1.01 – SCOPE, delete the section in its entirety and replace with the following new section:

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to perform all operations in connection with the monitoring well installation and development, preparing records of the drilling, ingress and egress, as specified and/or as shown on the Contract Drawings.

B. A total of four new monitoring wells (LH-6, LH-7, LH-8 and LH-9) are to be installed at 32 Lots Hollow Road. The location and coordinates of the new monitoring wells is attached to the end of this section. Boring logs of existing monitoring wells at the site are attached to the end of this section. The monitoring wells are to be constructed in accordance with MassDEP standard monitoring well guidelines. The monitoring wells will consist of 2-inch diameter PVC risers and 10-foot lengths of schedule 40, slotted PVC screen. The screens are to be surrounded by a filter pack of sand and the annulus of the borehole above the screen is to be sealed with bentonite clay. Each monitoring well is to be protected with a locked protective casing permanently cemented into place.

C. A total of three existing monitoring wells (LH-1, LH-2 and LH-3) are to be modified by removing the existing above ground cover, cutting the existing PVC casing to just below the proposed grade, and completing the wells with a flush to ground protective casing (6-inch minimum diameter), a removable locking cap and concrete pad. The location and coordinates of the monitoring wells are attached to the end of this section.

D. Contractor shall visit the Project Site, examine conditions and become thoroughly acquainted with the conditions for performing the Work. Contractor shall study the Specifications for the Work and compare the same with the information gathered during the examination of the Project Site, as no extra compensation will be authorized for extra Work caused by unfamiliarity with the Project Site and/or the conditions peculiar to the Work.

E. Attention is directed to the GENERAL INFORMATION and DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Page 02645-5, ARTICLE 2.03 – PROTECTIVE METAL CASINGS, COVERS AND LOCKS, delete the article in its entirety and replace with the following new article:

2.03 - PROTECTIVE METAL CASINGS, COVERS AND LOCKS

A. Provide protective metal casing(s) (guard pipes) with lockable covers a minimum of 5-feet in linear dimension.

B. Provide protective metal flush to ground protective cover (minimum 6-inch diameter) with lockable expandable cap.

C. Provide keyed alike metal locks for each.

D. Provide 10 keys.

C. Page 02645-5, ARTICLE 3.02 – INSTALLATION OF 2-INCH DIAMETER OBSERVATION WELLS, delete the article in its entirety and replace with the following new article:

3.02 – OBSERVATION/MONITORING WELLS

A. Installation of 2-inch Diameter Observation/Monitoring Wells

1. Wells shall be installed using hollow-stem auger or direct-push drilling equipment. Drilling equipment shall be sufficiently designed and powered to achieve depths of 150 feet in sand and gravel formations typical of Cape Cod. Drilling equipment shall have rotary capability, in case of obstructions, such as cobbles.

2. Wells shall be driven in the sequence, number and locations designated by the Engineer. Drilling and well installation Work shall be completed on an interrupted basis.
3. Borehole(s) shall be a 4.5-inch diameter cased hole.
4. Drilling shall proceed to a depth of approximately 130 feet below ground surface.
5. Continuous soil cores shall be obtained in no longer than 5-foot lengths.
6. 2-inch diameter PVC well screen shall be securely joined to the steel or PVC well casing. The entire string of casing and screen shall then be inserted inside the borehole to the bottom.
7. The 4.5-inch diameter drive casing shall be extracted and the native soil formation shall be allowed to cave in on the observation well screen and casing. If necessary, quartz sand shall be added to the annulus where the borehole does not collapse.
8. Bentonite shall be installed in the annulus where the borehole penetrates clay or sandy clay. In addition, a 2-foot long bentonite seal shall be installed in the annulus between the borehole wall and the well casing at the water table.
9. Where PVC is used for well casing, a suitable steel protective pipe shall be installed over the PVC and secured in place from ground surface to 3 feet below ground surface by placing quartz sand inside and outside the protective pipe. The top of the protective pipe shall have a locking cap. Steel protective pipes for PVC observation wells shall be set such that the rim of the PVC and the rim of the steel pipe are at the same elevation.
10. All caps for steel and PVC wells shall have vent holes.
11. Each well shall be installed at the depths approved by the Engineer.
12. Each observation well shall be developed by diaphragm pumping, flushing, backwashing, plunging, airlifting, centrifugal or submersible pumping, as appropriate, until it is substantially free of sand.
13. Wells shall be numbered consecutively, as directed by the Engineer. The well number shall be clearly marked with heavy duty weather-resistant paint or permanent marker at the top of each well casing and/or guard-pipe. The top of the well casing shall be left two feet above the ground at the well and special short lengths shall be used if required.
14. Complete written records of all Work shall be kept on forms supplied by the Engineer or a form prepared by the Contractor and acceptable to the Engineer. Permanent records shall be submitted to the Engineer within three (3) working days of completion of the Work.
15. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

B. Observation/Monitoring Well Modification

1. Existing observation/monitoring wells LH-1, LH-2 and LH-3 are to be modified by removing the existing above ground steel protective cover and concrete pad.
2. Existing PVC casing shall be cut to 3 to 5 inches below the proposed grade, as approved by the Engineer.
3. Complete wells with a flush to grade protective cover (6-inch minimum diameter) secured with a concrete pad.
4. Each 2-inch diameter PVC well shall be installed with a vented lockable cap.
5. The location of the observation/monitoring wells are shown on the figure attached to the end of this section.
6. The wells are to be protected during construction and repaired or replaced if damaged.

13. SECTION 03300, CAST-IN-PLACE CONCRETE

    A. Page 03300-22, ARTICLE 3.10 – CONCRETE FINISHES, add the following new paragraph:

        E. The following concrete fill locations do not require the use of an epoxy bonding agent:

            1. WWTF Basement Floor
            2. Pre-Equalization Tanks
            3. SBR Tanks
            4. Post-Equalization Tank
            5. Waste Activated Sludge Storage Tanks
            6. Thickened Sludge Storage Tank
            7. Plant Water Tank

14. SECTION 03420, PRECAST REINFORCED CONCRETE VAULTS

    A. Delete the section in its entirety.

15. SECTION 04120, STONE VENEER

    A. Page 04120-4, ARTICLE 2.01 – MANUFACTURERS, Paragraph A, delete subparagraph 2. in its entirety and replace with the following new subparagraph:

        2. Natural Stone Veneer International (NSVI), 390 W Rolling Meadows Drive, Fond du Lac, WI 54937; Tel: 920-923-2800. Web: www.NSVI.com

16. SECTION 08500, FIXED WINDOWS

    A. Page 08500-10, ARTICLE 2.01 – MANUFACTURERS, delete Paragraph E. in its entirety and replace with the following new paragraph:

        E. Basis of Design: (1) Kawneer, Norcross, GA: NX-3800 Window Series and (2) Fire Rated Window: Fyre-Tec – Series H950 Heavy Fixed Lite. Other acceptable manufacturers are: Technical Glass Products (TGP), Perrysburg, OH and Steel Windows and Doors USA, Bridgeport, CT.

    B. Page 08500-11, ARTICLE 2.03 – WINDOW OPERATION, Paragraph A.1., delete the subparagraph in its entirety and replace with the following new subparagraph:

        1. Not Used.

17. SECTION 11333, SEPTAGE RECEIVING STATION

    A. Page 11333-17, ARTICLE 3.03 – PROCESS PERFORMANCE GUARANTEE, Paragraph A., delete the words "…will occur three (3) years from Substantial Completion…" and replace with the following new words "…will occur one (1) year from Substantial Completion…".

18. SECTION 11365, ROTARY DRUM THICKENERS

    A. Page 11365-13, ARTICLE 3.03 – PROCESS PERFORMANCE GUARANTEE, Paragraph A., delete the words "…will occur three (3) years from Substantial Completion…" and replace with the following new words "…will occur one (1) year from Substantial Completion…".

19. SECTION 11399, EFFLUENT DISK FILTERS

    A. Page 11399-16, ARTICLE 3.03 – PROCESS PERFORMANCE GUARANTEE, Paragraph A., delete the words "…will occur three (3) years from Substantial Completion…" and replace with the following new words "…will occur one (1) year from Substantial Completion…".

20. SECTION 11600, SEQUENCING BATCH REACTORS

    A. Page 11600-22, ARTICLE 3.03 – PROCESS PERFORMANCE GUARANTEE, Paragraph A., delete the words "…will occur three (3) years from Substantial Completion…" and replace with the following new words "…will occur one (1) year from Substantial Completion…".

21. SECTION 13345, DATA NETWORK

A. Page 13345-2, ARTICLE 1.01 – SCOPE, Paragraph A., add the following to the end of the paragraph:

The work of this section shall be by the Contractor and as specified in SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL.

22. SECTION 13350, SCADA EQUIPMENT

A. Page 13350-7, add the following as new Article 2.06:

2.06 - COMPUTER WORK STATIONS

A. Provide quantity as shown on Contract Drawing 00 DI-601, SYSTEM ARCHITECTURE 1.

B. Industrial computer with panel mount 15-inch touch screen by Advantech or Equal.

C. Computer shall have the following minimum configuration:

1. Processor Intel Xenon quad Core
2. Processor Speed: 2GHZ
3. Dual Screen LCD flat HD screen, 20-inch size for desktop style work stations.
4. One (1) TB SATA har drive for data storage
5. One (1) 500GB SATA Hard Drive for operating system and applicable software
6. Internal DVD+/-RW Drive, 16X
7. PCI Graphics Card with 4 GB memory.
8. 4 MB L2 Cache Memory.
9. One 10/100/1000 Mbps RJ-45 connectivity Ethernet cards.
10. Scroll mouse.
11. Standard Windows keyboard.
12. One EIA-232 Serial Port.
13. 1 Parallel Ports standard.
14. 4 USB 2.0/3.0Ports.
15. Sound Card and speakers.
16. Panel mount option for installations in PLC panels as indicated with screen minimum size of 15 inches. Screen shall be touch type unit.

B. Page 13350-7, add the following as new Article 2.07:

2.07 - PRINTERS

A. Provide quantity as shown on Contract Drawing 00 DI-601, SYSTEM ARCHITECTURE 1.

B. Laser type color printer with scanner.

C. Color printers shall be capable of printing on letter

D. Printers shall be capable of printing on letter (8.5” x 11”) or tabloid (11”x17”) sheets of paper. The printer shall accept paper fed manually or from one of two paper trays, each with a minimum capacity of 200 sheets. The printer shall print at least 35 pages of text per minute at a resolution of 1200 dpi or greater. The printer shall contain a minimum of 48 MB of on-board RAM, expandable to 320 MB. The report printer shall be a Hewlett Packard LaserJet P4015 series or equal.

E. Report printer(s) shall be provided with a 10/100/1000 Base-TX interface to provide connectivity to the computers over the Ethernet network

C. Page 13350-7, add the following as new Article 2.08:

2.08 - LAPTOPS

A. Provide 2 Laptops.

B. Hardware

1. Provide Intel i7 Quad Core Processor, 2.6 GHz Minimum
2. 32 GB DDR4 Memory, and L2 512KB RAM cache
3. 1-DB SSD Hard disk.
4. Integrated controller
5. CDRW/DVD combo drive.
6. NVIDA GeForce graphics card.
7. 17-inch full HD Panel
8. I/O Ports 1- Parallel, 3 USB, 1 Serial, 1 HDMI 1 Keyboard (PS/2, 1 PS/2 Mouse
9. 104 Key Enhanced PS/2 Keyboard
10. Mouse Touch Pad
11. Network Interface 10/100/1000 Mbps
12. Power Supply – 115 VAC/60HZ, 230 VAC/50Hz

C. Software

1. Microsoft Office Professional, Adobe Acrobat Professional, HMI Software Configuration Package, PLC Control system programming software
2. Operating SystemMicrosoft windows professional latest version or latest version of Windows server based on configuration.
3. Provide all software as the most current release at the time of shop drawing submittal
4. Provide software keys.

D. Service – 1st, 2nd, and 3rd year on site included

E. Purchase the laptops within 1 year prior to substantial completion of the project with the most current hardware available at that time.

F. Manufactures – Dell, HP, IBM

8. SECTION 15900, HVAC CONTROL SYSTEMS

A. Page 15900-2, ARTICLE 1.01 – SCOPE, delete the first sentence in subparagraph G.1 and replace with the following new sentence:

All HVAC control system equipment, devices, hardware and software shall be manufactured by either Alerton Controls, Allen-Bradley, Johnson Controls, Inc. Siemens, or Schneider Electric.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 10 A-401, ENLARGED PLANS, ELEVATIONS, SCHED. – CONTROL ROOM

   Control Room Accessory Schedule, replace the Models for the following Item Numbers:

| Item Number | Model | Item Number | Model |
|---|---|---|---|
| 2 | W25C361624L | 5 | W25C361624L |
| 3 | W25C361648 | 6 | W25C361648 |
| 4 | W25C361624 | 7 | W25C361624 |

2. DRAWING 10 A-402, ENLARGED PLANS, ELEVATIONS, SCHED. – LAB ROOM

   Laboratory Room Accessory Schedule, replace the Generic Names, Models and Manufacturer for the following Item Numbers:

| Item Number | Generic Name | Model | Manufacturer |
|---|---|---|---|
| 3 | | Not Used | |
| 5 | Cabinet | W21C361615 | Kewaunee Scientific Corporation |
| 6 | Cabinet | W25C361648 | Kewaunee Scientific Corporation |
| 7 | Cabinet | W25C361615L | Kewaunee Scientific Corporation |
| 8 | Cabinet | W25C361624 | Kewaunee Scientific Corporation |
| 11 | Cabinet | W25C361630 | Kewaunee Scientific Corporation |
| 15 | Drawer | D08C352224 | Kewaunee Scientific Corporation |
| 16 | Corner Cabinet | G15C352214 | Kewaunee Scientific Corporation |
| 18 | Cabinet | W25C361615L | Kewaunee Scientific Corporation |
| 20 | Cabinet | W25C361624L | Kewaunee Scientific Corporation |
| 22 | Cabinet | E41C292248 | Kewaunee Scientific Corporation |
| 28 | Drawer | D08C352230 | Kewaunee Scientific Corporation |
| 36 | Drawer | D08C352230 | Kewaunee Scientific Corporation |
| 38 | Case | S41C842236 | Kewaunee Scientific Corporation |

3. DRAWING 10 A-406, ENLARGED STAIR 1 PLANS

   A. Stair 1 - Grade Level, add the following new note:

      Note: Safety Gate shall be provided at the top of the stairs. Refer to Safety Gate Detail on DRAWING 10 A-503, DETAILS MISC. I.

4. DRAWING 10 A-407, ENLARGED STAIR 2 PLANS

   A. Stair 2 - Grade Level, add the following new note:

      Note: Safety Gate shall be provided at the top of the stairs. Refer to Safety Gate Detail on DRAWING 10 A-503, DETAILS MISC. I.

5. DRAWING 10 A-502, SBR PLAN AND RAILING DETAILS, add the following new note:

   Note: Aluminum grating shall be used for stair treads and stair landings on the exterior access stairs to SBR tanks.

6. DRAWING 00 S-001, STRUCTURAL NOTES I
   A. Concrete, add the following to the end of Note 4:
      E. The following are the locations that qualify as a "Liquid Containing Structure":
         - WWTF Tank Covers
         - WWTF Basement Columns
         - Containment Curbs and Equipment Pads
         - SBR Tank Walkways
         - Plant Water Storage Tank Cover Slab
         - Sludge Loading Pad
         - Wick Distribution Box Cover Slab
7. DRAWING 10 D-304, SECTIONS IV, Section 4, Headworks, delete the 10" OC pickup penetrating the floor into Pre-Equalization Tank No. 1.
8. DRAWING 10 E-006, WWTF – ELECTRICAL INGLE LINE DIAGRAM II – MCC.10-1
   A. Delete the drawing in its entirety and replace with the new drawing as attached.
9. DRAWING 10 E-302, WWTF – GRADE LEVEL – SECURITY PLAN I
   A. Delete the drawing in its entirety and replace with the new drawing as attached.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 8**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of | | | |
| | $ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of | | | |
| | One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of | | | |
| | Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |

Company's Name

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| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as specified, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as specified, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as specified, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishing Section 11365 - Rotary Drum Thickeners, as specified, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| 2.R. | For conducting Performance Testing, as specified, the sum of | | | | |
| | Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 50,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$** - |

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

Company's Name

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD** - The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraints will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding its funding constraints. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in June 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$ -**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$ -**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$ -**

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive** | | | **$** - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | **$** - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | **$** - |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | **$** - |

Company's Name

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A1. | For Addition of the Equipment Storage Facility, as specified, the sum of $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-1** | **$ -** |

Company's Name

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

March 31, 2020

Mr. John Kelly, Town Administrator
Town of Orleans
19 School Road
Orleans, Massachusetts 02653

RE: ORLEANS – Final Individual Groundwater Discharge Permit, Town of Orleans Wastewater Treatment Facility, 29 Overland Way, Orleans Massachusetts and 32 and 43 Lots Hollow Road
Transmittal No. X282490
Groundwater Discharge Permit No.: 993-0

Dear Mr. Kelly:

In response to your application for a permit to discharge into the ground treated effluent from the proposed Town of Orleans Wastewater Treatment Facility and after due public notice, I hereby issue the attached final permit.

Since no comments objecting to the issuance of the permit were received by the Department during the public comment period, in accordance with 314 CMR 2.08, the permit becomes effective at issuance.

Parties aggrieved by the issuance of this permit are hereby advised of their right to request an Adjudicatory Hearing under the provisions of Chapter 30A of the Massachusetts General Laws and 314 CMR 1.00, Rules for the Conduct of Adjudicatory Proceedings. Unless the person requesting the adjudicatory hearing requests and is granted a stay of the terms and conditions of this permit, the permit shall remain fully effective.

Should you have any questions regarding this matter, please contact me at (508)946-2814 or at brian.dudley@mass.gov.

Very truly yours,

Gerard M. R. Martin for
Brian A. Dudley, Section Chief
Wastewater Management – Cape and Islands

Enclosures (Permit, Fact Sheet)

**This information is available in alternate format. Contact Michelle Waters-Ekanem, Director of Diversity/Civil Rights at 617-292-5751.**
**TTY# MassRelay Service 1-800-439-2370**
MassDEP Website: www.mass.gov/dep

Printed on Recycled Paper

ecc: Mr. Robert Canning, Health Agent
Board of Health
19 School Road
Orleans, MA 02653
Enclosures (Permit, Fact Sheet)

Mr. Tom Parece
AECOM Technical Services Incorporated
9 Jonathan Bourne Drive
Pocasset, MA 02559
Enclosures (Permit, Fact Sheet)

DEP/BWR/Wastewater Management Program/Boston
Attn: Linda Barba
Julianne Ture
Enclosures (Permit, Fact Sheet)

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

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Commissioner

# Individual Groundwater Discharge Permit
# Fact Sheet

## I. APPLICANT, FACILITY INFORMATION, and DISCHARGE LOCATION

**Name and Address of Applicant:** Town of Orleans, 19 School Road, Orleans, Massachusetts 02653

**Name and Address of Facility where discharge occurs:** Wastewater treatment at 29 Overland Way, Orleans, Massachusetts with discharges at 32 and 43 Lots Hollow Road, Orleans, Massachusetts.

**Discharge Information:**

Groundwater Discharge Permit Number: 993-0

The Groundwater Discharge Permit will allow the applicant to discharge 228,900 gallons per day (annual average) with a maximum of 595,100 gallons per day for Phase 1 and 350,000 gallons per day (annual average) with a maximum of 883,800 gallons per day for Phase 2 of treated sanitary wastewater from a municipal wastewater treatment facility to groundwaters of the Commonwealth.

The discharge sites are not in a Zone II or Interim Wellhead Protection Area of any public drinking water supply.

## II. LIMITATIONS AND CONDITIONS

Discharge permit limitations are as listed in the ground water permit and are in conformance with 314 CMR 5.00, the Groundwater Discharge Permit Program.

## III. PERMIT BASIS AND EXPLANATION OF EFFLUENT LIMITATIONS

An Individual Groundwater Discharge permit is required for this discharge in accordance with the Massachusetts Clean Water Act, M.G.L. c. 21, s. 26-53 and 314 CMR 5.03.

Effluent limitations are based upon the location of the discharge, the level of treatment, consideration of human health protection criteria and protection of the groundwaters of the Commonwealth.

The discharge will be via wicks located at 32 Lots Hollow Road. 43 Lots Hollow Road will serve as a backup site.

## IV. COMMENT PERIOD, HEARING REQUESTS, AND PROCEDURES FOR FINAL DECISIONS

The public comment period for this permit is thirty (30) days following public notice in *The Environmental Monitor*. The public notice for this Individual Groundwater Discharge Permit occurred on February 10, 2020

Requests for an adjudicatory hearing must be submitted within thirty (30) days of the issuance/denial of the permit, by any person who is aggrieved by such issuance/denial.

A final decision on the issuance/denial of this permit will be made after the public notice period, and review of any comments received during this period.

## V. STATE CONTACT INFORMATION

Additional information concerning the draft permit may be obtained between the hours of 9:00 a.m. and 5:00 p.m. Monday through Friday excluding holidays, from:

Gerard M.R. Martin

March 31, 2020

for: Brian A. Dudley, Section Chief
Wastewater Management Program – Cape and Islands

DATE

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

## INDIVIDUAL GROUNDWATER DISCHARGE PERMIT

Name and Address of Applicant: Town of Orleans, 19 School Road, Orleans, Massachusetts 02653

Date of Application: August 29, 2019
Application/Permit No. 993-0

Date of Issuance: March 31, 2020
Date of Expiration: March 31, 2025

Effective Date: March 31, 2020

## AUTHORITY FOR ISSUANCE

Pursuant to authority granted by Chapter 21, Sections 26-53 of the Massachusetts General Laws, as amended, 314 CMR 2.00, and 314 CMR 5.00, the Massachusetts Department of Environmental Protection (the Department or MassDEP) hereby issues the following permit to: **Town of Orleans** (hereinafter called "the permittee") authorizing discharges to the ground from the wastewater treatment facility located at **Town of Orleans Wastewater Treatment Facility, 29 Overland Way, Orleans Massachusetts** with effluent recharge located at **32 and 43 Lots Hollow Road, Orleans, Massachusetts** such authorization being expressly conditional on compliance by the permittee with all terms and conditions of the permit hereinafter set forth.

Gerard M.R. Martin

FOR: Brian A. Dudley, Section Chief
Wastewater Management – Cape and Islands

March 31, 2020
Date

This Information is available in alternate format. Contact Michelle Waters-Ekanem, Director of Diversity/Civil Rights at 617-292-5751.
TTY# MassRelay Service 1-800-439-2370
MassDEP Website: www.mass.gov/dep

Printed on Recycled Paper

I. SPECIAL CONDITIONS

**A. Effluent Limits**

1) The permittee is authorized to discharge into the ground from the wastewater treatment facilities for which this permit is issued a treated effluent whose characteristics within one month of startup and continuing thereafter shall not exceed the following values:

| Effluent Characteristics | Discharge Limitations |
|---|---|
| Flow | Phase 1: 228,900 gpd (annual average)<br>595,100 gpd (maximum day)<br>Phase 2: 350,000 gpd (annual average)<br>883,800 gpd (maximum day) |
| Oil and grease | 15 mg/l |
| Total Suspended Solids (TSS) | 30 mg/l |
| Total Nitrogen ($NO_2 + NO_3 + TKN$) | 10 mg/l |
| Nitrate-Nitrogen | 10 mg/l |
| Biochemical Oxygen Demand, 5-day @20°C ($BOD_5$) | 30 mg/l |
| Settleable Solids | 0.1 ml/l |
| Fecal Coliform | 200 colonies/100 ml |
| Total Residual Chlorine | 4 mg/l |

a) The pH of the effluent shall not be less than 6.5 nor greater than 8.5 at any time or not more than 0.2 standard units outside the range measured at the upgradient monitoring wells (LH-6 and MW-14).

b) Prior to discharging Phase 2 flow, the Permittee shall evaluate the operational experience with the wicks to determine if the wicks at 32 Lots Hollow Road are capable of accommodating the maximum day flow. Pending the results of that evaluation, the Department reserves the right to require development of additional wicks with plans to be submitted by the Permittee through a BRP WP 68 Treatment Works Plan Approval Without Permit Modification.

c) The compliance sampling point for Total Residual Chlorine shall be at the end of the force main prior to discharge into the wicks.

d) Redevelopment and cleaning of the wicks may periodically require dosages of chlorine in excess of the effluent limit. Redevelopment and cleaning procedures and protocols shall be included in the WWTF's Operation and Maintenance Manual (O&M) as approved by the Department. The permittee shall provide the Department with a 24 hour notification in advance of any redevelopment and cleaning activity, except in an instance of extreme emergency in which case notification shall be within 24 hours of emergency redevelopment and cleaning activity.

e) The discharge of the effluent shall not result in any demonstrable adverse effect on the groundwater or violate any water quality standards that have been promulgated.

f) The monthly average concentration of BOD and TSS in the discharge shall not exceed 15 percent of the monthly average concentrations of BOD and TSS in the influent into the permittee's wastewater treatment facility.

g) When the average annual flow exceeds 80 percent of the permitted flow limitations, the permittee shall submit a report to the Department describing what steps the permittee will take in order to remain in compliance with the permit limitations and conditions, inclusive of the flow limitations established in this permit.

## B. Monitoring and Reporting

1) The permittee shall monitor and record the quality of the **influent** and the quality and quantity of the **effluent** prior to discharge to the leaching facilities according to the following schedule and other provisions:

**INFLUENT:**

| Parameter | Minimum Frequency of Analysis | Sample Type |
|---|---|---|
| pH | Daily | Grab |
| Septage (quantity) | Daily | report |
| TSS | Weekly | 24-hr Composite |
| $BOD_5$ | Monthly | 24-hr Composite |
| Oil & Grease | Monthly | Grab |
| Total Nitrogen ($NO_2 + NO_3 + TKN$) | Monthly | 24-hr Composite |
| Sodium | Monthly | Grab |
| Chloride | Monthly | Grab |
| Volatile Organic Compounds | Quarterly | Grab |

**EFFLUENT:**

| Parameter | Minimum Frequency of Analysis | Sample Type |
|---|---|---|
| Flow | Daily | Continuous reading |
| pH | Daily | Grab |
| $BOD_5$ | Monthly | 24-hr Composite |
| Total Nitrogen ($NO_2$+$NO_3$+TKN) | Monthly | 24-hr Composite |
| Nitrate Nitrogen | Monthly | 24-hr Composite |
| Ammonia as Nitrogen | Monthly | 24-hr Composite |
| Total Suspended Solids | Weekly | 24-hr Composite |
| Settleable Solids | Weekly | Grab |
| Total Dissolved Solids | Weekly | Grab |
| Total Solids | Weekly | Grab |
| Oil & Grease | Monthly | Grab |
| Fecal Coliform | Monthly | Grab |
| Total Phosphorus | Quarterly | Grab |
| Orthophosphate | Quarterly | Grab |
| Total Residual Chlorine | If and When Applied | Grab |
| Volatile Organic Compounds | Annually | Grab |

a) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

b) Total Residual Chlorine shall only be reported if it is added to the treatment process as part of wick well maintenance. Use of chlorine shall be noted in the monthly discharge monitoring reports and effluent concentrations shall be noted at that time.

c) Testing for Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Total Solids (TS) is to monitor for solids discharging to the wicks.

2) The permittee shall install the approved monitoring wells at least 90 days prior to treatment facility start-up. The permittee shall install the upgradient monitoring wells, LH-6 and MW-14 and the downgradient monitoring wells LH-7, LH-8 and LH-9 as shown on the approved plan titled "Figure 11, Groundwater Monitoring Locations 32 and 43 Lots Hollow Road" as found in the " Project Summary of the Groundwater Discharge Permit (GWDP) Application 32 and 43 Lots Hollow Road, Town of Orleans, Massachusetts" prepared by AECOM Technical Services, Inc. and dated July 24, 2019. Labels identifying each monitoring well's identification in accordance with the above-referenced approved plan shall be affixed to the steel protective casing of each monitoring well.

The permittee shall monitor, record and report the quality of water in the approved monitoring wells according to the following schedule and other provisions:

| **Parameter** | **Sample type** | **Sampling Frequency** |
|---|---|---|
| pH | Grab | Monthly |
| Static Water Level Elevation | Measurement | Monthly |
| Specific Conductance | Grab | Monthly |
| Total Nitrogen | Grab | Quarterly |
| Nitrate Nitrogen | Grab | Quarterly |
| Total Phosphorus | Grab | Quarterly |
| Orthophosphate | Grab | Quarterly |
| Volatile Organic Compounds | Grab | Annually |

a) Static Water Level shall be expressed as an elevation and shall be referenced to the surveyed datum established for the site. It shall be calculated by subtracting the depth to the water table from the surveyed elevation of the top of the monitoring well's PVC well casing/riser.

b) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

3) Any grab sample or composite sample required to be taken less frequently than daily shall be taken during the period of Monday through Friday inclusive. All composite samples shall be taken over a 24 hour period.

4) The permittee shall submit all monitoring reports within 30 days of the last day of the reporting month to MassDEP and to the Board of Health, 59 School Road, Orleans, Massachusetts 02653. All discharge monitoring reports submitted to MassDEP must be submitted through eDEP. To register for electronic submission go to: **http://www.mass.gov/eea/agencies/massdep/service/online/edep-online-filing.html**

## C. Supplemental Conditions

1) The permittee shall notify the Department at least thirty (30) days in advance of the proposed transfer of ownership of the facility for which this permit is written. Said notification shall include a written agreement between the existing and new permittees containing a specific date for transfer of permit, responsibility, coverage and liability between them.

2) A staffing plan for the facility shall be submitted to the Department once every two years and whenever there are staffing changes. The staffing plan shall include the following components:

a) The operator(s)'s name(s), operator grade(s) and operator license number(s);
b) The number of operational days per week;
c) The number of operational shifts per week;
d) The number of shifts per day;
e) The required personnel per shift;
f) Saturday, Sunday and holiday staff coverage;
g) Emergency operating personnel

The initial staffing plan will be submitted to the Department prior to the wastewater treatment facility's clean water test.

3) The permittee is responsible for the operation and maintenance of all sewers, pump stations, and treatment units for the permitted facility, which shall be operated and maintained under the direction of a properly certified wastewater operator.

4) Operation and maintenance of the proposed facility must be in accordance with 314 CMR 12.00, "Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges", and, 257 CMR 2.00, "Rules and Regulations for Certification of Operators of Wastewater Treatment Facilities".

a) The facility has been rated (in accordance with 257 CMR 2.00), to be a Grade 5 facility. Therefore, the permittee shall provide for oversight by a Massachusetts Certified Wastewater Treatment plant operator (Chief Operator) Grade 5 or higher. The permittee will also provide for a backup operator who shall possess at least a valid Grade 5 license.

b) The date and time of the operator's inspection along with the operator's name and certification shall be recorded in the log book on location at the treatment facility. All daily inspection logs consistent with the O&M Manual requirements shall be kept at the facility for a period of three (3) years.

c) Records of operation of wastewater treatment facilities or disposal systems required by the Department shall be submitted on forms supplied by the Department or on other forms approved by the Department for such use. Monthly reports shall be certified by the wastewater treatment plant operator in charge and shall be included in the discharge monitoring reports submitted each month.

5) If the operation and maintenance of the facility is to be contracted to a private concern, the permittee shall submit a copy of the contract, consistent with what is required by the approved Operation & Maintenance manual and signed only by the contractor, to the appropriate MassDEP Regional Office for review and approval ninety (90) days **prior** to the start up of the facility. Along with the contract, a detailed listing of all contract operation obligations of the proposed contractor at other facilities shall also be submitted. The permittee shall not begin operation of the treatment facility until the Department approves the contract.

6) All tests or analytical determinations to determine compliance with permit standards and requirements:

a) Effluent samples shall be collected, transported and stored in accordance with *Standard Methods for the Examination of Water and Wastewater;*

b) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other methods are approved by the Department; and,

c) Samples shall be analyzed by a Massachusetts Certified laboratory unless otherwise approved by the Department.

7) The permittee shall notify the appropriate MassDEP Regional Office, in writing, within thirty (30) days of the following events:

a) The date of treatment plant start up.
b) Any interruption of the treatment system operation, other than routine maintenance.
c) Final shutdown of the treatment system.

8) The permittee shall contract to have any and all solids and sludges generated by the treatment system for which this permit is issued removed off site by a properly licensed waste hauler for disposal at an EPA/MassDEP approved facility. The name and license number of the hauler along with the quantity of wastes removed and the date(s) of removal shall be reported by the permittee in writing to the appropriate MassDEP Regional Office.

9) Simultaneously with the permit renewal application at year fifteen (2035) following the initiation of plant operations, the permittee shall submit two reports to the Department for its review and approval:

   a) An engineering report, prepared by a registered professional engineer, that outlines in sufficient detail what modifications (if any) to the facility or other changes are required to insure that the facility can remain in compliance with its GWDP and other applicable requirements through the next 5 year permit term (year 2040) and beyond; and

10) In the event that effluent limits are not met, or the discharge is determined to impair groundwater quality in accordance with 314 CMR 5.16(1), the permittee may be obligated to modify, supplement or replace the permitted treatment process so as to ensure that the discharge does not impair the ability of the groundwater to act as an actual or potential source of potable water.

11) Pursuant to M.G.L. Chapter 21A, section 18(a), and 310 CMR 4.03, holders of this Permit may be subject to annual compliance assurance fees as assessed each year on July 1st and invoiced by MassDEP. Failure of the Permit holder to pay applicable annual compliance assurance fees shall result in the automatic suspension of the permit by operation of law under the statute. If fee non-payment continues for sixty days or more, MassDEP has the statutory option of revoking the Permit, denying any other pending permit applications filed by the Permit holder or taking other enforcement action. Permit holders are required to notify MassDEP in writing if they wish to relinquish or transfer a permit. Failure to do so will result in the continued assessment of fees.

**D. Appeal Rights**

During the thirty (30) day period following issuance of this permit, a Notice of Claim for an Adjudicatory Appeal may be sent by any person aggrieved (the "Petitioner") by the issuance to:

Case Administrator
Office of Appeals and Dispute Resolution
Massachusetts Department of Environmental Protection
One Winter Street/2nd Floor
Boston, MA 02108

310 CMR 1.01(6)(b) requires the Notice of Claim to: include sufficient facts to demonstrate aggrieved person status; state the facts which are grounds for the appeal specifically, clearly and concisely; and, state relief sought. The permit shall become or remain effective at the end of the 30 day appeal period unless the person filing the Notice of Claim requests, and is granted, a stay of its terms and conditions. If a permit is modified under 314 CMR 2.10, only the modified terms and conditions may be subject to an Adjudicatory Appeal. All other aspects of the existing permit shall remain in effect during any such Adjudicatory Appeal.

Per 310 CMR 4.06, the hearing request to the Commonwealth will be dismissed if the filing fee is not paid. Unless the Petitioner is exempt or granted a waiver, a valid check payable to the Commonwealth to Massachusetts in the amount of $100.00 must be mailed to:

Commonwealth of Massachusetts
Department of Environmental Protection
P.O. Box 4062
Boston, MA 02211

The filing fee is not required if the Petitioner is a city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority effective January 14, 1994, or any municipal housing authority; or, per MGL 161A s. 24, the Massachusetts Bay Transportation Authority. The Department may waive the adjudicatory hearing filing fee for a Petitioner who shows that paying the fee will create an undue financial hardship. A Petitioner seeking a waiver must file, along with the hearing request, an affidavit setting forth the facts believed to support the claim of undue financial hardship.

## II. GENERAL PERMIT CONDITIONS

### 5.16: General Conditions

The following conditions apply to all individual and general permits:

(1) No discharge authorized in the permit shall cause or contribute to a violation of 314 CMR 4.00: *Massachusetts Surface Water Quality Standards*. Upon promulgation of any amended standard, the permit may be modified to comply with such standard in accordance with the procedures in 314 CMR 2.10: *Modification, Suspension, Revocation and Renewal of Permits and General Permit Coverage* and 314 CMR 5.12. Except as otherwise provided in 314 CMR 5.10(3)(c), 5.10(4)(a)2. and 5.10(9), no discharge authorized in the permit shall impair the ability of the ground water to serve as an actual or potential source of potable water. Evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water includes, without limitation, analysis of samples taken in a downgradient well that demonstrates one or more exceedances of the applicable water quality based effluent limitations set forth in 314 CMR 5.10. In those cases where it is shown that a measured parameter exceeds the applicable water quality based effluent limitations set forth in 314 CMR 5.10 at the upgradient monitoring well, evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water is deemed to exist if a measured parameter in any downgradient well exceeds the level of that same measured parameter in the upgradient well for the same sampling period. A statistical procedure approved by the Department shall be used to determine when a measured parameter exceeds the allowable level.

(2) Duty to Comply. The permittee shall comply at all times with the terms and conditions of the permit, 314 CMR 5.00, M.G.L. c. 21, §§ 26 through 53, and all applicable state and federal statutes and regulations.

(3) Standards and Prohibitions for Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established by § 307(a) of the Federal Act, 33 U.S.C. § 1317(a), for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(4) Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and equipment installed or used to achieve compliance with the terms and conditions of the permit, 314 CMR 12.00: *Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges*, and 257 CMR 2.00: *Certification of Operators of Wastewater Treatment Facilities*. All equipment shall be maintained in an acceptable condition for its intended use.

(5) Duty to Halt or Reduce Activity. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production, discharges, or both, until the facility is restored or an alternative method of treatment is provided. A permittee may not raise as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

(6) Power Failure. In order to maintain compliance with the effluent limitations and prohibitions of the permit, the permittee shall either:

(a) provide an alternative power source sufficient to operate the wastewater control facilities; or

(b) halt, reduce or otherwise control production or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

(7) Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any adverse impact on human health or the environment resulting from non-compliance with the permit. Additionally, the permittee shall take all necessary steps to prevent an operational upset of the PWTF or POTW.

(8) Duty to Provide Information. The permittee and any operator of the permitted facility shall furnish to the Department within a reasonable time as specified by the Department any information which the Department may request to determine whether cause exists for modifying, suspending, revoking and reissuing, or terminating the permit, or to determine whether the permittee is complying with the terms and conditions of the permit.

(9) Inspection and Entry. The permittee shall allow the Department or its authorized representatives to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records required by the permit are kept;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;

(c) Inspect at reasonable times any facilities, equipment, practices, or operations regulated or required under the permit; and

(d) Sample or monitor at reasonable times for the purpose of determining compliance with the terms and conditions of the permit.

(9A) The permittee shall physically secure the treatment works and monitoring wells and limit access to the treatment works and monitoring wells only to those personnel required to operate, inspect and maintain the treatment works and to collect samples.

(9B) The permittee shall identify each monitoring well by permanently affixing to the steel protective casing of the well a tag with the identification number listed in the permit.

(10) Monitoring. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other test procedures are specified in the permit.

(11) Recordkeeping. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and all records of all data used to complete the application for the permit, for a period of at least five years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Records of monitoring information shall include without limitation:

(a) The date, exact place, and time of sampling or measurements;
(b) The individual(s) who performed the sampling or measurement;
(c) The date(s) analyses were performed;
(d) The individual(s) who performed the analyses;
(e) The analytical techniques or methods used; and
(f) The results of such analyses.

(12) Prohibition of Bypassing. Except as provided in 314 CMR 5.16(13), bypassing is prohibited and the Department may take enforcement action against a permittee for bypassing unless:

(a) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
(c) The permittee submitted notice of the bypass to the Department:
1. In the event of an anticipated bypass, at least ten days in advance, if possible; or
2. In the event of an unanticipated bypass, as soon as the permittee has knowledge of the bypass and no later than 24 hours after its first occurrence.

(13) Bypass not Exceeding Limitations. The permittee may allow a bypass to occur which does not cause effluent limitations to be exceeded, but only if necessary for the performance of essential maintenance or to assure efficient operation of treatment facilities.

(14) Permit Actions. The permit may be modified, suspended, or revoked for cause. The filing of a request by the permittee for a permit modification, reissuance, or termination, or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

(15) Duty to Reapply. If the permittee wishes to continue an activity regulated by the permit after the expiration date of the permit, the permittee must apply for and obtain a new permit. The permittee shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department in writing.

(16) Property Rights. The permit does not convey any property rights of any sort or any exclusive privilege.

(17) Other Laws. The issuance of a permit does not authorize any injury to persons or property or invasion of other private rights, nor does it relieve the permittee of its obligation to comply with any other applicable Federal, State, or local law, or regulation.

(18) Oil and Hazardous Substance Liability. Nothing in the permit shall be construed to preclude the institution of any legal action or relieve the permittee of any responsibilities, liabilities, or penalties to which the permittee is or may be subject under § 311 of the Federal

Act, 33 U.S.C. § 1321, and M.G.L. c. 21E.

(19) Removed Substances. Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed in a manner consistent with applicable Federal and State laws and regulations including, but not limited to, the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, and the Federal Act, 33 U.S.C. § 1251 *et seq.*, the Massachusetts Hazardous Waste Management Act, M.G.L. c. 21C, and the Federal Resource Conservation and Recovery Act, 42 U.S.C. § 6901, *et seq.*, 310 CMR 19.000: *Solid Waste Management* and 310 CMR 30.000: *Hazardous Waste*.

(20) Reporting Requirements.

(a) Monitoring Reports. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) at the intervals specified in the permit. If a permittee monitors any pollutant more frequently than required by the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Beginning on December 2, 2017, a permittee shall submit all DMRs electronically, using the electronic reporting system designated by the Department. A permittee may seek a waiver of this requirement by submitting a written request for the Department's approval.

(b) Compliance Schedules. Reports of compliance or non-compliance with, or any progress reports on interim and final requirements contained in any compliance schedule in the permit shall be submitted no later than 14 days following each schedule date.

(c) Planned Changes. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility or activity which could significantly change the nature or increase the quantity of pollutants discharged. Unless and until the permit is modified, any new or increased discharge in excess of permit limits or not specifically authorized by the permit constitutes a violation.

(d) Anticipated Non-compliance. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in non-compliance with permit requirements.

(e) 24 Hour Reporting. The permittee shall report any non-compliance which may endanger health or the environment. Any information shall be communicated orally within 24 hours of the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain: a description of the non-compliance, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance. The following shall be included as information which must be reported within 24 hours:

1. Any unanticipated bypass which exceeds any effluent limitation in the permit; and
2. Any violation of a maximum daily discharge limitation for any of the pollutants required by the permit to be reported within 24 hours.

(f) Other Non-compliance. The permittee shall report all instances of non-compliance not reported under 314 CMR 5.16(20)(a), (b), or (e) at the time monitoring reports are submitted. The reports shall contain the information listed in 314 CMR 5.16(20)(e).

(g) Toxics. All manufacturing, commercial, mining, or silvicultural dischargers must notify

the Department as soon as they know or have reason to believe:

1. That any activity has occurred, or will occur, that would result in the discharge of any toxic pollutant listed in 314 CMR 3.17: *Appendix B - Toxic Pollutants* not limited by the permit, if that discharge will exceed the highest of the following notification levels:

a. 100 micrograms per liter (100 ug/l);

b. 200 micrograms per liter (200 ug/l) for acrolein and acrylonitrile, 500 micrograms per liter (500 ug/l) for 2,4-dinitrophenol, and for 2-methyl-4,6-dinitrophenol, and one milligram per liter (1 mg/l) for antimony;

c. Five times the maximum concentration value reported for that pollutant in the permit application; or

2. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

(h) Indirect Dischargers. All Publicly Owned Treatment Works shall provide adequate notice to the Department of the following:

1. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to § 301 or § 306 of the Federal Act, 33 U.S.C. § 1311 or 1316, if it were directly discharging those pollutants; and

2. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(i) Information. Where a permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit the relevant facts or correct information.

(j) The permittee shall notify the Department in writing within seven days of any change in contract operators.

(21) Signatory Requirement. All applications, reports, or information submitted to the Department shall be signed and certified in accordance with 314 CMR 5.14 and 5.15.

(22) Severability. The provisions of the permit are severable. If any provision of the permit, or the application of any provision of the permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of the permit, shall not be affected thereby.

(23) Reopener Clause. The Department reserves the right to make appropriate revisions to the permit to establish any appropriate effluent limitations, schedules of compliance, or other provisions, as authorized by the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, or the Federal Act, 33 U.S.C. § 1251 *et seq.*, to bring all discharges into compliance with these statutes.

(24) Approval of Treatment Works. All discharges and associated treatment works authorized in 314 CMR 5.00 shall remain in compliance with the terms and conditions of the permit. Any modification of the approved treatment works shall require written approval of the Department prior to the construction of the modification.

(25) Transfer of Permits.

(a) RCRA Facilities. Any permit which authorizes the operation of a RCRA facility subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities* shall be valid only for the person to whom it is issued and may not be transferred.

(b) Transfers by Modification. Except as provided in 314 CMR 5.16(25)(a) and (c), a permit may be transferred by the permittee to a new permittee if the permit has been modified or revoked and reissued in accordance with 314 CMR 5.12(2), or a minor modification is made to identify the new permittee in accordance with 314 CMR 5.12(3) and (4).

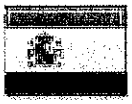
(c) Automatic Transfers. For facilities other than Privately Owned Wastewater Treatment Facilities (PWTFs) that treat at least some sewage from residential uses, hospitals, nursing or personal care facilities, residential care facilities, or assisted living facilities, PWTFs that have been required to establish, fund and maintain financial assurance mechanism(s) pursuant to 314 CMR 5.15(6), and RCRA facilities subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities*, a permit may be automatically transferred in accordance with 314 CMR 5.12(5).

(26) Permit Compliance Fees and Inspection Information. Except as otherwise provided, any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43, and 314 CMR 5.00 shall submit the annual compliance assurance fee established in accordance with M.G.L. c. 21A, § 18 and 310 CMR 4.00: *Timely Action Schedule and Fee Provisions*, as provided in 314 CMR 2.12: *Applications, Fees and Inspection Information.* The requirement to submit the annual compliance fee does not apply to any local government unit other than an authority. Any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43 and 314 CMR 5.00, may be required to submit inspection information annually, as provided in 314 CMR 2.12.

**Massachusetts Department of Environmental Protection**
**One Winter Street, Boston MA 02108 • Phone: 617-292-5751**
**Communication For Non-English Speaking Parties - 310 CMR 1.03(5)(a)**

**1 English:**

This document is important and should be translated immediately. If you need this document translated, please contact MassDEP's Diversity Director at the telephone numbers listed below.

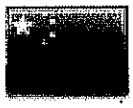


**2 Español (Spanish):**

Este documento es importante y debe ser traducido inmediatamente. Si necesita este documento traducido, por favor póngase en contacto con el Director de Diversidad MassDEP a los números de teléfono que aparecen más abajo.

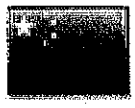
**3 Português (Portuguese):**

Este documento é importante e deve ser traduzida imediatamente. Se você precisa deste documento traduzido, por favor, entre em contato com Diretor de Diversidade da MassDEP para os números de telefone listados abaixo.



**4(a) 中國（傳統）(Chinese (Traditional):**

本文件非常重要，應立即翻譯。如果您需要翻譯這份文件，請用下面列出的電話號碼與Mass DEP的多樣性總監聯繫。



**4(b) 中国（简体中文）(Chinese (Simplified):**

本文件非常重要，应立即翻译。如果您需要翻译这份文件，请用下面列出的电话号码与Mass DEP的多样性总监联系。

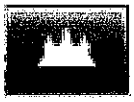
**5 Ayisyen (franse kreyòl) (Haitian) (French Creole):**

Dokiman sa-a se yon bagay enpòtan epi yo ta dwe tradui imedyatman. Si ou bezwen dokiman sa a tradui, tanpri kontakte Divèsite Direktè MassDEP a nan nimewo telefòn ki nan lis pi ba a.

**6 Việt (Vietnamese):**

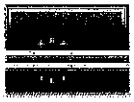
Tài liệu này là rất quan trọng và cần được dịch ngay lập tức. Nếu bạn cần dịch tài liệu này, xin vui

lòng liên hệ với Giám đốc MassDEP đa dạng tại các số điện thoại được liệt kê dưới đây.



**7 ប្រទេសកម្ពុជា (Kmer (Cambodian):**

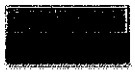
ឯកសារនេះគឺមានសារៈសំខាន់និងគួរត្រូវបានបកប្រែភ្លាម។ ប្រសិនបើអ្នកត្រូវបានបកប្រែ ឯកសារនេះសូមទំនាក់ទំនងឆ្មោតជានាយក MassDEP នៅលេខទូរស័ព្ទដែលបានរាយខាងក្រោម។



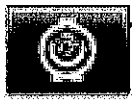
**8 Kriolu Kabuverdianu (Cape Verdean):**

*Es documento é importante e deve ser traduzido imidiatamente. Se bo precisa des documento traduzido, por favor contacta Director de Diversidade na MassDEP's pa es numero indicode li d'boche.*

**9 Русский язык (Russian):**

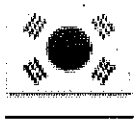


Этот документ является важным и должно быть переведено сразу. Если вам нужен этот документ переведенный, пожалуйста, свяжитесь с директором разнообразия MassDEP по адресу телефонных номеров, указанных ниже.



**10 العربية (Arabic):**

هذه الوثيقة الهامة وينبغي أن تترجم على الفور. اذا كنت بحاجة الى هذه الوثيقة المترجمة، يرجى الاتصال مدير التنوع في MassDEPعلى أرقام الهواتف المدرجة أدناه.

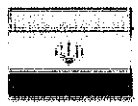


**11 한국어 (Korean):**

이 문서는 중요하고 즉시 번역해야합니다. 당신이 번역이 문서가 필요하면 아래의 전화 번호로 MassDEP의 다양성 감독에 문의하시기 바랍니다.

**12 հայերեն (Armenian):**

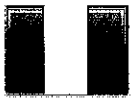
Այս փաստաթուղթը շատ կարեւոր է եւ պետք է թարգմանել անմիջապես. Եթե Ձեզ անհրաժեշտ է այս փաստաթուղթը թարգմանվել դիմել MassDEP բազմազանությունը տնօրեն է հետախոսահամարների թվարկված են ստորեւ.



**13 فارسی (Farsi (Persian):**

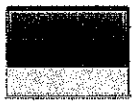
این سند مهم است و باید فورا ترجمه شده است.

اگر شما نیاز به این سند ترجمه شده، لطفا با ما تماس تنوع مدیر MassDEP در شماره تلفن های ذکر شده در زیر.



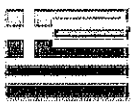
**14 Français (French):**

Ce document est important et devrait être traduit immédiatement. Si vous avez besoin de ce document traduit, s'il vous plaît communiquer avec le directeur de la diversité MassDEP aux numéros de téléphone indiqués ci-dessous.



**15 Deutsch (German):**

Dieses Dokument ist wichtig und sollte sofort übersetzt werden. Wenn Sie dieses Dokument übersetzt benötigen, wenden Sie sich bitte Diversity Director MassDEP die in den unten aufgeführten Telefonnummern.



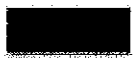
**16 Ελληνική (Greek):**

Το έγγραφο αυτό είναι σημαντικό και θα πρέπει να μεταφραστούν αμέσως. Αν χρειάζεστε αυτό το έγγραφο μεταφράζεται, παρακαλούμε επικοινωνήστε Diversity Director MassDEP κατά τους αριθμούς τηλεφώνου που αναγράφεται πιο κάτω.

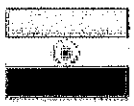
**17 Italiano (Italian):**

Questo documento è importante e dovrebbe essere tradotto immediatamente. Se avete bisogno di questo documento tradotto, si prega di contattare la diversità Direttore di MassDEP ai numeri di telefono elencati di seguito.

**18 Język Polski (Polish):**

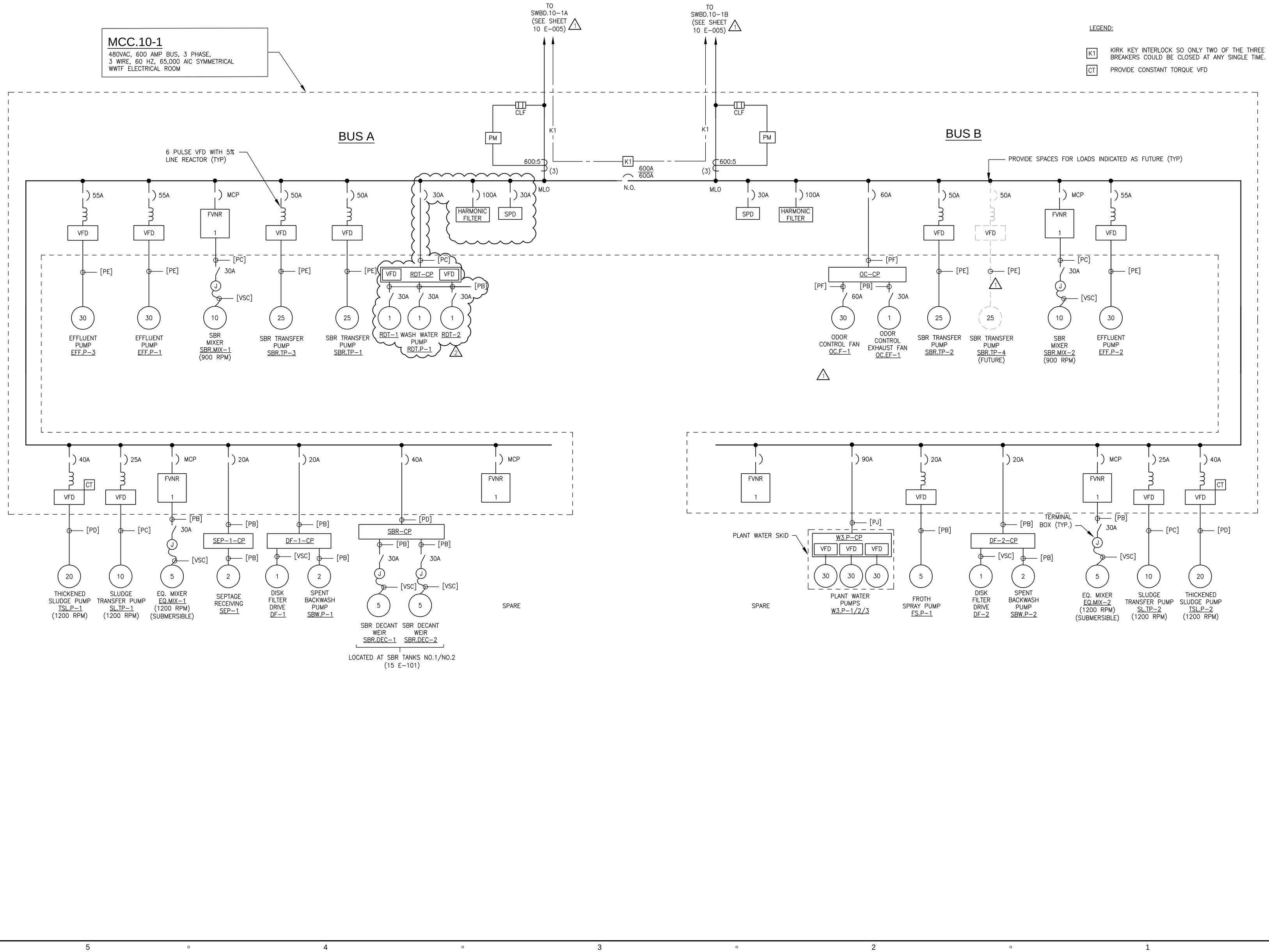


Dokument ten jest ważny i powinien być natychmiast przetłumaczone. Jeśli potrzebujesz tego dokumentu tłumaczone, prosimy o kontakt z Dyrektorem MassDEP w różnorodności na numery telefonów wymienionych poniżej.



**19 हिन्दी (Hindi):**

यह दस्तावेज महत्वपूर्ण है और तुरंत अनुवाद किया जाना चाहिए. आप अनुवाद इस दस्तावेज़ की जरूरत है, नीचे सूचीबद्ध फोन नंबरों पर MassDEP की विविधता निदेशक से संपर्क करें.

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LAST UPDATE: Friday, April 10, 2020 10:56:09 AM
PLOT DATE: Friday, April 10, 2020 10:57:26 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 2 | 04-10-2020 | ADDENDUM 8 |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

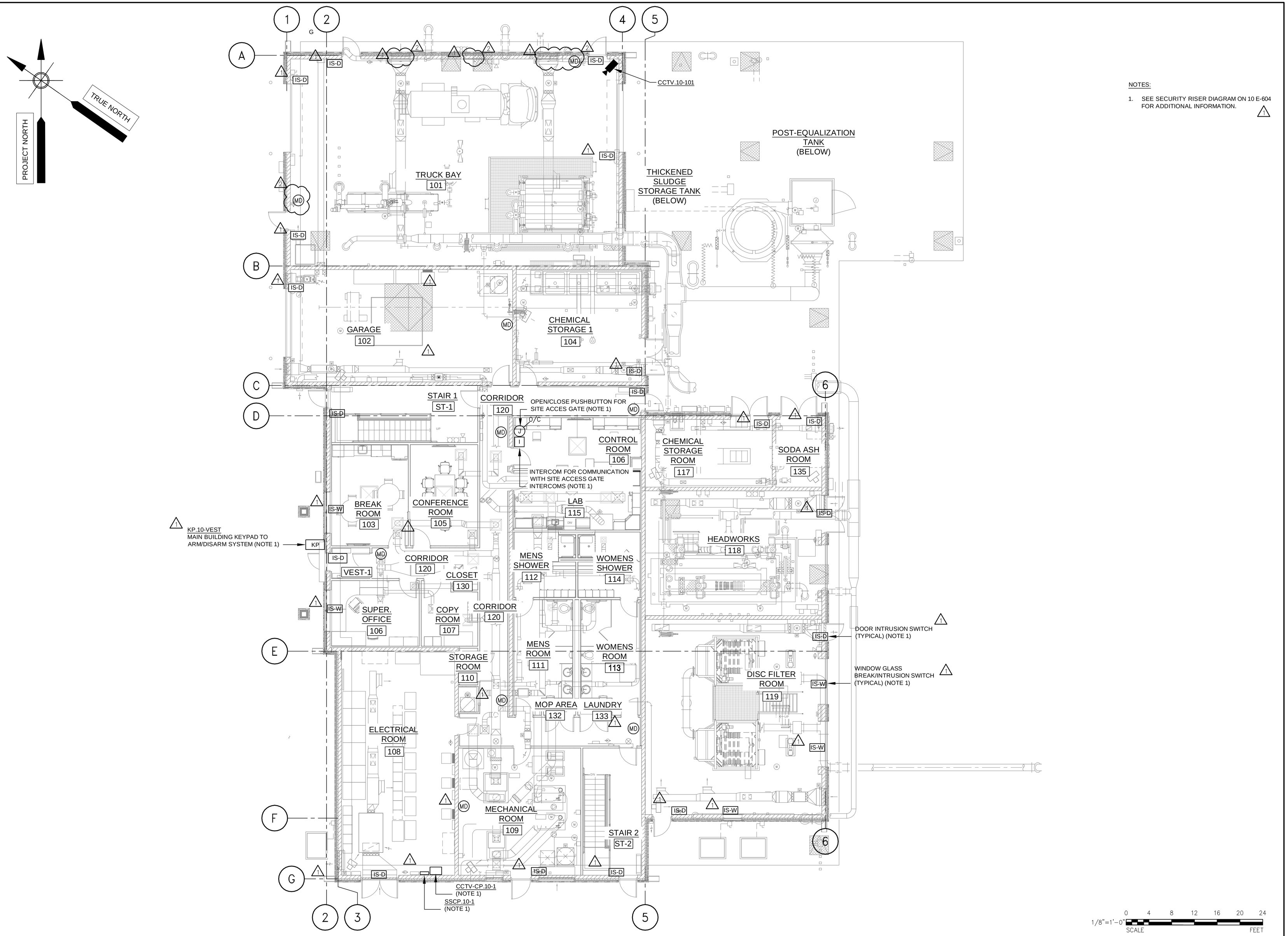
ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL SINGLE LINE DIAGRAM II - MCC.10-1

**SHEET NUMBER**

# 10 E-006




NOTES:

1. SEE SECURITY RISER DIAGRAM ON 10 E-604 FOR ADDITIONAL INFORMATION. (1)

1/8"=1'-0" SCALE 0 4 8 12 16 20 24 FEET

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LAST UPDATE: Friday, April 10, 2020 10:56:00 AM
PLOT DATE: Friday, April 10, 2020 10:57:41 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
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| | | |
| 2 | 04-10-2020 | ADDENDUM 8 |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. STEWART |
| Drawn By: | M. STEWART |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - GRADE LEVEL - SECURITY PLAN I

**SHEET NUMBER**

# 10 E-302

April 30, 2020

**ADDENDUM NO. 9**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 9 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 12 pages and 26 pages of attachments for a total of 44 pages.

## ATTACHMENTS

1. Orleans_MA-2019-01-Bid Form_Add_9-04-30-20
2. Section 15420, Plumbing Insulation
3. Drawing 10 A-102, Grade Level Plan
4. Drawing 10 A-201, Elevations
5. Drawing 10 A-603, Windows and Louver Schedules
6. Drawing 10 S-104, Grade Level Plan II
7. Drawing 10 E-101, WWTF – Lower Level – Power Plan I
8. Drawing 10 E-102, WWTF – Lower Level – Power Plan II
9. Drawing 10 E-606, WWTF – Electrical Riser Diagrams III
10. Drawing 10 E-607, WWTF – Electrical Riser Diagrams IV
11. Drawing 10 E-614, WWTF – Electrical Wiring Schematics II
12. Drawing 10 E-616, WWTF – Electrical Wiring Schematics IV

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. GENERAL

   A. Sub-Bid Opening – May 6, 2020 at 11:00 a.m.

   Sub-Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive Sub-Bids on May 6, 2020 starting at 8:00 a.m. The Sub-Bids will be taken inside to be opened at 11:00 a.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The Sub-Bid Opening will be broadcasted live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

   https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

B. General Bid Opening – May 13, 2020 at 2:00 p.m.

General Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive General Bids on May 13, 2020 starting at 8:00 a.m. The General Bids will be taken inside to be opened at 2:00 p.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The General Bid Opening will be broadcasted live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

C. PDF copies of the Sub-Bids and General Bids received but not including documents not allowed by law, will be available on the Owner's website within 7 calendar days of each bid opening.

2. ADDENDUM NO. 7

A. Page AD.7-3, delete Item No.7, Compressed Air System in its entirety and replace with the following new item:

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 9 | Compressed Air System | $30,000 | A-1B. |

Notes:

9. Item No. 9 - The allowance is for providing a complete Compressed Air System, including all equipment, piping, labor and accessories in accordance with SECTION 11140, COMPRESSED AIR SYSTEMS.

B. Page AD.7-7, Item No. 25, Paragraph B., delete the words "…preparation of their bid for PART IV – ALTERNATIVES, Item A-1 - Addition of the Equipment Storage Facility. The measurement…" and replace with the words "…preparation of their bid for PART IV – ALTERNATIVES, Item A-1B. - Addition of the Equipment Storage Facility. The measurement…".

3. ADDENDUM NO. 8

C. Page AD.8-3, delete Item No.9, Performance Testing in its entirety and replace with the following new item:

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 10 | Performance Testing | $50,000 | 2.R. |

Notes:

10. Item No. 10 - The allowance is for the cost of the Performance Testing in accordance with SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

4. SECTION 00410, FORM OF GENERAL BID

A. Delete "Orleans_MA-2019-01-Bid Form_Add_8-04-10-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_9-04-30-20" in both hard copy and Microsoft Excel format.

B. The Bid and Sub-bid Forms in Excel Format may be downloaded from the Tighe & Bond website. You must click on the "pre-qualified" button to access the Forms. Once obtained, in most cases a yellow bar will appear on the top of the screen labeled as "Security Warning". If this occurs, you must select the "Enable Content" button in order to properly utilize the file.

5. SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS

A. Page 01650-9, ARTICLE 1.12 – PERFORMANCE TESTING, Paragraph B.3., add the following new subparagraph:

c. At the time of Performance Testing, the Engineer, Contract Operator and Aqua Aerobics will determine if seed (i.e. quantity and quality) is required to be obtained by the Contractor. If required, the costs to obtain the seed shall be paid for under the allowance specified in SECTION 01020, ALLOWANCES.

B. Page 01650-10, ARTICLE 1.12 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING, Paragraph B., add the following new subparagraph:

14. Provide an initial full fill of the emergency generator fuel tank to be used for start-up and testing. Refill the fuel tank following start-up and testing.

6. SECTION 05500, Miscellaneous Metals

A. Page 05500-2, PART 1 - GENERAL, Article 1.00 – SUBBID REQUIREMENTS

Paragraph D.1., add the following Contract Drawing(s) numbered:

10 D-106 30 D-101 30 E-101

B. Page 05500-11, ARTICLE 2.14 HATCHES, Paragraph A., delete the paragraph in its entirety and replace with the following paragraph:

1. Hatches shall be of the styles, types and sizes shown on the Contract Drawings. All hatches and covers shall be rated Heavy Duty intended for use in vehicular travel areas and capable of withstanding HL-93, HS-20 with 30 percent impact, or M306 loading. Manufacturer shall guarantee proper operation and defects in material or workmanship for a period of five (5) years. All hatches shall be of aluminum or cast-iron construction as manufactured by the following manufacturers or an approved equal:

EJ
1125 Pearl Street, Brockton, MA 02301
Phone: 508-586-3130
https://www.ejco.com/am/en/?region=americas

Pennsylvania Insert Corporation
490 First Avenue, Royersford, PA 19468
Phone: 610-948-9688
www.pennsylvaniainsert.com

USF Fabrication
3200 West 84 Street, Hialeah, FL 33018
Phone: 860-398-0496
http://www.usffab.com/usffab-products/catalog/product_details/44

C. Page 05500-11, ARTICLE 2.14 HATCHES, Paragraph B., delete the paragraph in its entirety and replace with the following new paragraph:

A. Exterior Hatches shall have a 1-1/2-inch drainage coupling located in the front right corner of the Hatch channel frame. Hardware shall be stainless steel factory mill finish and bituminous coating applied to the exterior of the frame. Hatches that are not shown connected to a drainage system, shall be provided with extensions to the drainage coupling to allow drainage to the areas below.

D. Page 05500-11, ARTICLE 2.14 HATCHES, delete Paragraph C. in its entirety.

E. Page 05500-11, ARTICLE 2.14 HATCHES, delete Paragraph D. in its entirety.

7. SECTION 07900, JOINT SEALANTS

A. Page 07900-2, ARTICLE 1.01 – SCOPE, renumber Paragraph C. to Paragraph A.

B. Page 07900-2, ARTICLE 1.01 – SCOPE Paragraph A., add the following new subparagraph:

4. Construction joint materials for concrete work shall be in accordance with SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

C. Page 07900-2, ARTICLE 1.01 – SCOPE, renumber Paragraph D. to Paragraph B.

8. SECTION 09200, FURRING AND GYPSUM CEILING

A. Page 09200-4, ARTICLE 3.02 – INSTALLATION, delete Paragraph B.2. in its entirety and replace with the following new paragraph:

2. Control Joint Spacing: 12 feet o.c. and located as indicated on the drawings.

9. SECTION 09250, DRYWALL CONSTRUCTION

   A. Page 09250-5, ARTICLE 3.02 – GYPSUM WALLBOARD INSTALLATION, Paragraph C.1.a., add the following new subparagraph:

      (4) Install Control Joint in locations indicated on the drawings.

   B. Page 09250-5, ARTICLE 3.02 – GYPSUM WALLBOARD INSTALLATION, Paragraph C.2.a., add the following new subparagraph:

      (3) Install Control Joint in locations indicated on the drawings.

10. SECTION 10420, PLAQUE

   A. Page 10420-2, ARTICLE 2.01 – PLAQUE, Paragraph A., Etched Insert, add the following note:

      Note 1: The Etched Insert is the Town Seal made of the same material as the overall plaque.

   B. Page 10420-3, ARTICLE 2.01 – PLAQUE, after Paragraph C., renumber Paragraph A. and Paragraph B. to Paragraph D. and Paragraph E., respectively.

11. SECTION 10440, SIGNS

   A. Page 10440-5, ARTICLE 2.02 - SAFETY SIGNS, delete Paragraph C through Paragraph F. in their entirety and replace with the following new paragraph:

      C. Refer to SECTION 10600, IDENTIFICATION SYSTEMS for additional information.

12. SECTION 10525, FIRST AID AND FIRE FIGHTING EQUIPMENT

   A. Page 10525-3, ARTICLE 2.01 – EQUIPMENT, Paragraph B. Fire Extinguishers, add the following new subparagraph:

      5. Fire Extinguishers are noted on the DRAWING 00 A-001, ARCHITECTURAL SYMBOLS, NOTES AND ABBREVIATIONS as “FE”. Each FE location is identified above and on the Drawings. All FE are to be surface mounted. No recessed cabinets.

13. SECTION 11326, MECHANICALLY CLEANED FINE SCREENS

   A. Page 11326-8, ARTICLE 2.07 – CONTROL SYSTEM

      1) Paragraph B. add the following sentence to the end of the paragraph:

         PLC shall be MicroLogix 1400 or approved equal.

      2) Add the following as new Paragraph I.:

         I. Miscellaneous

            1. All Panels require UPS. Provide UPS sized to provide at least 15 minutes of back-up power to the PLC.

            2. Provide 10” HMI, Allen Bradley PanelView Plus or approved equal.

            3. Provide a managed industrial Ethernet switch with at least four (4) ports, installed with the panel in order to connect the panel to the plant SCADA system. Managed Ethernet switch shall be Allen Bradley Stratix 8000 or approved equal.

            4. Physical switches (Screen HOA FOR, (2) Screen SOV HOA and E-Stop) shall be provided on the LCS and are not required on the main PLC cabinet.

            5. Screen level measurement shall be Single Siemens HydroRanger 200 HMI with (2) STH Transducers or approved equal.

            6. All PLC’s shall be AB CompactLogix, AB MicroLogix or approved equal.

B. Page 11326-10, ARTICLE 2.09 – MECHANICALLY CLEANED SCREEN SCHEDULE, delete the article in its entirety and replace with the following new article:

2.09 - MECHANICALLY CLEANED SCREEN SCHEDULE

| | |
|---|---|
| Type: | Raw Wastewater, which includes both domestic and industrial conditions. |
| Temperature: | 45 degrees to 65 degrees F |
| pH: | 6-8 |
| Screen Data: | |
| Number of Screens: | 1<br>Note: In the future, another screen may be furnished and installed (not part of this Project) in place of the manual bar rack in the bypass channel. |
| Hydraulic Capacity: | |
| Design Peak Flow: | 1,042 gpm/screen (1.5 mgd) |
| Design Average Flow: | 135 gpm/screen (0.2 mgd) |
| Maximum Headloss in Wastewater at Peak Design Flow at 10 inches downstream submergence: | 10.5. inches |
| Screen Openings Diameter: | 1/4-inch (6 mm) |
| Screening Basket Diameter: | 20 inches |
| Maximum Screen Incline: | 48 degrees |
| Wash System: | |
| Flow Rate (Max): gpm | 15 |
| Pressure Required, psi: | 60 |
| Drive Motor Hp: | 1-1/2 |
| Screen Channel: | |
| Width, in: | 20 |
| Maximum Water Depth, in: | 28 |
| Channel Depth, in: | 44 |
| Discharge Height: | |
| From channel bottom to discharge chute bottom, feet | 2-3/4 |

14. SECTION 11377, ROTARY POSITIVE DISPLACEMENT BLOWERS AND APPURTENANCES

    A. Page 11377-4, ARTICLE 1.07 – QUALITY ASSURANCE, delete the Paragraph F. in its entirety and replace with the following new paragraph:

        F. The Contractor shall obtain the blowers, motors, filters, silencers, acoustical enclosures, controls and appurtenances from the blower manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

            1. Variable frequency motor controllers are supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

            2. The blower system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

                a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the blower and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, blower manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the blower and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection.

                b. Also include all motor data and information that has been used for the coordination.

15. SECTION 12300, LABORATORY FURNISHINGS

    A. Page 12300-8, ARTICLE 2.01 – FURNISHINGS, Paragraph E.4.d., delete subparagraph (1) in its entirety and replace with the following new subparagraph:

        (1) Fume Hoods shall be in accordance with the Laboratory Room Accessory Schedule on DRAWING 10 A-402, ENLARGED PLANS, ELEVATIONS SCHED. – LAB ROOM.

16. SECTION 12500, FURNITURE

    A. Page 12500-3, ARTICLE 2.01 - MANUFACTURERS, delete Paragraph B. in its entirety and replace with the following new paragraph:

        B. Refer to Furniture Schedule on drawings.

            1. HON furniture is the proprietary manufacturer for all office furniture unless another manufacturer is identified. All other listed items which show a different manufacturer are to be ‘basis of design’ products in order to establish a minimum standard of quality.

17. SECTION 13350, SCADA EQUIPMENT

    A. Page 13350, ARTICLE 2.01 – SOFTWARE, delete Paragraph A. in its entirety and replace with the following new paragraphs:

        A. All software shall be of the latest version available at the time of submittal review.

        B. Rockwell Automation Factory Talk View SE to match software in use at the Water Department. Provide two software clients.

        C. WIN 911 software for plant alarm management.

        D. A SQL database and XL Reporter will be utilized to develop the plant reports. Reports shall be archived daily but shall be readily accessible to plant operators for one week after generation.

        E. Provide CMMS software to receive run time from the SCADA software so that work orders can be triggered on actual time.

        F. Data applications will be stored on external drivers provided by SI with one-touch backup initiation.

18. SECTION 15056, PIPE SUPPORTS

    A. Page 15056-9, ARTICLE 3.08 – INSTALLATION OF BUILDING ATTACHMENTS, delete Paragraph A. in its entirety and replace with the following new paragraph:

        A. Support piping from structural framing, unless otherwise indicated. Support of piping off of structural CMU wall is acceptable. Provide anchorage into grouted cells. Piping can be supported from SBR tank walls.

19. SECTION 15420, PLUMBING INSULATION

    A. Add new SECTION 15420, PLUMBING INSULATION, as attached.

20. SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING

    A. Page 15500-35. ARTICLE 2.31 – SHEETMETAL DUCTWORK, delete Paragraph A. in its entirety and replace with the following new paragraph:

        A. Provide all ductwork consisting of ducts, plenums and sleeves as required for the various air systems. Except for in chemical storage areas, all ductwork shall be sheetmetal ductwork as specified herein. Ductwork in or serving chemical storage areas and specific process areas as identified on the Drawings shall be fiberglass reinforced plastic conforming to SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

    B. Page 15500-35. ARTICLE 2.32 – FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK, delete Paragraph A. in its entirety and replace with the following new paragraph:

        A. Ductwork in or serving chemical storage and specific process areas as identified on the Drawings shall be fiberglass reinforced plastic ductwork in accordance with SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

21. SECTION 15857, ODOR CONTROL SYSTEMS – CARBON

    D. Page 15857-2, ARTICLE 1.01 – SCOPE, Paragraph C., add the following new subparagraph:

        3. All FRP ductwork, mating components, gaskets and all associated hardware between the Odor Control Fan and Mist/Grease Filter.

    E. Page 15857-8, ARTICLE 2.02 - SEISMIC DESIGN REQUIREMENTS, delete Paragraph C. in its entirety and replace with the following new paragraph:

        C. Provide all equipment bases, anchorage and supports designed in accordance with the seismic requirements indicated and specified. The Engineer is responsible for the design of the concrete foundation/equipment pads.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. ADDENDUM NO. 6

    A. Page AD.6-8 Item No. 3, Delete the note in its entirety.

2. DRAWING 00 C-105, YARD PIPING PLAN I – WWTF

    A. Add the following new note:

        4. Gasoline/Oil/Sand Separators shall be in accordance with DRAWING 99 P-502, DETAILS II.

3. DRAWING 00 C-109, DRAIN PROFILES

    A. Drain Profile 1, 12-inch PW Overflow shall be PVC.

4. DRAWING 10 A-102, GRADE LEVEL PLAN

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

5. DRAWING 10 A-201, ELEVATIONS I

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

6. DRAWING 10 A-303, SECTION – WALLS

   A. Detail 1 - South Wall Section, replace "2" Cont. rigid insulation R-10. Typ." with "2" Cont. rigid insulation R-10. Typ. (See note below)"

   B. Detail 1 - South Wall Section, add the following new note:

      Note: 2" rigid insulation thickness is required to meet the minimum R-value requirements listed for mass walls below grade.

7. DRAWING 10 A-402, ENLARGED PLANS, ELEVATIONS, SCHED. – LAB ROOM

   A. Laboratory Room Accessory Schedule, add the following to Item 22:

      Model: E41C292248

      Manufacturer: Kewaunee Scientific Corporation

8. DRAWING 10 A-404, ENLARGED PLANS, ELEVATIONS, SCHED. – OFFICE/COPIER ROOM

   A. Office/Copier Room Accessory Schedule, add the following to Item 3:

      Model: H882 with counter-top to match other furniture.

      Manufacturer: The HON Company

9. DRAWING 10 A-503, DETAILS – MISC. I

   A. Detail 1 - Alum Hatch HL-93, replace "Alum Hatch HL-93" with "Alum. Heavy Duty Hatch".

   B. Detail 1 - Alum. Heavy Duty Hatch, add the following new notes:

      1. All interior and exterior hatches shall be Heavy Duty.

      2. Heavy Duty hatches shall be intended for vehicular loadings and capable of withstanding HL-93, HS-20 with 30 percent impact or M306 loadings.

   C. Detail 3 - Alum Hatch

      1. Delete Detail 3 - Alum Hatch in its entirety.

10. DRAWING 10 A-601, ROOM FINISH SCHEDULE

    A. Room Finish Schedule, add the following new note:

       Note: Floors identified with SC shall be provided with a dustproof sealer in accordance with SECTION 03345, CONCRETE FLOOR TREATMENT.

    B. Room Finish Schedule Legend, add the following new abbreviation:

| Abbreviation | Material |
|---|---|
| EFC | Epoxy Floor Coating |

11. DRAWING 10 A-603, WINDOWS AND LOUVER SCHEDULES

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

12. DRAWING 10 A-608, SIGNAGE

    A. No Storage Sign Detail, add the following new notes:

       Notes:

       1. Signs shall be made of 1/8-inch thick aluminum with stainless steel mounting hardware.

       2. Signs shall be mounted at the base and top of each ladder that accesses the attic.

       3. Four (4) signs shall be provided.

13. DRAWING 99 A-607, PARTITION TYPES

    A. Partition Type V1, add the following remark:

       Partition Type V1 is a shaft wall assembly with stub spacing at 24" on center.

14. DRAWING 00 S-001 – STRUCTURAL NOTES I

    A. CONCRETE, delete Note 5 in its entirety and replace with the following new note:

       5. Provide fiber reinforced concrete having a 28-day compressive strength of 4,000 psi for all concrete infills and toppings. All fill shall be fiber reinforced unless reinforcement is indicated otherwise on the drawings.

15. DRAWING 10 S-104, GRADE LEVEL PLAN II

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

16. DRAWING 00 D-002, GENERAL NOTES AND ABBREVIATIONS

    A. General Note 13, add the following to the end of the note:

       All wall castings with water stops for all buried and submerged pipelines shall be provided in accordance with the Wall Penetration (New Construction) Details shown on DRAWING 99 D-501, DETAILS I.

    B. General Notes, add the following new note:

       34. All pipe support quantities, types, anchorage and the like shall be in accordance with SECTION 15056, PIPE SUPPORTS.

17. DRAWING 00 D-004, SCHEDULES I

    A. Slide Gate Schedule, Tag No. RWW SG-5, 6, add the following new remark:

       Slides Gates are wall mounted against a plain end pipe wall casting in the Headworks channel as shown on DRAWING 10 D-105, FACILITY UPPER PLAN II.

    B. Slide Gate Schedule, Tag No. SBR SG-1, 2, add the following new remark:

       Slides Gates are to be thimble mounted with a Type "F" thimble.

18. DRAWING 10 D-104 – FACILITY UPPER PLAN I

    A. Sodium Hypochlorite/PACL Room, delete the words "Scale (Typical)" and replace with the words "Scale mounted on concrete pedestals (Typical)".

    B. Garage, delete the words "8'- 0" x 8'– 0" Equipment Hatch" and replace with the words "6'- 0" x 6'-0" clear opening Heavy-Duty Equipment Removal/Access Hatch".

    C. Over Thickened Sludge Storage Tank, delete the words "3'- 0" x 3'- 0" Access Hatch (Typ.)" and replace with the words "3'- 0" x 3'- 0" Heavy-Duty Equipment Removal/Access Hatch (Typ.)".

    D. Over Post Equalization Tank, delete the words "3'- 0" x 3'- 0" Equipment Removal Hatch (Typ.)" and replace with the words "3'- 0" x 3'- 0" Heavy-Duty Equipment Removal/access Hatch (Typ.)".

    E. Sodium Hypochlorite / PACL Room, delete the words "FRP Grating (Typ.) El = 56.70. See Arch. Dwg's for Details" and replace with the words ""FRP Grating (Typ.) El = 57.00. See Arch. Dwg's for Details".

    F. Sodium Hypochlorite / PACL Room, add the following new note:

       Scales to be set on the FRP grating. Provide Type 316L stainless steel anchorage connections to the grating in accordance with the scales' manufacturer requirements.

19. DRAWING 10 D-307 – SECTIONS VII

    A. SECTION 8., delete the words "FRP Grating El = 56.70" and replace with the words "FRP Grating El = 57.00".

20. DRAWING 30 D-101, WICK DISTRIBUTION VAULT PLAN AND SECTIONS

    A. Delete the words "3'-0" x 3'-0" Access Hatch" and replace with the words "3'-0" x 3'-0" Heavy Duty Access Hatch".

21. DRAWING 99 D-504, DETAILS IV

    A. Seal Water Panel Piping for Pumps with Packing and Split Mechanical Seal and Pressure Sensors, add the following new notes:

        4. Seal water is required at the pumps without the spiral track mechanical seal - SBR Transfer Pumps and Thickened Sludge Pumps.

        5. Provide floor mounted equipment drain, 2-inch piping and associated fittings and supports from seal water system to basement gutter for each SBR Transfer Pump and each Thickened Sludge Pump.

22. DRAWING 00 M-002, SCHEDULES I

    A. Hydronic Cabinet Unit Heater Schedule, revise 10-CUH-2 TYPE to “Horizontal Recessed-Ceiling Mounted” and Model No. to “Trane/ FFEB020”.

    B. Hydronic Cabinet Unit Heater Schedule, Note 2. add the following to the end of the note: “No OA Connection”.

23. DRAWING 10 M-102, WWTF LOWER PLAN II – DUCTWORK

    A. Basement Pump Rom, Column 4 and between Column F and G, delete the words “24”x12 ER” and replace with the words “24”x12” SAR”.

24. DRAWING 10 M-104, WWTF UPPER PLAN II - DUCTWORK

    A. Note 8., delete the third line and replace with the following:

        To/from water heater 10-DWH-1. Coordinate the location of the duct, flue and heater provided by Plumbing. See Note 7.

25. DRAWING 10 M-108, WWTF MECHANICAL ROOM – PART PLAN

    A. Mechanical Room, at top center of room, delete the words “X” HWS” and replace with the words “4” HWS”.

26. DRAWING 00 E-001, General Notes, add the following new note:

    7. All floor mounted electrical equipment including, but not limited to, Switchboards, MCCs and VFDs, shall be provided with a concrete equipment pad in accordance with DRAWING 99 S-503, STRUCTURAL STANDARD DETAILS III.

27. DRAWING 10 E-003, WWTF – ELECTRICAL SITE PLAN – FIBER NETWORK I

    A. Trench Detail S1 and Trench Detail S-2, revise the trench details to be in accordance with the trench details shown of DRAWING 00 C-106, YARD PIPING PLAN II & PROFILE – WWTF.

28. DRAWING 10 E-606, WWTF – ELECTRICAL RISER DIAGRAMS III

    A. Septage Receiving System – Riser Diagrams

        1) Add the following new note:

            Note: Three E-Stop LCS are required: (a) Main Control Station located in Room 102, Garage; (b) Local Control Station at the Septage Receiving System located in Room 101, Truck Bay; and (c) Sludge Loading Area (Exterior).

        2) Provide inspection door limit switch. Refer to SECTION 99999, ATTACHMENTS - ATTACHMENT A - SECTION 11333 Septage Receiving Station Huber Technology, Inc. Proposal, Instrumentation Drawings and Contract electrical and instrumentation drawings.

29. DRAWING 10 E-101, WWTF – LOWER LEVEL – POWER PLAN I

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

30. DRAWING 10 E-102, WWTF – LOWER LEVEL – POWER PLAN II

    A. Delete the drawing in its entirety and replace with the new drawing, as attached.

31. DRAWING 10 E-606, WWTF – ELECTRICAL RISER DIAGRAMS III
    A. Delete the drawing in its entirety and replace with the new drawing, as attached.
32. DRAWING 10 E-607, WWTF – ELECTRICAL RISER DIAGRAMS IV
    A. Delete the drawing in its entirety and replace with the new drawing, as attached.
33. DRAWING 10 E-614, WWTF – ELECTRICAL WIRING SCHEMATICS II
    A. Delete the drawing in its entirety and replace with the new drawing, as attached.
34. DRAWING 10 E-616, WWTF – ELECTRICAL WIRING SCHEMATICS DIAGRAMS IV
    A. Delete the drawing in its entirety and replace with the new drawing, as attached.
35. DRAWING 10 DI-604, DISK FILTER P&ID
    A. Notes, add the following new note:
        6. The motor operated valves located on the Disk Filter influents shall be provided by the General Contractor.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 9**

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Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of<br>$ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of<br>$ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of<br>One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |

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| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as specified, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as specified, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as specified, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishing Section 11365 - Rotary Drum Thickeners, as specified, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| 2.R. | For conducting Performance Testing, as specified, the sum of | | | | |
| | Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 50,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ -** |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD** - The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraints will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding its funding constraints. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in June 2020.

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$** -

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | **$ -** |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-1A | For Addition of the Equipment Storage Facility, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |
| A-1B | For providing Compressed Air System, as specified, the sum of | | | |
| | Thirty Thousand Dollars and No Cents<br>$ 30,000.0 | Allowance | 1 | $ - |
| | | | **Total of Bid Items A-1A. Through A-1B., inclusive** | **$ -** |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stair | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-1** | **$ -** |

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer, Section 04200, Unit Masonry and Accessories and Section 03450, Precast Architectural Concrete | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work, Section 05120, Structural Steel and Section 05511, Pre-Engineered Aluminum Stairs | | $ - |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping | | $ - |
| 3D | Section 07610, Metal Roofing, Section 07710, Roof Specialties and Section 07600, Wall Flashing and Sheet Metalwork | | $ - |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09800, Protective Coating, Section 09850, High Performance Coating and Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

**SECTION 15420**

**PLUMBING INSULATION**

**(Filed Sub-Bib Required)**

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## PART 1 - GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of SECTION 15420, PLUMBING INSULATION is a part of DIVISION 15, PLUMBING whhich requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. DIVISION 15, PLUMBING. See SECTION 15400, PLUMBING SYSTEMS.

B. The Work of SECTION 15420, PLUMBING INSULATION, requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. Provide new field-applied insulation for new piping as indicated and in compliance with Contract Documents.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025 - MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS and as specified herein.

1. Product Data - Annotate descriptive data to show the specific manufacturer, material and specifications, thicknesses, etc. of each item.

a. Piping insulation and jackets

**1.05 – PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All material shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and maintain material warranties.

C. Receiving:

1. All material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard material in accordance with manufacturer's recommendations.

4. Store material protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions - Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, performance, and reliability equal to that specified. Materials shall be the product of a single manufacturer insofar as possible.

C. Workmanship and Design - Install products that comply with state, local and federal codes and regulations.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American Society for Testing Materials (ASTM):

1. A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

2. A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications

3. C195: Mineral Fiber Thermal Insulating Cement

4. C547: Mineral Fiber Pipe Insulation

5. C1136: Flexible, Low Permeance Vapor Retarders for Thermal Insulation

6. D1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

7. E 84: Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

1. 255: Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL):

1. 723: Test for Surface Burning Characteristics of Building Materials

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the approval of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If Work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Attend regular coordination and job progress meetings required.

**1.10 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes, including but not limited to, Massachusetts Building Code.
2. Massachusetts Department of Environmental Protection.
3. Local Fire Department
4. Occupational Safety and Health Administration (OSHA)
5. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Architect, Owner, Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and approval, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Packaging and Labeling:

1. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer’s stamp or label attached giving name of manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

B. Surface Burning Characteristics:

1. Materials shall be plenum-rated having flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

C. Recycled Materials:

1. Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this Section. The minimum recycled material content of the following insulation types are:

a. Rock Wool: 75 percent slag by weight

b. Fiberglass: 20 to 25 percent glass cullet by weight

c. Plastic Rigid Foam: 9 percent recovered material

**2.02 - PIPING INSULATION**

A. Insulation material shall conform to Table 15420-1. Mineral fiber insulation shall be minimum 3.5 pounds per cubic foot density, minimum 500 degrees F rated, and maximum 0.24 R-factory at 75 degrees F. Insulation thickness shall be as listed in Table 15420-2. Insulate all ping listed in these tables. Where piping is located in unheated spaces such as ceiling spaces and crawl spaces or outdoors, provide insulation thickness one inch greater than indicated in Table 15420-2. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

B. Fittings Insulation - Factory pre-molded insulation inserts for pipe fittings, flanges and valves shaped to fit the specific fitting to be insulated. Inserts shall be of same material as the straight pipe. Inserts shall be of same thickness as the straight pipe insulation.

C. Piping Insulation Jackets:

1. All-Purpose Jacket: Insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2. PVC Jackets: ASTM D1784 polyvinyl chloride (PVC) jackets, minimum 20 mil thick, factory pre-molded PVC fitting covers, UV-resistant, gloss white finish.

3. Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage, and factory pre-molded fitting covers, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface.

D. Lavatory Kits - Kits specifically designed for insulating lavatory waste and supply finish piping for ADA compliance, fabricated from UV resistant PVC, with tear-to-fit trim grooves, internal ribs and internal fasteners, and vent slots to keep air space between covers and piping dry, glossy white finish. Manufactured by Truebro or accepted equal.

**2.03 - ADHESIVES, SEALANTS, AND COATING COMPOUNDS**

A. Lagging Adhesive: Fire resistant, for pipe insulation.

1. Provide appropriate class recommended by insulation manufacturer for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation.

2. Provide appropriate class for attaching fibrous glass insulation to metal surfaces.

B. Insulation and Vapor Barrier Adhesive: ASTM C916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

C. Mineral Fiber Insulation Cement: ASTM C195.

D. Vapor Barrier Coating: Provide in accordance with insulation manufacturers' recommendations.

E. Weatherproof Coating: For outside applications, provide in accordance with insulation and jacket manufacturer's recommendations.

**2.04 - ACCESSORY MATERIALS**

A. Staples: ASTM A167, Type 304 or 316 stainless steel outside-clinch type.

B. Insulation Bands: 1/2-inch wide; 26 gage Type 304 or 316 stainless steel.

C. Vapor Barrier Materials: ASTM C1136. Resistant to flame, moisture penetration, and mold growth, color white.

D. Fibrous Glass Cloth and Tape: 20 by 20 maximum size mesh. Tape shall be 4 inch wide rolls. Tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Plumbing Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

D. Do not insulate the following:

1. Unions
2. ASME stamps
3. Cleanouts or handholes
4. Manufacturer’s nameplates
5. Chrome plated pipes
6. Flexible connectors

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - PIPING INSULATION**

A. Insulation (Except Cellular Glass and Calcium Silicate Insulation):

1. Place sections of insulation around pipe and joints tightly butted into place.
2. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 15420-1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating, or manufacturer’s weatherproof coating for outside service, unless pipe insulation is supplied with factory-applied self-seal lap. Apply coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1-1/2 inches past the break in both directions. At penetrations by pressure gages, thermometers, etc. fill voids with coating. Seal with a brush coat of the same coating.

B. Cellular Glass and Calcium Silicate Insulation:

1. Provide in accordance with manufacturer’s printed instructions.

C. Piping Insulation Jackets:

1. All Purpose Jackets

a. Provide all-purpose jackets to cover straight pipe runs. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center and ½ inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inch wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inch. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

2. Polyvinyl Chloride (PVC) Jackets:

a. Provide PVC jacketing system to cover all pipe fittings, flanges and valves of services to be insulated except as noted herein. Do not provide PVC jacketing where exposed to weather. Provide PVC jacketing only in ambient temperatures below 150 degrees F. Do not provide PVC jacketing at insulated pipe through-penetrations.

b. Secure jacketing with jacket manufacturer's solvent welding adhesive to seal all lap joints in the system. For services where vapor barrier is required, provide vapor retarder mastic compatible with PVC as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer.

3. Stainless Steel Jackets:

a. Provide stainless steel jacketing system to cover all straight runs, pipe fittings, flanges and valves of services to be insulated where exposed to weather or exposed to ambient temperatures 150 degrees F and above. Provide stainless steel jacketing at insulated pipe through-penetrations.

b. Provide insulation bands to secure jackets to insulation. Provide factory prefabricated metal covers for insulation on fittings, valves, and flanges. For services where vapor barrier is required, provide vapor retarder mastic as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with insulation bands at not more than 9 inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer.

D. Hangers and Anchors:

1. Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide insulation protection shields.

2. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, molded mineral fiber, rigid foam or other approved material, all minimum 15 psi compressive strength, of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable.

3. Where anchors are secured to piping carrying medium less than 60 degrees F that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

E. Through-Penetrations:

1. Where interior wall is penetrated, extend a stainless steel jacket 2 inches out on either side of wall and secure on each end with an insulation band. Where floor is penetrated, extend a stainless steel jacket from a point flush with the bottom of the floor slab to a point 10 inches above floor with one insulation band at the floor and one not more than 1 inch from end of stainless steel jacket. Where exterior wall is penetrated, extend stainless steel jacket through sleeve to a point 2 inches beyond interior surface of wall and secure on each end with an insulation band.

2. Provide insulation inserts beneath the stainless steel jacket. Insulation inserts shall be of calcium silicate or cellular glass of the same thickness as adjacent insulation. Insulation inserts shall cover full pipe circumference and be not less in length than the stainless steel jacket. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating.

F. Flanges, Unions, Valves and Fittings for Piping:

1. Factory fabricated removable and reusable insulation covers shall be used. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2-1/2 inches, elbows insulated using insulation segments shall not have less than three segments per elbow. Place and join segments with manufacturer's recommended water-vapor resistant, fire retardant adhesive appropriate for the temperature limit of the service. Overlap tape seams 1 inch. Total dry film thickness shall be not less than 1/16-inch. Unions are not to be insulated; taper insulation to union at a 45 degree angle.

2. PVC Fitting Covers: Install factory premolded one-piece PVC fitting covers over insulation.

3. Stainless Steel Fitting Covers: Install factory-fabricated one-piece fitting covers over insulation. Secure covers with no less than 3 insulation bands per cover.

G. Piping Exposed to Weather:

1. Stainless Steel Jackets: Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with insulation bands at not more than 9 inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Cover circumferential strips with butt joints, not less than 4 inches wide, of material identical to the jacket material. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

2. Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches.

**3.04 - FIELD QUALITY CONTROL**

A. Except as otherwise permitted herein, Plumbing systems shall be cleaned and tested prior to application of insulation. Obtain Engineer's approval of systems before applying field insulation. Visually inspect to ensure that insulation materials provided conform to Specifications. Inspect installation of insulation for compliance with requirements.

1. Piping systems shall not be insulated before systems pressure testing and related inspections.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

**See Attached Tables**

**TABLE 15420-1**
**INSULATION MATERIAL FOR PIPING**

| Service | Material | Spec | Type | Class | Vapor Barrier Required |
|---|---|---|---|---|---|
| Plumbing Domestic Hot Water & Tempered Water, and Recirculating Piping (Maximum 200 degrees F) | Mineral Fiber | ASTM C547 | I | | No |
| Plumbing Domestic Cold Water Piping and Service Water Piping | Mineral Fiber | ASTM C547 | I | | Yes<br>Yes |
| Water Cooler Drain Piping (to sewer tie-in) | Mineral Fiber | ASTM C547 | | 1 | Yes |

**TABLE 15420-2**
**PIPING INSULATION THICKNESS (INCH)**

| Service | Material | Tube and Pipe Size (Inches) | | | | |
|---|---|---|---|---|---|---|
| | | 1/8 - 7/8 | 1 – 1 1/4 | 1 1/2 - 3 | 4 – 6 | 8 – 10 |
| Plumbing Domestic Hot Water & Tempered Water, and Recirculating Piping (Maximum 140°F) | Mineral Fiber | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |
| Plumbing Domestic Cold Water Piping and Service Water Piping | Mineral Fiber | 1/2 | 1/2 | 1 | 1 | 1 |
| Water Cooler Drain Piping (to Sewer Tie-In) | Mineral Fiber | - | 1/2 | 1 | - | - |

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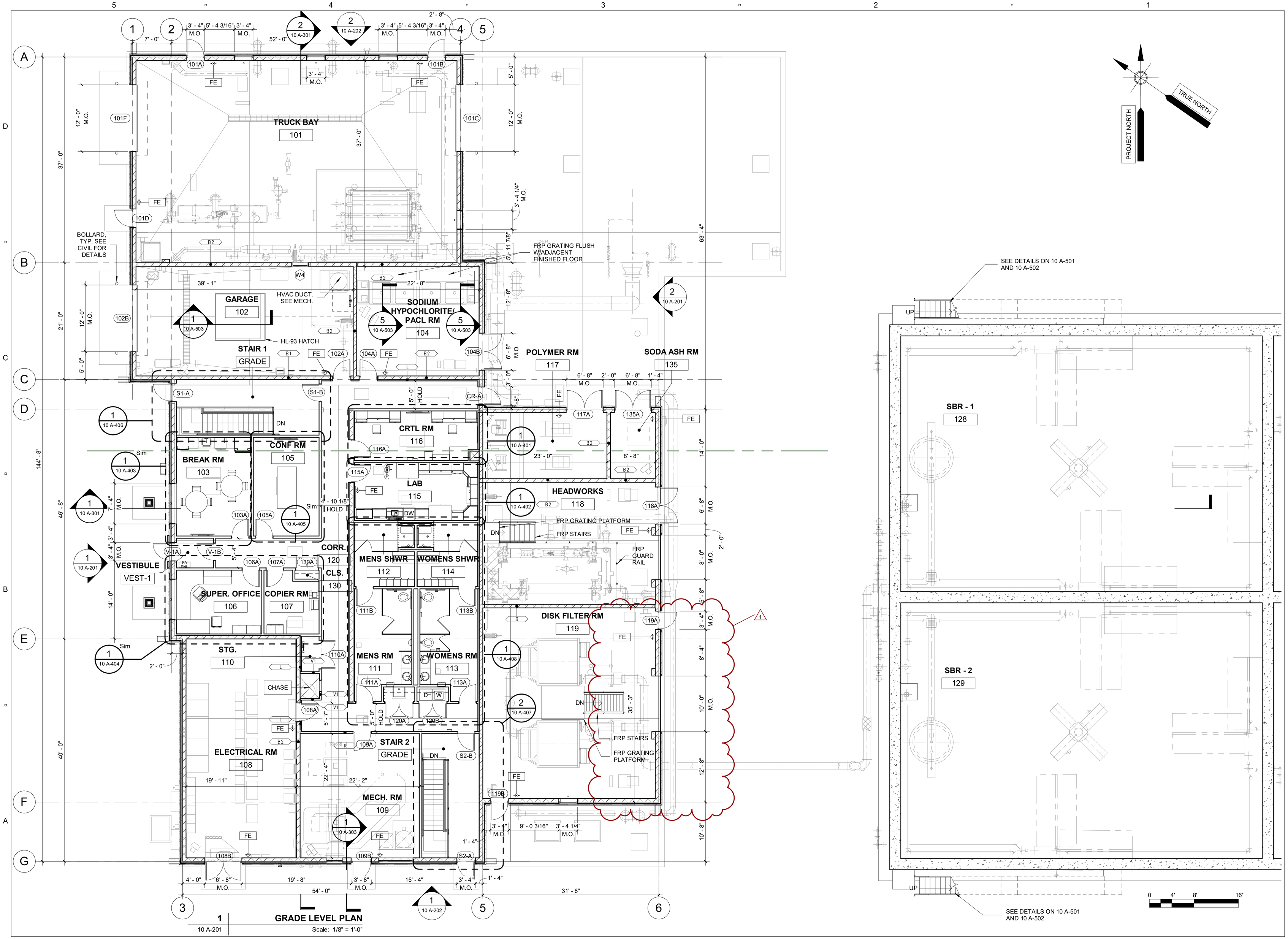



1 GRADE LEVEL PLAN
10 A-201 Scale: 1/8" = 1'-0"

PATH/FILENAME: BIM 360://CI-AMER (USA) 60587515-Orleans Downtown Area WWTF/10 Admin Building.rvt
PLOT DATE: 4/28/2020 1:27:55 PM

60587515

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND EFFLUENT DISPOSAL
CONTRACT No. 2019-01
SRF No. 4486

**OWNER**

TOWN OF ORLEANS

19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

REGISTERED ARCHITECT
COMMONWEALTH OF MASSACHUSETTS
1/7/2020

**ISSUE/REVISION**

| I/R | Date | Description |
|---|---|---|
| 1 | 4/27/2020 | FILTER WALL REV. |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. PICONE |
| Drawn By: | M.PICONE |
| Dept Check: | G. OTTERSON |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | 1/8" = 1'-0" |

**DISCIPLINE**

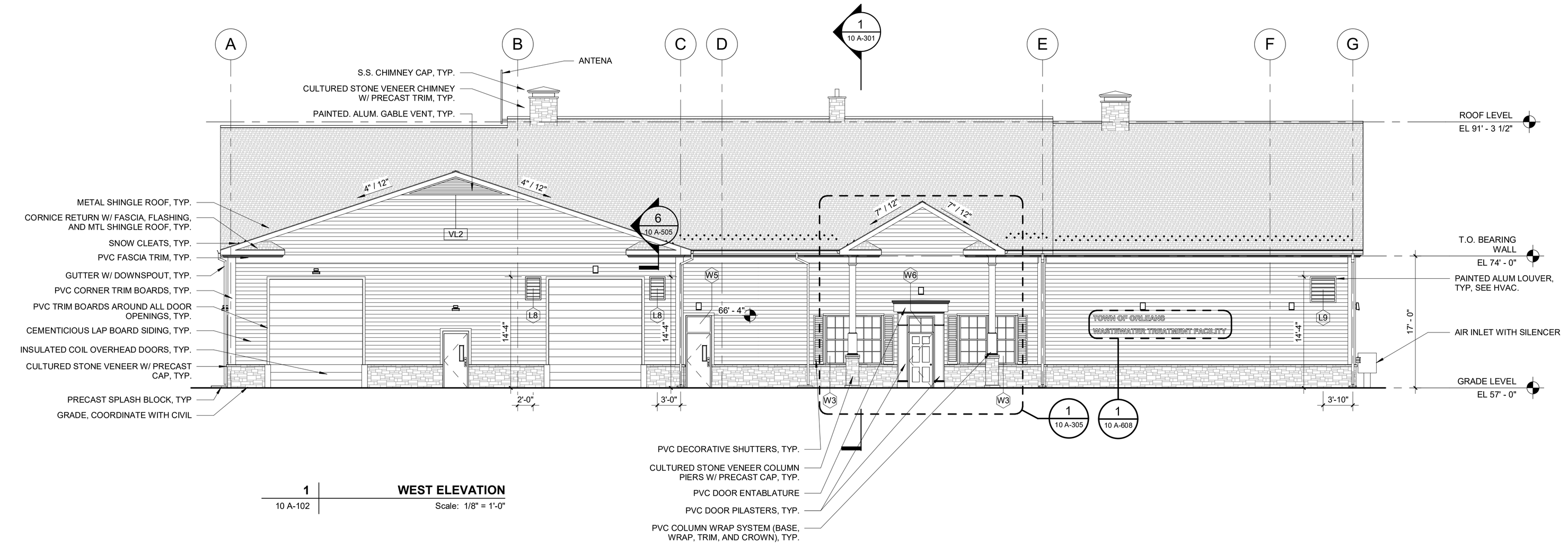
ARCHITECTURAL

**SHEET TITLE**

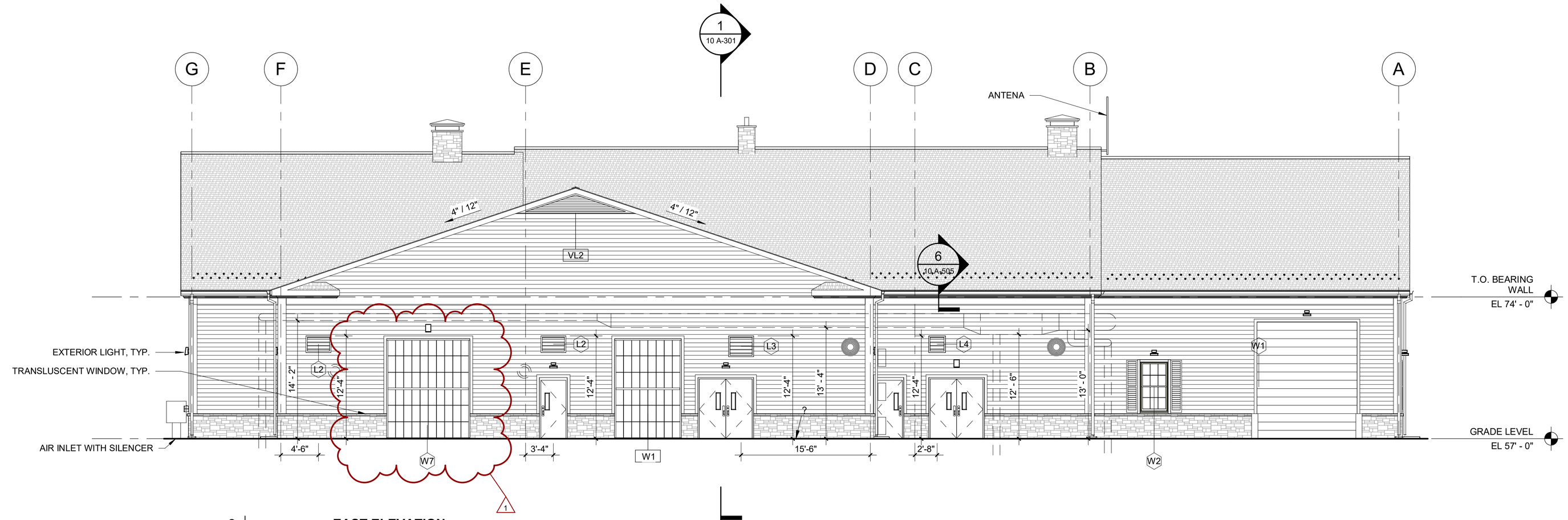
GRADE LEVEL PLAN

**SHEET NUMBER**

10 A-102




**1** | **WEST ELEVATION**
10 A-102 | Scale: 1/8" = 1'-0"




**2** | **EAST ELEVATION**
10 A-102 | Scale: 1/8" = 1'-0"

FOR TYPICAL NOTES SEE ELEVATION 1/10 A-201

0 4' 8' 16'

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PLOT DATE: 4/28/2020 1:27:59 PM

60587515

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND EFFLUENT DISPOSAL
CONTRACT No. 2019-01
SRF No. 4486

**OWNER**

TOWN OF ORLEANS

19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

REGISTERED ARCHITECT
RALPH RITTER
32200
CHELMSFORD
COMMONWEALTH OF MASSACHUSETTS
1/17/2020

**ISSUE/REVISION**

| | | |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| 1 | 4/27/2020 | FILTER WALL REV. |
| I/R | Date | Description |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. PICONE |
| Drawn By: | M.PICONE |
| Dept Check: | G. OTTERSON |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | 1/8" = 1'-0" |

**DISCIPLINE**

ARCHITECTURAL

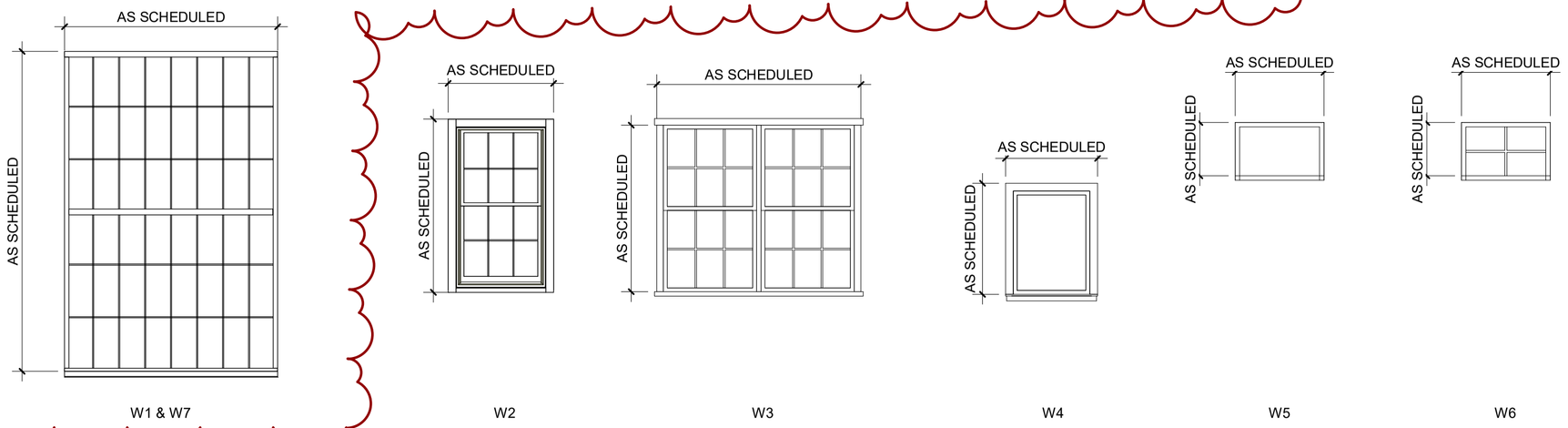
**SHEET TITLE**

# ELEVATIONS I

**SHEET NUMBER**

# 10 A-201

| WINDOW SCHEDULE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP | | | |
| TYPE | WIDTH | HEIGHT | MATERIAL | FINISH | GLAZING | HEAD | JAMB | SILL | COUNT |
| W1 | 8' - 0" | 12' - 0" | ALUM | ANOD | FIBERGLASS | TWH | TWJ-A/B | TWS | 1 |
| W2 | 3' - 4" | 6' - 0" | ALUM | ANOD | INSULATED | WH-1 | WJ-1 | WS-1 | 5 |
| W3 | 7' - 4" | 6' - 4" | ALUM | ANOD | INSULATED | WH-2 | WJ-2 | WS-2 | 2 |
| W4 | 3' - 0" | 4' - 0" | ALUM | ANOD | 3/4" FIRE RATED GLASS (90 MIN) | WH-3 | WJ-3 | WS-3 | 1 |
| W5 | 3' - 0" | 2' - 0" | ALUM | ANOD | INSULATED | DH-W1 | WJ-4 | DH-W1 | 1 |
| W6 | 3' - 0" | 2' - 0" | ALUM | ANOD | INSULATED | DH-W2 | WJ-5 | DH-W2 | 1 |
| W7 | 10' - 0" | 12' - 0" | ALUM | ANOD | FIBERGLASS | TWH | TWJ-A/B | TWS | 1 |




## WINDOW LEGEND

Scale: 1/4" = 1'-0"

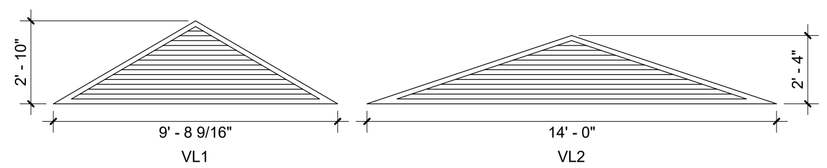
| No. | TYPE |
|---|---|
| 1 | 1/4" INTERIOR TEMPERED GLASS |
| 2 | 1" EXT INSULATED TEMPERED GLASS |
| 3 | 3/4" FIRE RATED GLASS (45 MIN) |
| 4 | 3/4" FIRE RATED GLASS (90 MIN) |

## GLASS SCHEDULE

Scale: 1/4" = 1'-0"

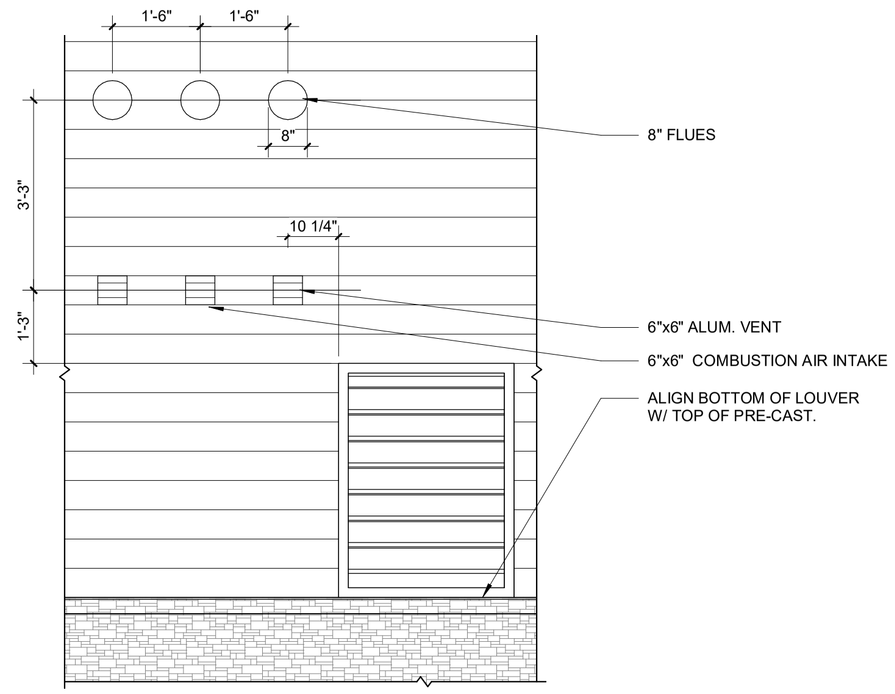
| HVAC LOUVER SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| | | | GROUP | | | |
| TYPE | WIDTH | HEIGHT | HEAD | JAMB | SILL | COUNT |
| L1 | 3' - 4" | 3' - 0" | LH-1 | LJ-1 | LS-1 | 2 |
| L2 | 3' - 0" | 2' - 0" | LH-1 | LJ-1 | LS-1 | 2 |
| L3 | 3' - 0" | 2' - 6" | LH-1 | LJ-1 | LS-1 | 1 |
| L4 | 2' - 0" | 2' - 0" | LH-1 | LJ-1 | LS-1 | 2 |
| L5 | 6' - 0" | 2' - 0" | LH-1 | LJ-1 | LS-1 | 1 |
| L6 | 3' - 0" | 4' - 0" | LH-1 | LJ-1 | LS-1 | 1 |
| L7 | 6' - 3" | 12' - 10" | LH-1 | LJ-1 | LS-1 | 1 |
| L8 | 2' - 0" | 3' - 0" | LH-1 | LJ-1 | LS-1 | 2 |
| L9 | 3' - 4" | 3' - 4" | LH-1 | LJ-1 | LS-1 | 1 |

| GABLE LOUVER SCHEDULE | | | |
|---|---|---|---|
| Family | Volume | Type Mark | Count |
| Gable_Louver_Vent | 1.41 CF | VL1 | 2 |
| Gable_Louver_Vent | 1.73 CF | VL2 | 2 |




## GABLE LOUVER LEGEND

Scale: 1/4" = 1'-0"




NOTE: SEE HVAC DRAWINGS

## 1 MECH. RM. INTAKES, FLUES

10 A-202

Scale: 1/2" = 1'-0"

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND EFFLUENT
DISPOSAL
CONTRACT No. 2019-01
SRF No. 4486

**OWNER**

TOWN OF ORLEANS

19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

REGISTERED ARCHITECT
WILLIAM BITTERS
No. 32
CHELSEA, MA
COMMONWEALTH OF MASSACHUSETTS
1/17/2020

**ISSUE/REVISION**

| I/R | Date | Description |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| 1 | 4/27/2020 | FILTER WALL REV. |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | M. PICONE |
| Drawn By: | L.TIBBITTS |
| Dept Check: | G. OTTERSON |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | As indicated |

**DISCIPLINE**

ARCHITECTURAL

**SHEET TITLE**

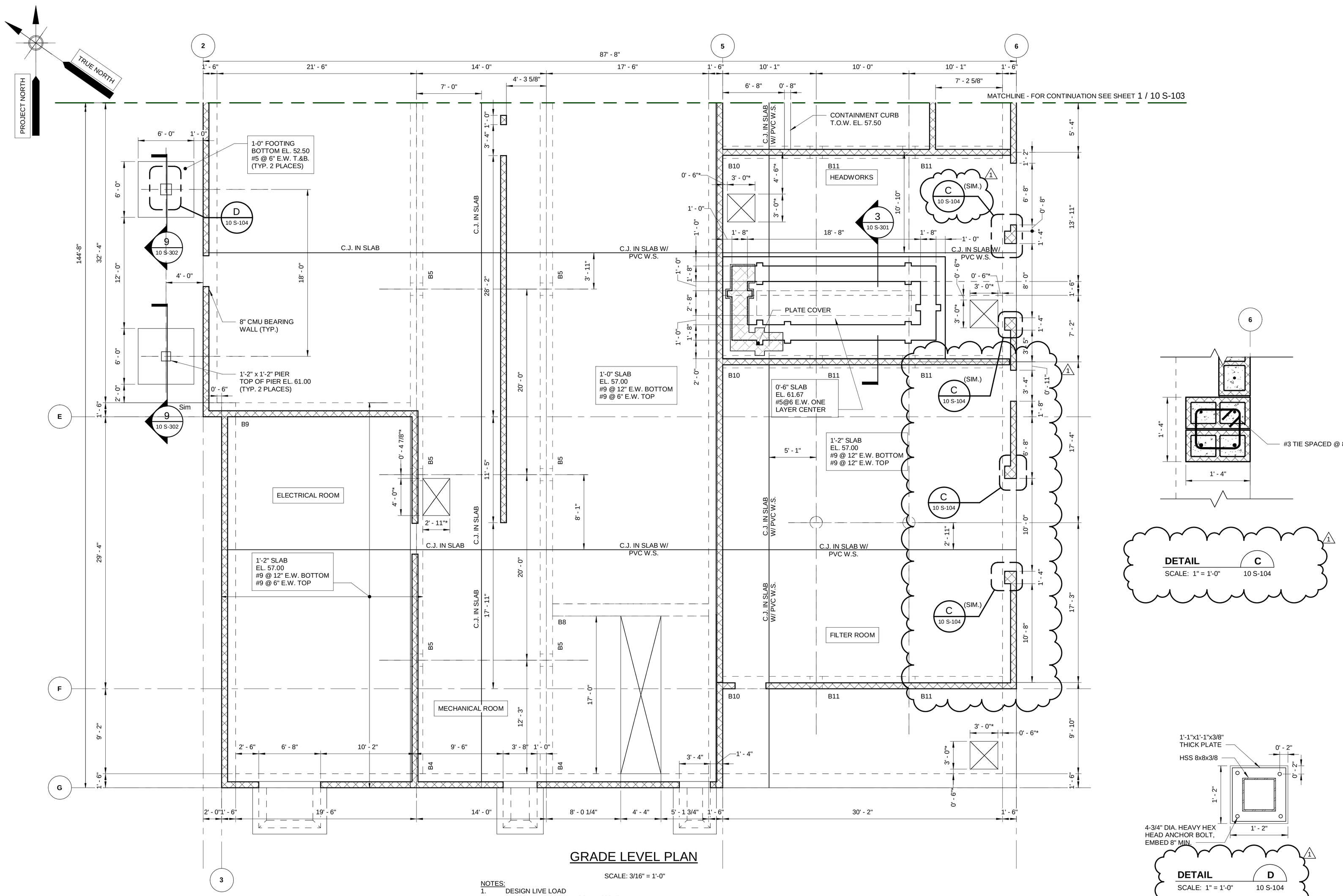
# WINDOW AND LOUVER SCHEDULES

**SHEET NUMBER**

# 10 A-603

PATH/FILENAME: BIM 360://CI-AMER (USA) 60587515-Orleans Downtown Area WWTF/10 Admin Building.rvt
PLOT DATE: 4/28/2020 1:27:59 PM

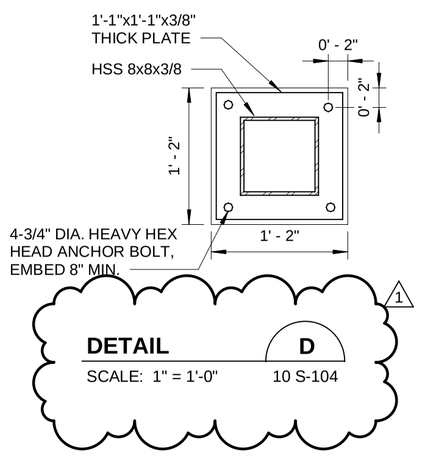
60587515







DETAIL C
SCALE: 1" = 1'-0" 10 S-104




DETAIL D
SCALE: 1" = 1'-0" 10 S-104

## GRADE LEVEL PLAN

SCALE: 3/16" = 1'-0"

NOTES:
1. DESIGN LIVE LOAD
   - A. ELECTRICAL ROOM = 300PSF
   - B. TRUCK BAY, GARAGE, AND EXTERIOR SLABS = 250PSF OR HL93 TRUCK LOAD
   - C. PROCESS AREAS = 250PSF
2. ALL OTHER AREAS = 125PSF
3. SEE SHEET 10 S-501 FOR BEAM SCHEDULE

* COORDINATE LOCATION AND SIZE OF OPENING WITH EQUIPMENT PURCHASED

| MASONRY WALL REINFORCEMENT | | | | |
|---|---|---|---|---|
| WALL THICKNESS | MAXIMUM WALL HEIGHT | BOND BEAM W/ 2-#5 SPACING | HORIZONTAL REINFORCEMENT | VERTICAL REINFORCEMENT |
| 8" CMU | 18'-0" | 4'-0" | 3 - 9 ga. @16" | #5 @ 24" |

SCALE: 1" = 1'-0"

SCALE: 3/16" = 1'-0"

PATH/FILENAME: BIM 360://CI-AMER (USA) 60587515-Orleans Downtown Area WWTF/10 S-WWTF.rvt
PLOT DATE: 4/27/2020 10:47:54 AM

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND EFFLUENT
DISPOSAL
CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA

19 SCHOOL ROAD
ORLEANS, MA
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 4/27/2020 | FILTER WALL REV. |
| | | |
| | | |
| | | |
| | | |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | J. WELCH |
| Drawn By: | J. WELCH |
| Dept Check: | M. MALENFANT |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2019 |
| Scale: | AS NOTED |

**DISCIPLINE**

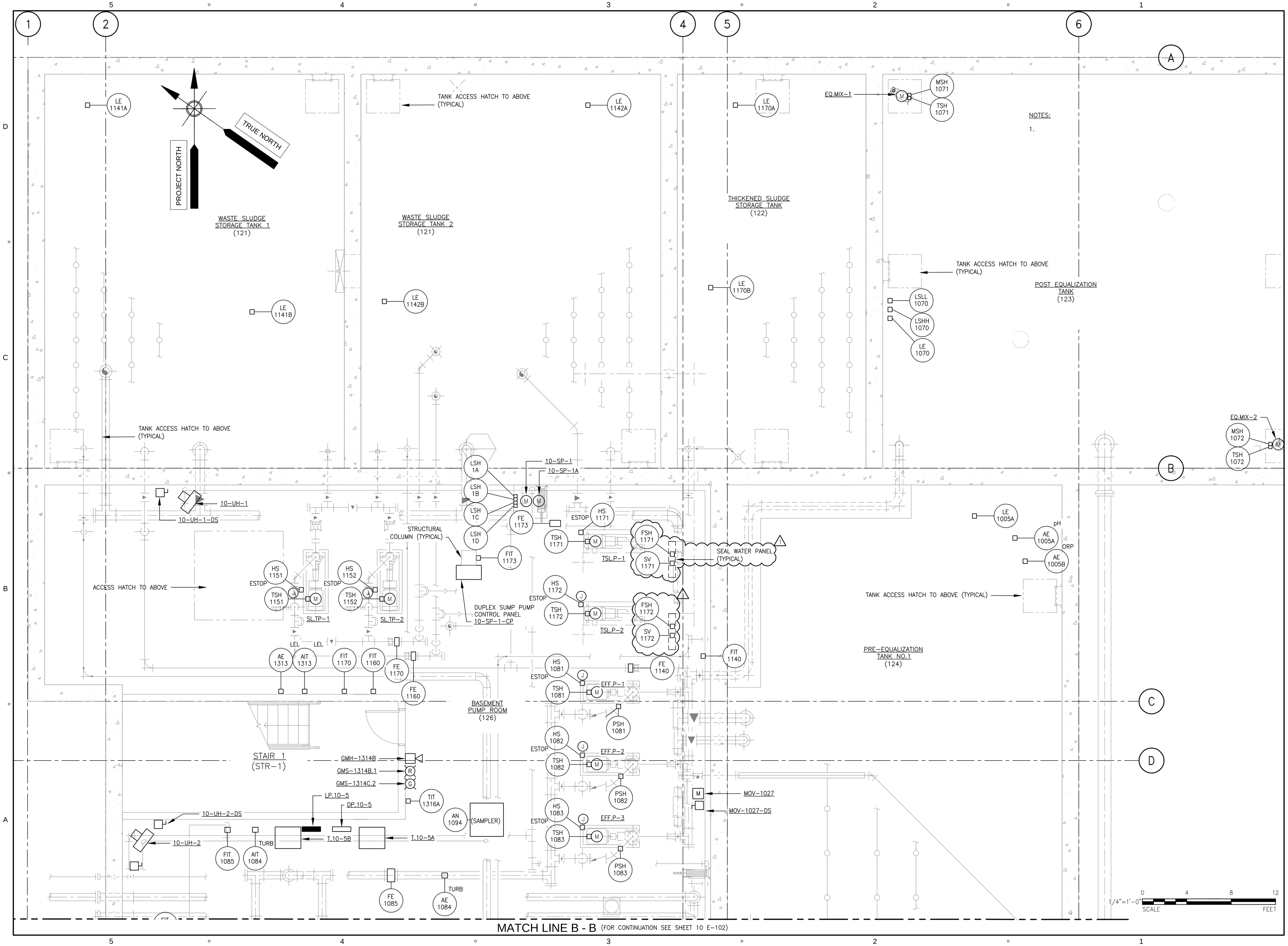
STRUCTURAL

**SHEET TITLE**

GRADE LEVEL PLAN II

**SHEET NUMBER**

10 S-104




NOTES:

1.

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEET\SE\10 E-101.DWG
LAST UPDATE: Thursday, April 30, 2020 8:53:24 AM
PLOT DATE: Thursday, April 30, 2020 12:07:36 PM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 04-30-2020 | ADDENDUM 9 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

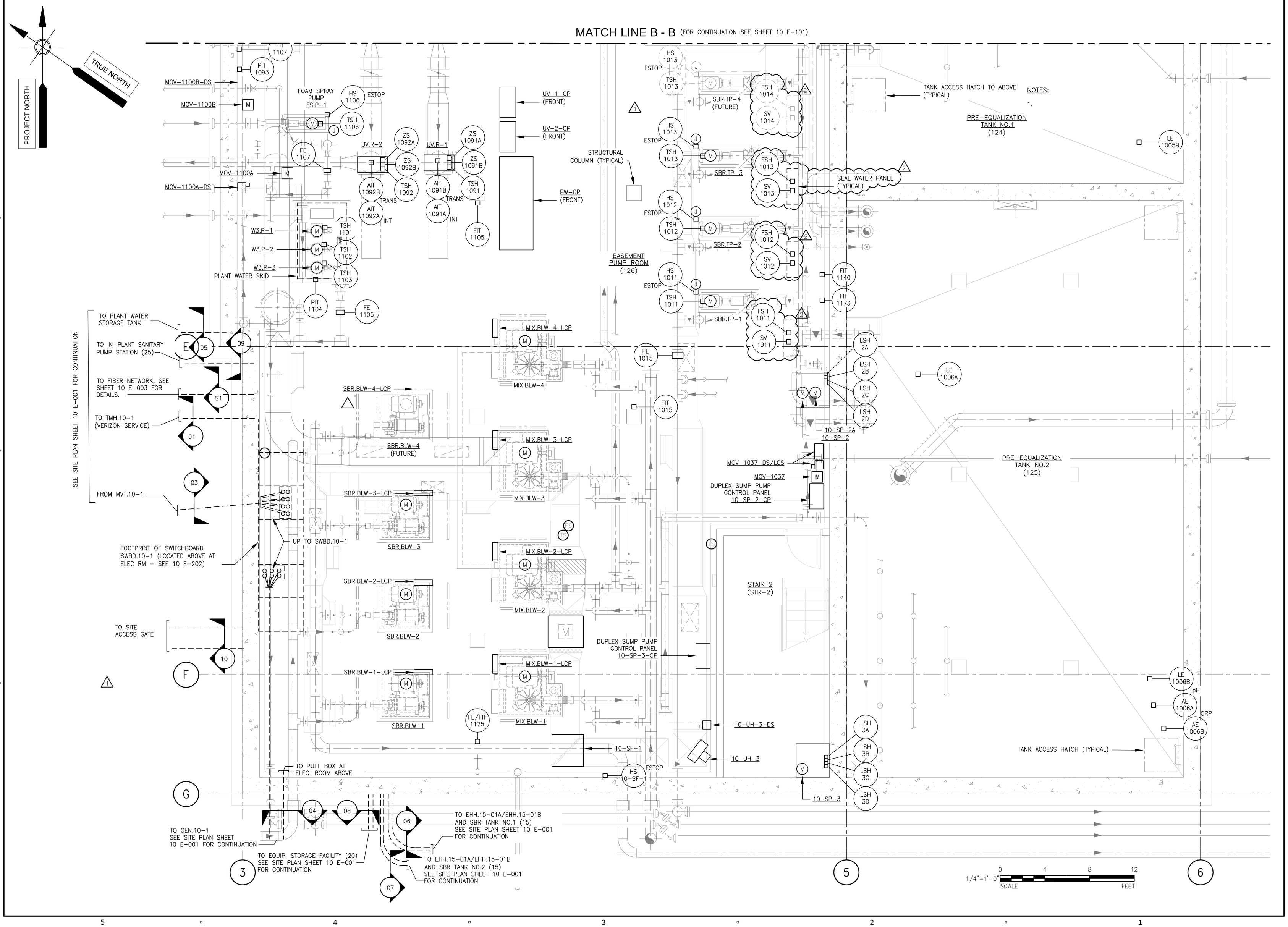
ELECTRICAL

**SHEET TITLE**

# WWTF - LOWER LEVEL - POWER PLAN I

**SHEET NUMBER**

# 10 E-101





AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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PHONE: (508) 833-6950
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**REGISTRATION**


**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 2 | 04-30-2020 | ADDENDUM 9 |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

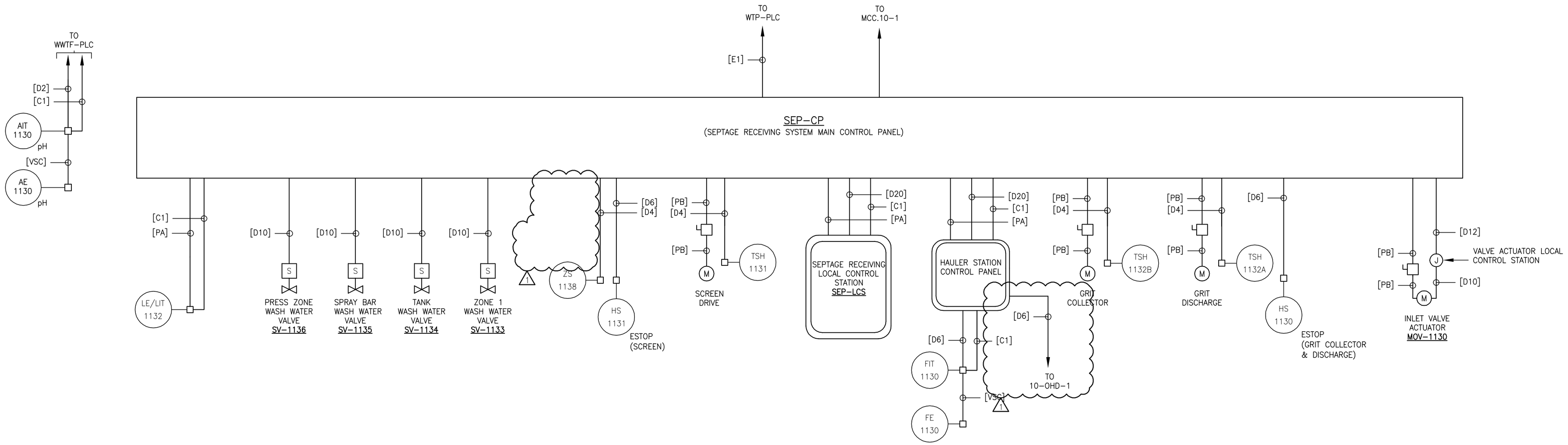
**SHEET TITLE**

# WWTF - LOWER LEVEL - POWER PLAN II

**SHEET NUMBER**

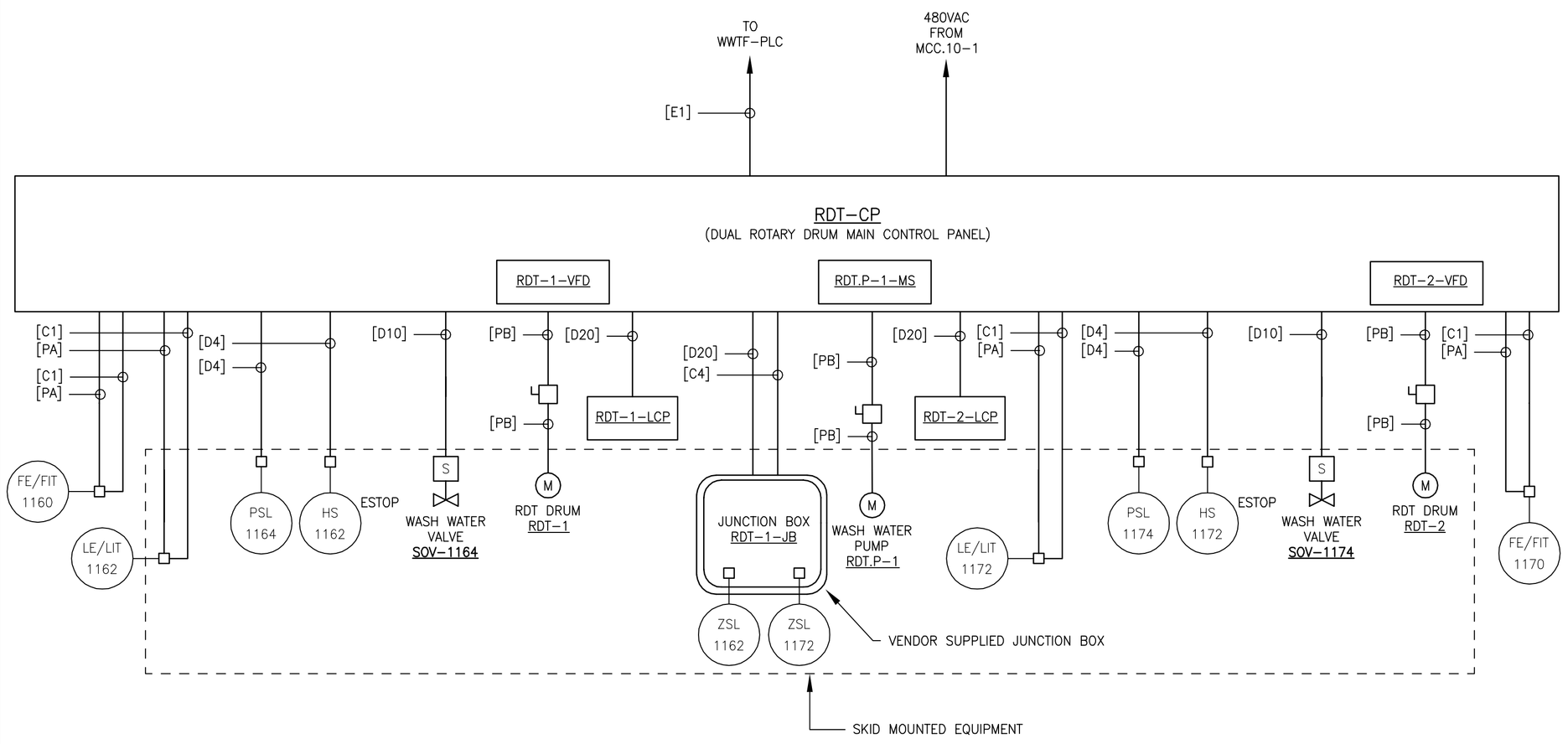
# 10 E-102


PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-102.DWG
LAST UPDATE: Thursday, April 30, 2020 9:24:53 AM
PLOT DATE: Thursday, April 30, 2020 12:07:49 PM



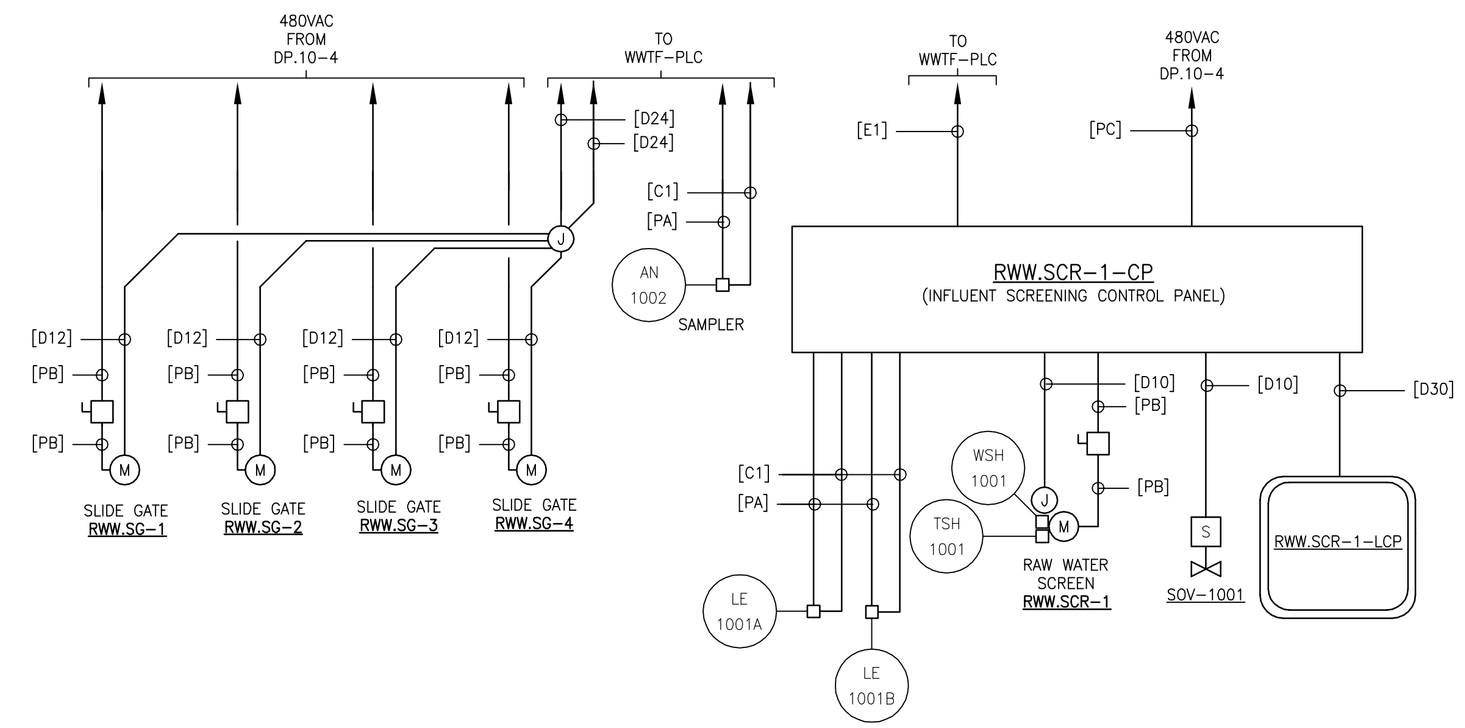

## SEPTAGE RECEIVING SYSTEM - RISER DIAGRAMS

NTS




## ROTARY DRUM THICKENER - RISER DIAGRAM

NTS




## HEADWORKS - RISER DIAGRAMS

NTS

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LAST UPDATE: Thursday, April 30, 2020 12:04:15 PM
PLOT DATE: Thursday, April 30, 2020 12:07:57 PM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 04-30-2020 | ADDENDUM 9 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

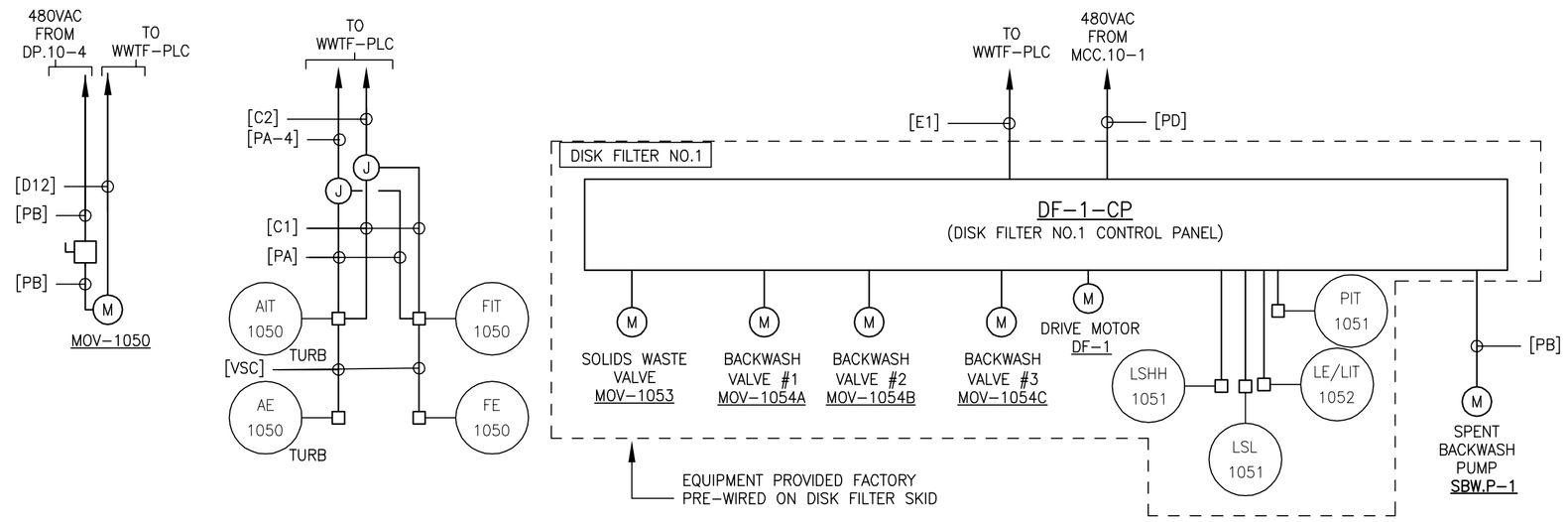
ELECTRICAL

**SHEET TITLE**

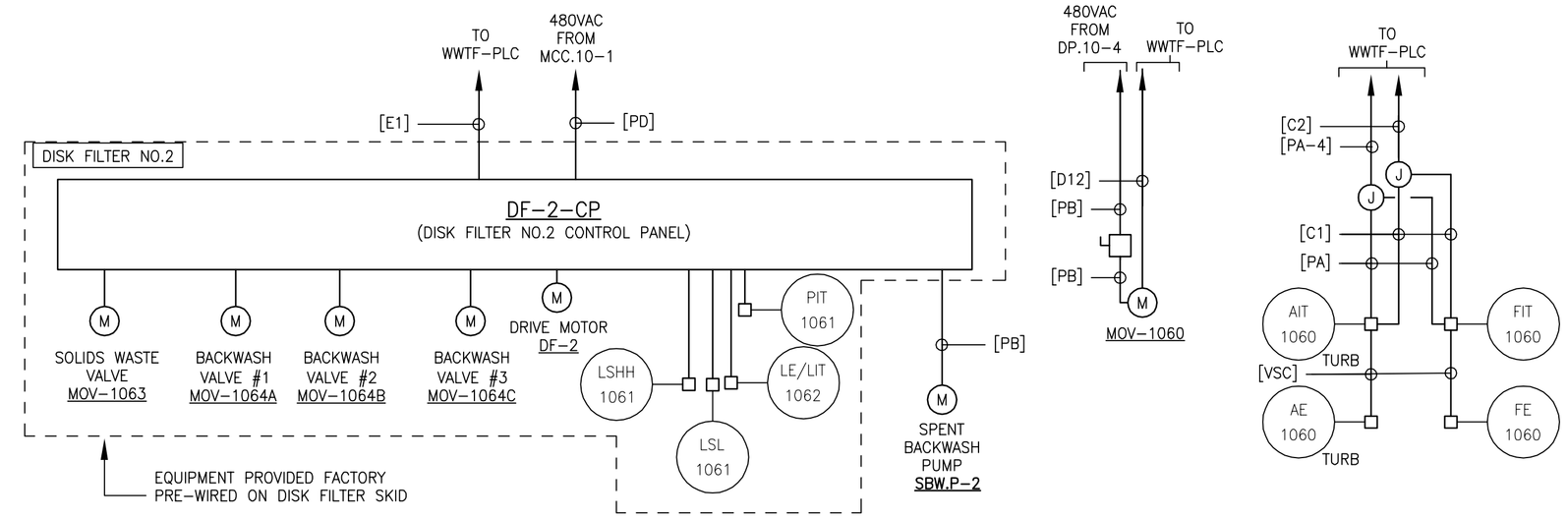
# WWTF - ELECTRICAL RISER DIAGRAMS III

**SHEET NUMBER**

# 10 E-606



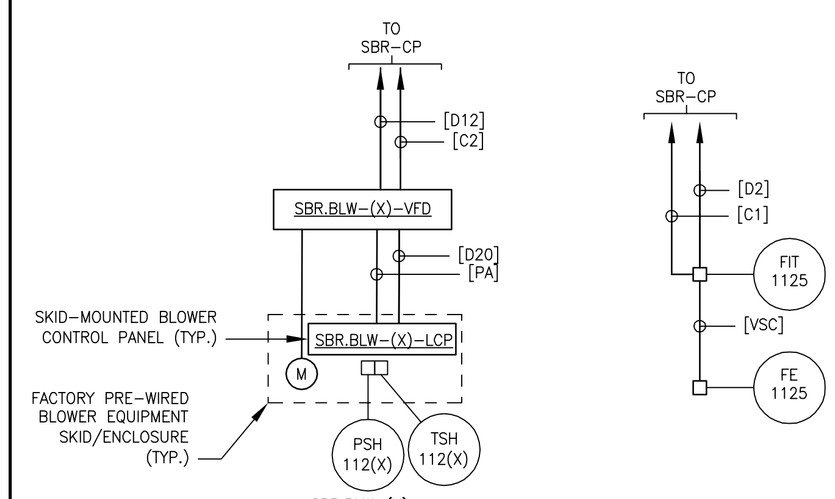

DISK FILTER NO.1 - RISER DIAGRAM




DISK FILTER NO.2 - RISER DIAGRAM

# DISK FILTERS - RISER DIAGRAMS

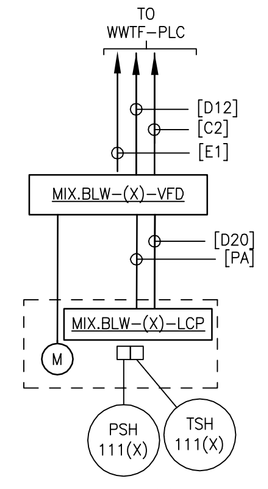
NTS




SBR.BLW–(X)
SBR BLOWER NO.(X)

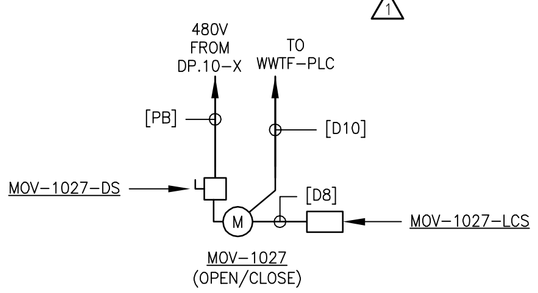
| SBR BLOWER SBR.BLW–(X) | SBR BLOWER VFD SBR.BLW–(X)–VFD | LOCAL CONTROL PANEL SBR.BLW–(X)–LCP | TSH–112(X), PSH–112(X) | ESTOP HS–112(X) |
|---|---|---|---|---|
| SBR.BLW–1 | SBR.BLW–1–VFD | SBR.BLW–1–LCP | 1121 | 1121 |
| SBR.BLW–2 | SBR.BLW–2–VFD | SBR.BLW–2–LCP | 1122 | 1122 |
| SBR.BLW–3 | SBR.BLW–3–VFD | SBR.BLW–3–LCP | 1123 | 1123 |
| SBR.BLW–4 (FUTURE) | SBR.BLW–4–VFD | SBR.BLW–4–LCP | 1124 | 1124 |

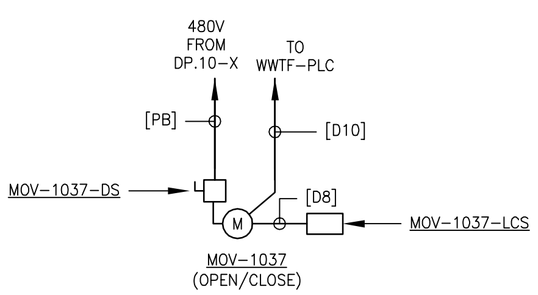



MIX.BLW–(X)
MIX BLOWER NO.(X)

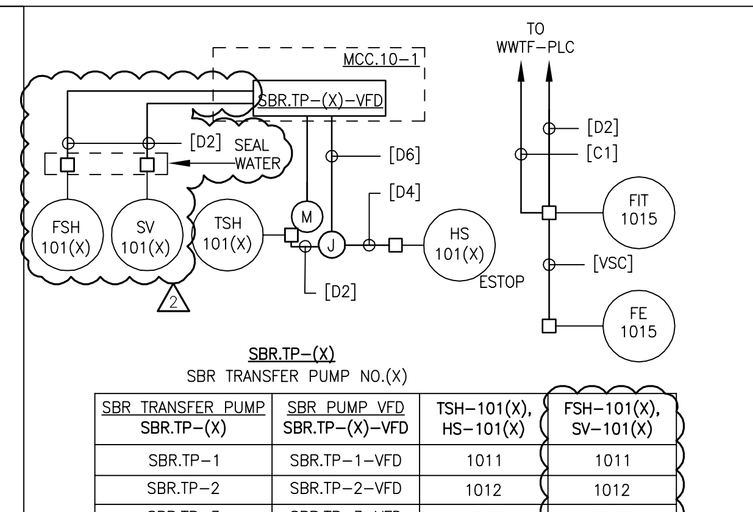
| MIX BLOWER MIX.BLW–(X) | MIX BLOWER VFD MIX.BLW–(X) | LOCAL CONTROL PANEL MIX.BLW–(X)–LCP | TSH–111(X), PSH–111(X) | ESTOP HS–111(X) |
|---|---|---|---|---|
| MIX.BLW–1 | MIX.BLW–1–VFD | MIX.BLW–1–LCP | 1111 | 1111 |
| MIX.BLW–2 | MIX.BLW–2–VFD | MIX.BLW–2–LCP | 1112 | 1112 |
| MIX.BLW–3 | MIX.BLW–3–VFD | MIX.BLW–3–LCP | 1113 | 1113 |
| MIX.BLW–4 | MIX.BLW–4–VFD | MIX.BLW–4–LCP | 1114 | 1114 |



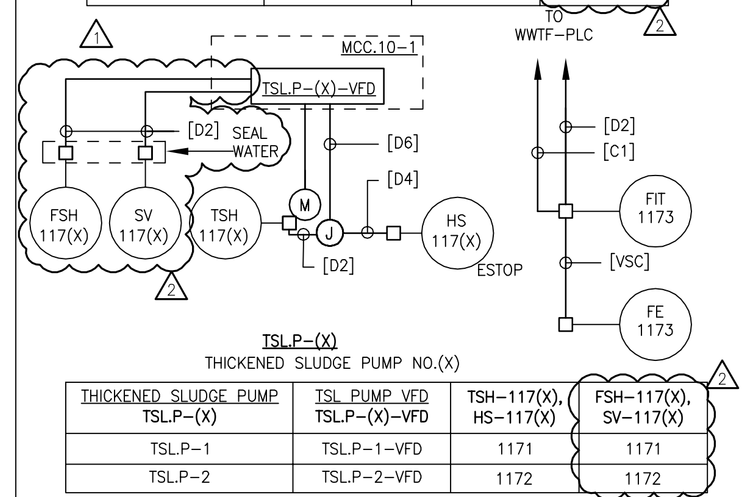

## WWTF BLOWERS - RISER DIAGRAMS

NTS



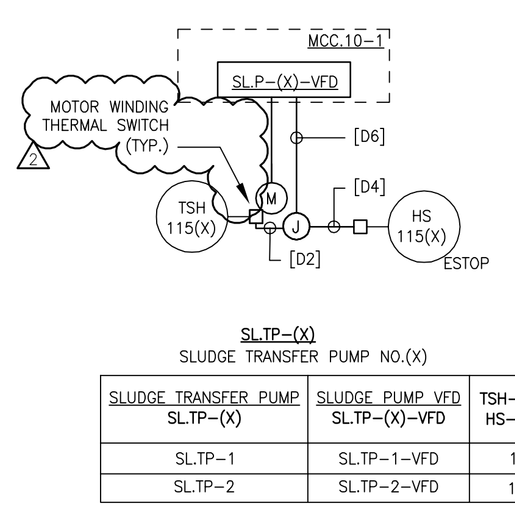

SBR.TP–(X)
SBR TRANSFER PUMP NO.(X)

| SBR TRANSFER PUMP SBR.TP–(X) | SBR PUMP VFD SBR.TP–(X)–VFD | TSH–101(X), HS–101(X) | FSH–101(X), SV–101(X) |
|---|---|---|---|
| SBR.TP–1 | SBR.TP–1–VFD | 1011 | 1011 |
| SBR.TP–2 | SBR.TP–2–VFD | 1012 | 1012 |
| SBR.TP–3 | SBR.TP–3–VFD | 1013 | 1013 |
| SBR.TP–4 (FUTURE) | SBR.TP–4–VFD | 1014 | 1014 |



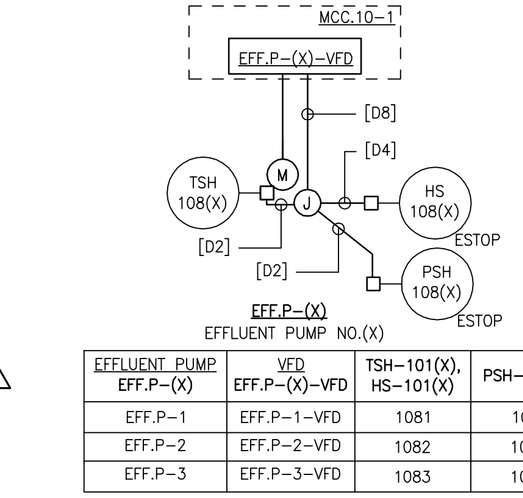

TSL.P–(X)
THICKENED SLUDGE PUMP NO.(X)

| THICKENED SLUDGE PUMP TSL.P–(X) | TSL PUMP VFD TSL.P–(X)–VFD | TSH–117(X), HS–117(X) | FSH–117(X), SV–117(X) |
|---|---|---|---|
| TSL.P–1 | TSL.P–1–VFD | 1171 | 1171 |
| TSL.P–2 | TSL.P–2–VFD | 1172 | 1172 |



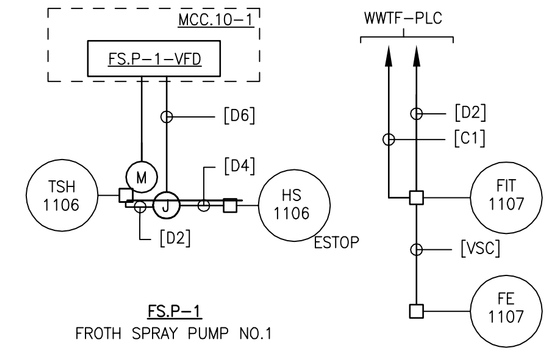

SL.TP–(X)
SLUDGE TRANSFER PUMP NO.(X)

| SLUDGE TRANSFER PUMP SL.TP–(X) | SLUDGE PUMP VFD SL.TP–(X)–VFD | TSH–115(X), HS–115(X) |
|---|---|---|
| SL.TP–1 | SL.TP–1–VFD | 1151 |
| SL.TP–2 | SL.TP–2–VFD | 1152 |

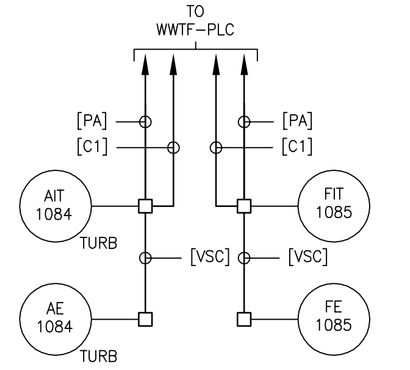



EFF.P–(X)
EFFLUENT PUMP NO.(X)

| EFFLUENT PUMP EFF.P–(X) | VFD EFF.P–(X)–VFD | TSH–101(X), HS–101(X) | PSH–101(X) |
|---|---|---|---|
| EFF.P–1 | EFF.P–1–VFD | 1081 | 1081 |
| EFF.P–2 | EFF.P–2–VFD | 1082 | 1082 |
| EFF.P–3 | EFF.P–3–VFD | 1083 | 1083 |




FS.P–1
FROTH SPRAY PUMP NO.1




## WWTF PUMPS - RISER DIAGRAMS

NTS

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

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9 JONATHAN BOURNE DRIVE
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www.aecom.com

**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 2 | 04-30-2020 | ADDENDUM 9 |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

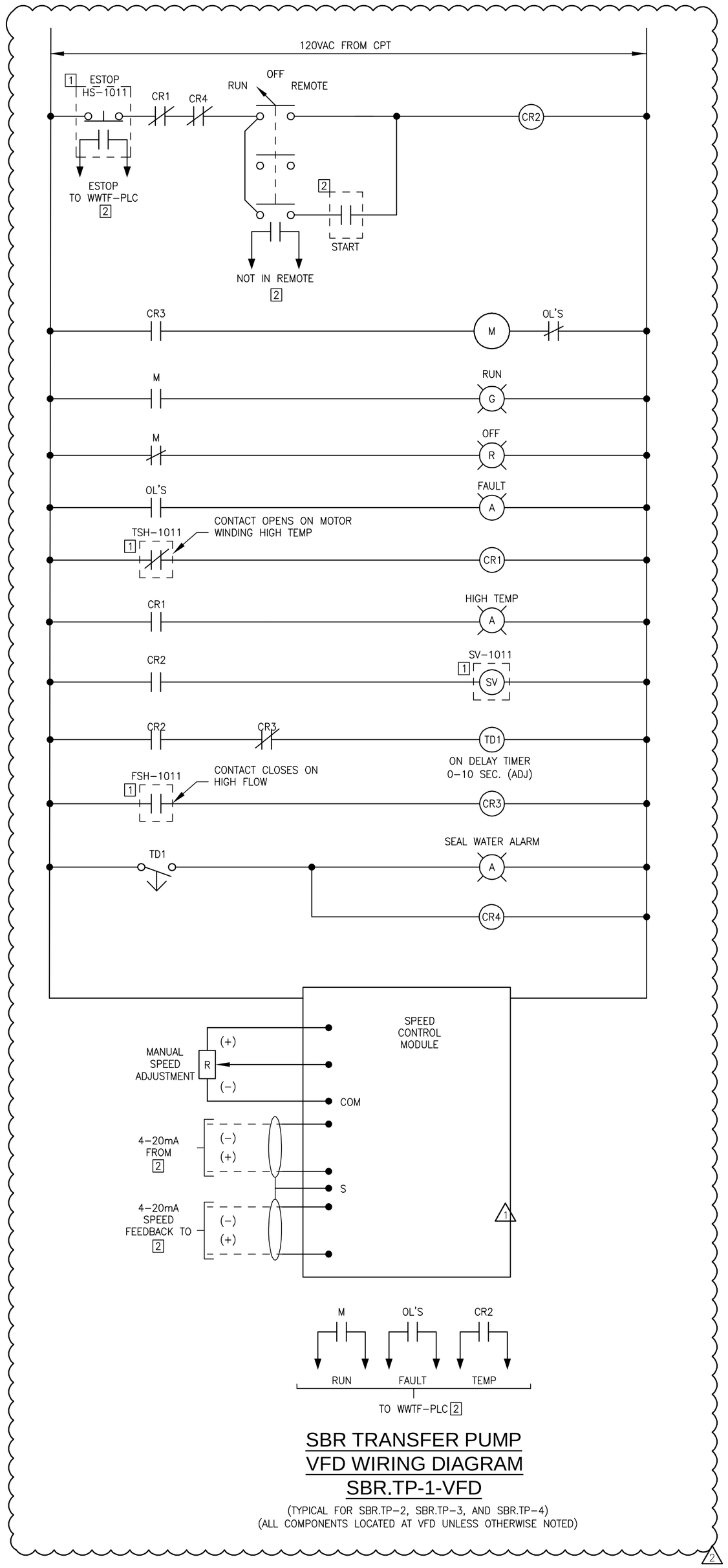
**SHEET TITLE**

**WWTF - ELECTRICAL RISER DIAGRAMS IV**

**SHEET NUMBER**

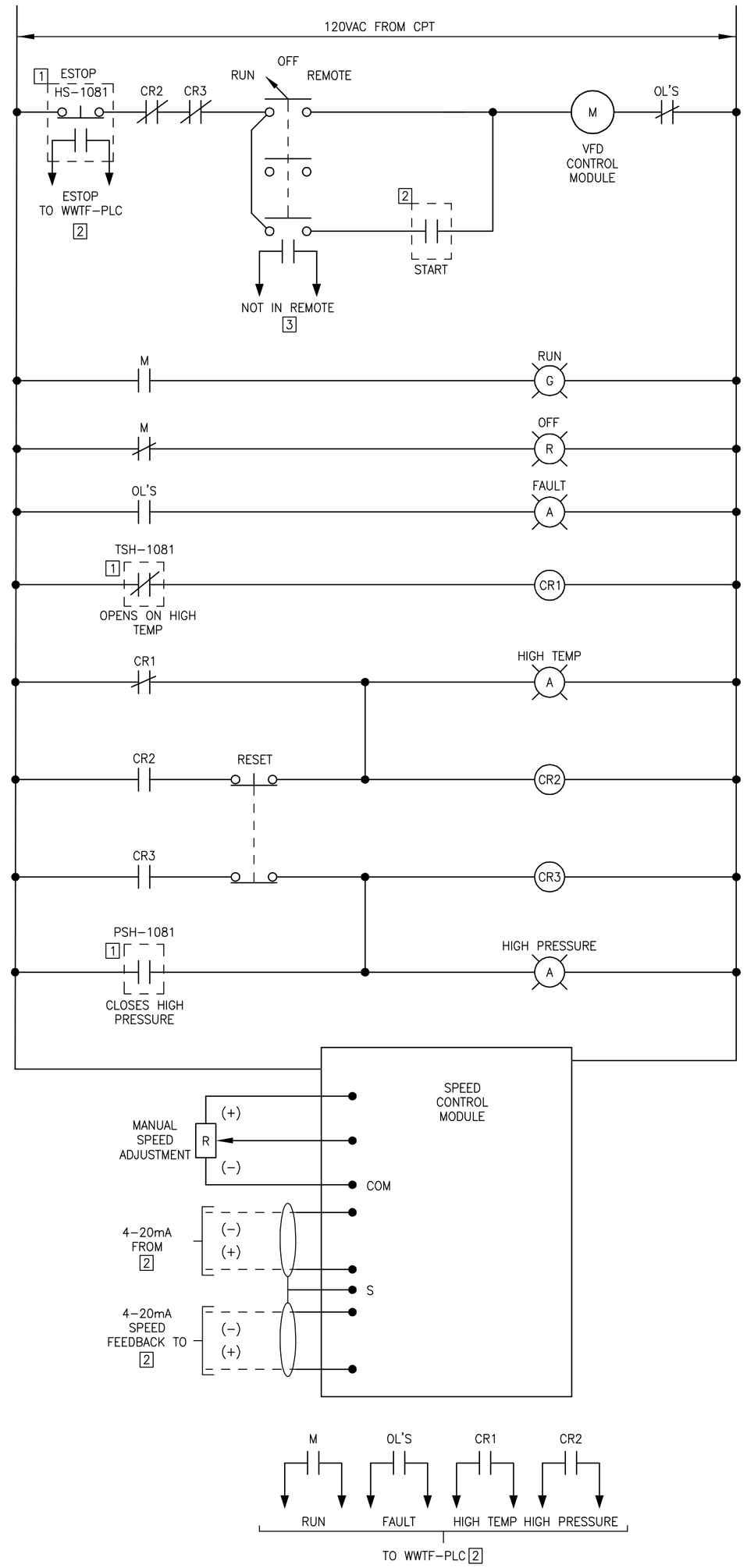
**10 E-607**

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E10 E-607.DWG
LAST UPDATE: Thursday, April 30, 2020 10:47:38 AM
PLOT DATE: Thursday, April 30, 2020 12:08:06 PM




SBR TRANSFER PUMP
VFD WIRING DIAGRAM
SBR.TP-1-VFD

(TYPICAL FOR SBR.TP-2, SBR.TP-3, AND SBR.TP-4)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)




EFFLUENT PUMP
VFD WIRING DIAGRAM
EFF.P-1-VFD

(TYPICAL OF EFF.P-2/3)
(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)

LEGEND

| | |
|---|---|
| 1 | DEVICE LOCATED AT EQUIPMENT |
| 2 | FROM/TO WWTF-PLC |
| 3 | FROM/TO SBR-CP |
| 4 | FROM/TO 10-ATC-1 |
| 5 | FROM/TO 20-ATC-1 |

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10 E-614.DWG
LAST UPDATE: Thursday, April 30, 2020 11:59:34 AM
PLOT DATE: Thursday, April 30, 2020 12:08:20 PM

AECOM

**PROJECT**

DOWNTOWN AREA
WWTF AND
EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| 2 | 04-30-2020 | ADDENDUM 9 |
| 1 | 03-24-2020 | ADDENDUM 7 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

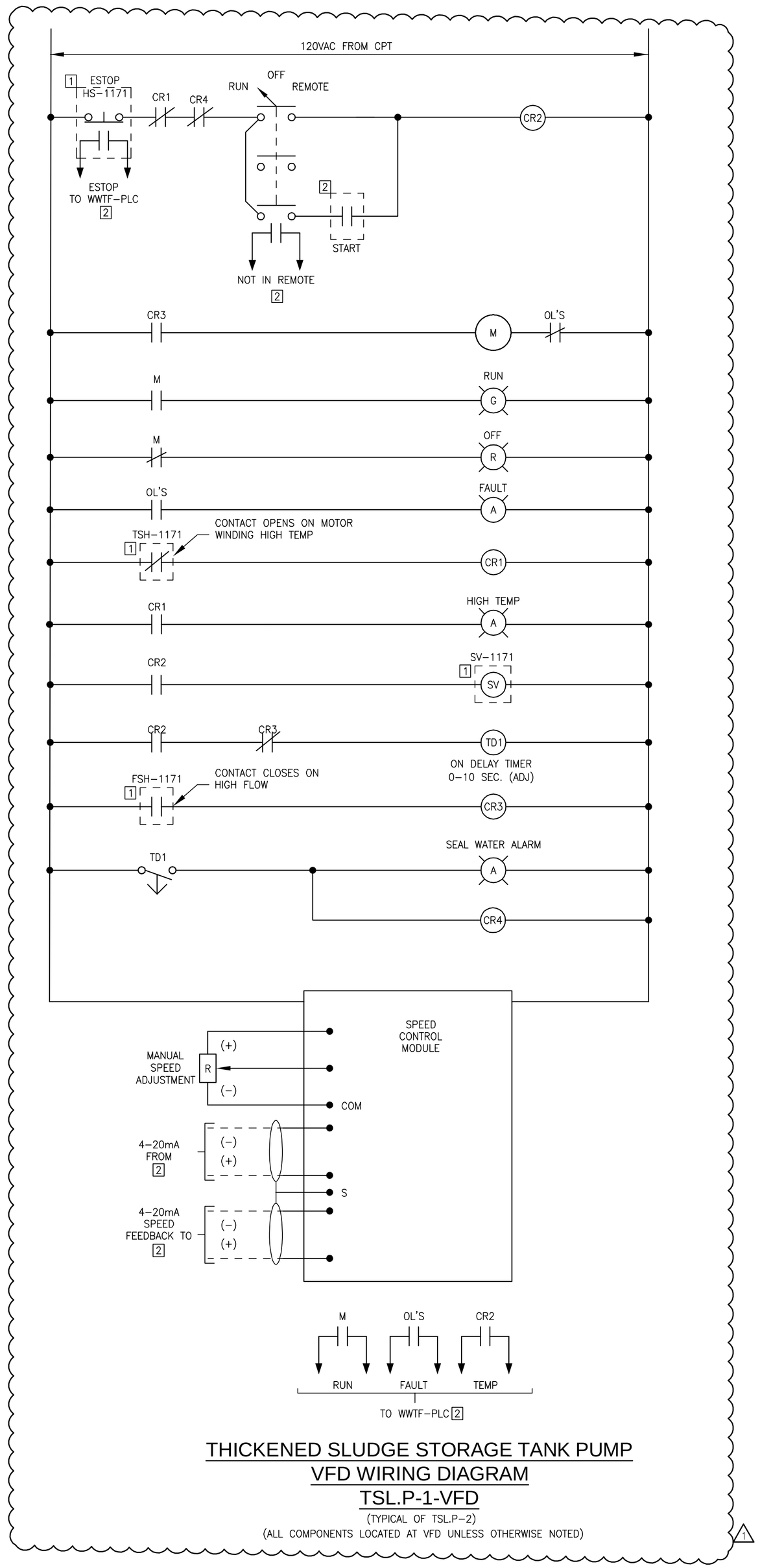
ELECTRICAL

**SHEET TITLE**

**WWTF - ELECTRICAL WIRING SCHEMATICS II**

**SHEET NUMBER**

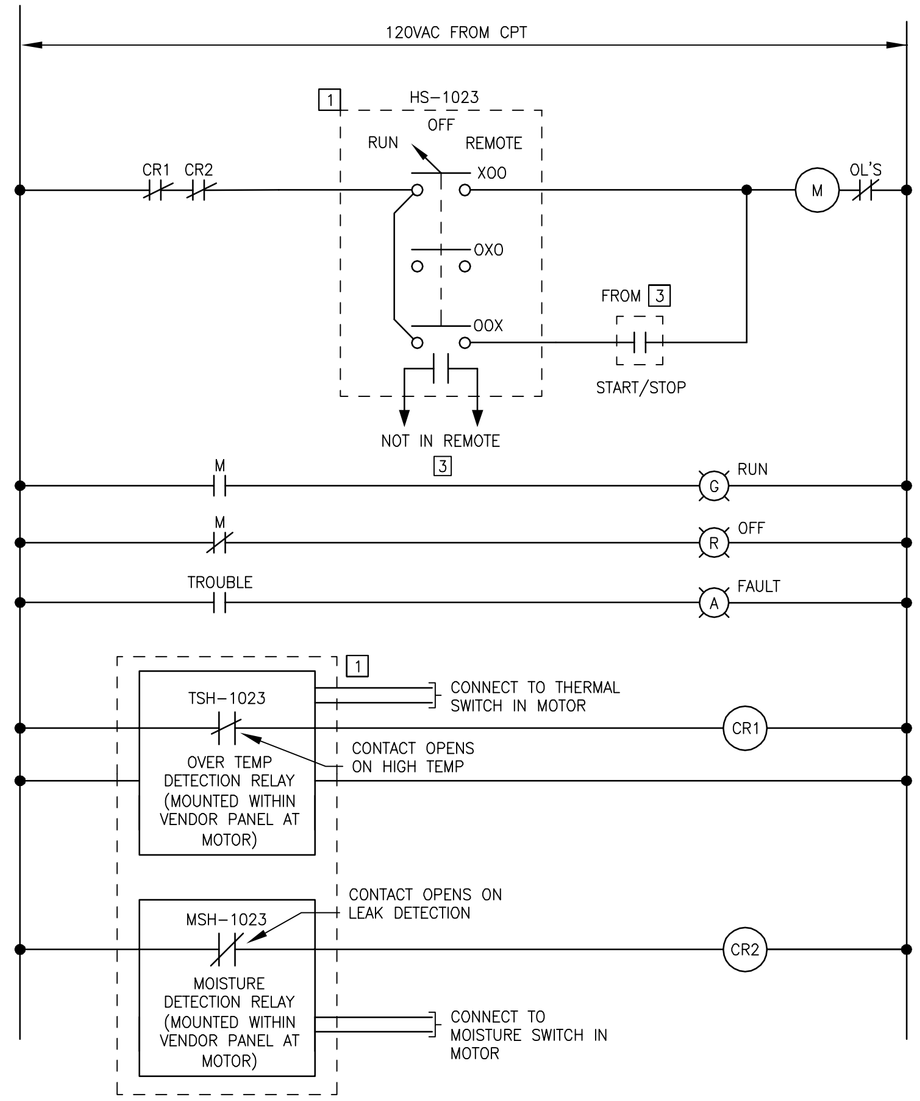
**10 E-614**

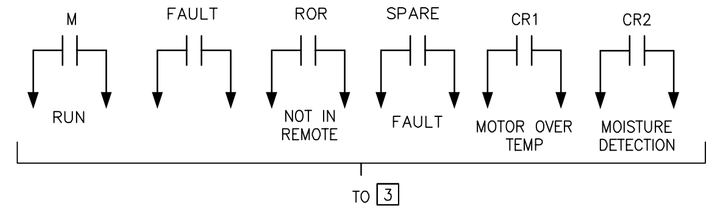



## THICKENED SLUDGE STORAGE TANK PUMP VFD WIRING DIAGRAM TSL.P-1-VFD

(TYPICAL OF TSL.P-2)

(ALL COMPONENTS LOCATED AT VFD UNLESS OTHERWISE NOTED)

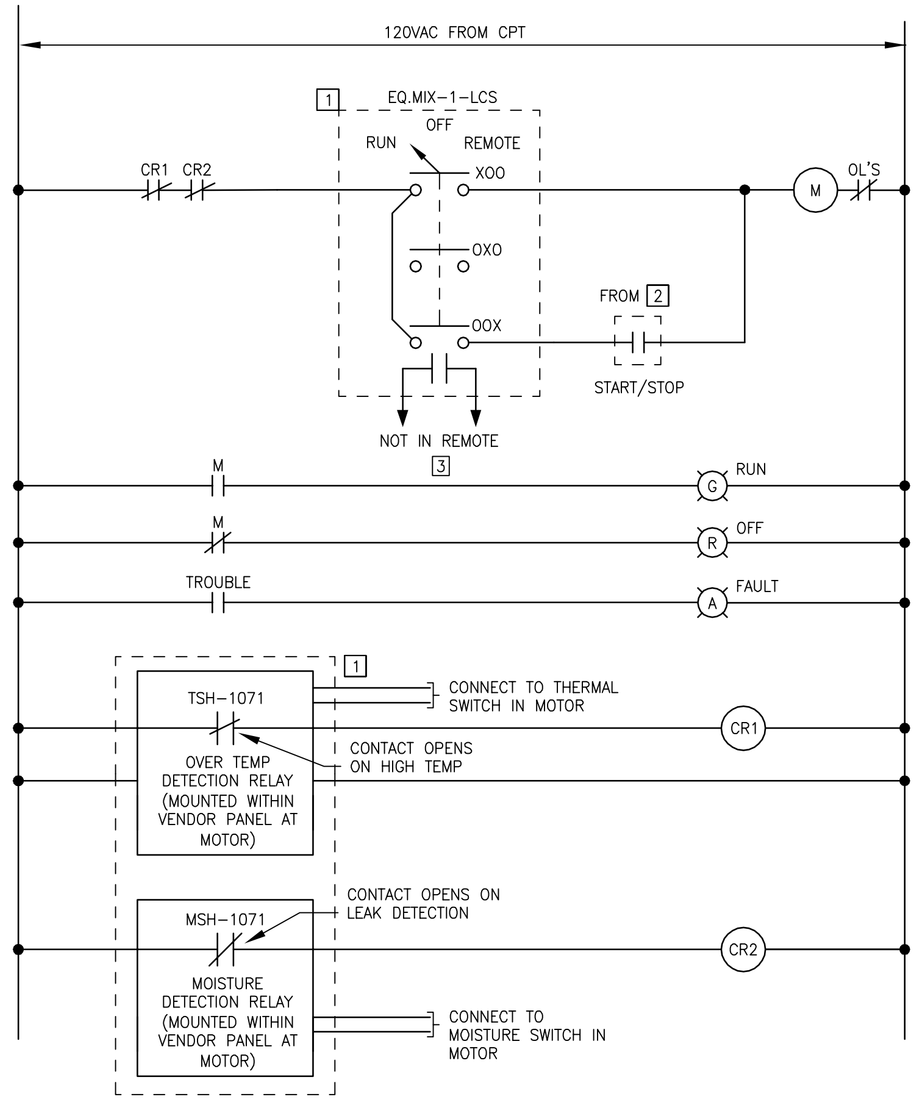


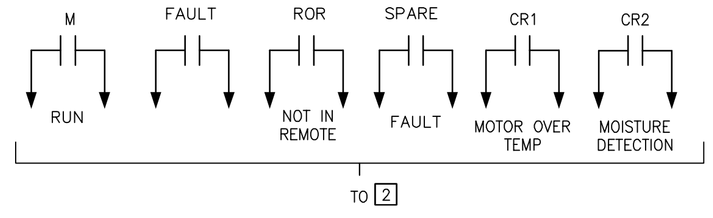




## SBR TANK MIXER MOTOR STARTER WIRING DIAGRAM SBR.MIX-1

(TYPICAL FOR SBR.MIX-2)

(ALL COMPONENTS LOCATED AT MCC UNLESS OTHERWISE NOTED)




## EQ TANK MIXER MOTOR STARTER WIRING DIAGRAM EQ.MIX-1

(TYPICAL FOR EQ.MIX-2)

(ALL COMPONENTS LOCATED AT MCC UNLESS OTHERWISE NOTED)

LEGEND

| | |
|---|---|
| 1 | DEVICE LOCATED AT EQUIPMENT |
| 2 | FROM/TO WWTF-PLC |
| 3 | FROM/TO SBR-CP |
| 4 | FROM/TO 10-ATC-1 |
| 5 | FROM/TO 20-ATC-1 |

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|
| 1 | 04-30-2020 | ADDENDUM 9 |

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | A. ABRAHAM |
| Drawn By: | A. ABRAHAM |
| Dept Check: | Y. RIZK |
| Proj Check: | T. PARECE |
| Date: | JANUARY 2020 |
| Scale: | AS NOTED |

**DISCIPLINE**

ELECTRICAL

**SHEET TITLE**

# WWTF - ELECTRICAL WIRING SCHEMATICS IV

**SHEET NUMBER**

# 10 E-616

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\ELD E-616.DWG
LAST UPDATE: Thursday, April 30, 2020 12:02:25 PM
PLOT DATE: Thursday, April 30, 2020 12:08:33 PM

May 1, 2020

**ADDENDUM NO. 10**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 10 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 2 pages and 20 pages of attachments for a total of 22 pages.

## ATTACHMENTS

1. Orleans_MA-2019-01-Bid Form_Add_10-05-01-20
2. Orleans_MA-2019-01-Subbid Form_Add_10-05-01-20

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. GENERAL

   A. Sub-Bid Opening – May 6, 2020 at 11:00 a.m.

   Sub-Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive Sub-Bids on May 6, 2020 starting at 8:00 a.m. The Sub-Bids will be taken inside to be opened at 11:00 a.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The Sub-Bid Opening will be broadcasted live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

   https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

   B. General Bid Opening – May 13, 2020 at 2:00 p.m.

   General Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive General Bids on May 13, 2020 starting at 8:00 a.m. The General Bids will be taken inside to be opened at 2:00 p.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The General Bid Opening will be broadcasted live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

   https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

C. PDF copies of the Sub-Bids and General Bids received but not including documents not allowed by law, will be available on the Owner's website within 7 calendar days of each bid opening.

2. SECTION 00200, INSTRUCTIONS TO BIDDERS

A. ARTICLE 1.03 – PREPARATION OF BID, Paragraph A., delete subparagraph 2.l. in its entirety and replace with the following new subparagraph:

l. The two low bidders shall submit Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services DBE forms (EEO-DEP-190C, EEO-DEP-191C and the DBE Certification of United States Citizenship form) by the close of business on the third business day after the bid opening.

B. ARTICLE 1.03 – PREPARATION OF BID, Paragraph B., delete subparagraph 2.d. in its entirety and replace with the following new subparagraph:

d. Not Used

C. ARTICLE 1.03 – PREPARATION OF BID, Paragraph B., delete subparagraph 2.l. in its entirety and replace with the following new subparagraph:

l. Not Used

3. SECTION 00410, FORM OF GENERAL BID

A. Delete "Orleans_MA-2019-01-Bid Form_Add_9-04-30-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_10-05-01-20" in both hard copy and Microsoft Excel format.

B. The Microsoft Excel Form is not required to be Signed.

C. General Bidders are required to submit: (a) SECTION 00410, FORM OF GENERAL Bid (Pages 00410-1 through 00410-30, inclusive); (b) "Orleans_MA-2019-01-Bid Form_Add_10-05-01-20"; and (c) the additional documents specified in SECTION 00200, INSTRUCTIONS TO BIDDERS.

4. SECTION 00420, FORM OF SUBBID

A. Delete "Orleans_MA-2019-01-SubBid Form_Add_7-03-24-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-SubBid Form_Add_10-05-01-20" in both hard copy and Microsoft Excel format.

B. The Microsoft Excel Form is not required to be Signed.

C. Sub-bidders are required to submit: (a) "Orleans_MA-2019-01-SubBid Form_Add_10-05-01-20"; and (b) the additional documents specified in SECTION 00200, INSTRUCTIONS TO BIDDERS.

5. SECTION 15400, PLUMBING SYSTEMS

A. Page 15400-2, ARTICLE 1.00 - SUB-BID REQUIREMENTS, delete Paragraph B. in its entirety and replace with the following new paragraph:

B. A sub-bid submitted for the Work of DIVISION 15, PLUMBING shall include the complete Work specified in all of the following Sections:

1. SECTION 15195, NATURAL GAS PIPING

2. SECTION 15400, PLUMBING SYSTEMS

3. SECTION 15420, PLUMBING INSULATION

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

None

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 10**

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of | | | |
| | $ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of | | | |
| | $ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of | | | |
| | One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of | | | |
| | Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as specified, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as specified, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as specified, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishing Section 11365 - Rotary Drum Thickeners, as specified, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| 2.R. | For conducting Performance Testing, as specified, the sum of | | | | |
| | Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 50,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD - The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraints will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding its funding constraints. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in June 2020.**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$** -

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-1A | For Addition of the Equipment Storage Facility, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |
| A-1B | For providing Compressed Air System, as specified, the sum of | | | |
| | Thirty Thousand Dollars and No Cents | | 1 | $ - |
| | $ 30,000.00 | Allowance | | |
| | | **Total of Bid Items A-1A. Through A-1B., inclusive** | | **$ -** |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-1** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

| | |
|---|---|
| Company's Name | Date |
| Company's Address | **Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.** |

Date:

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

**PART I - BASE BID**

1. The work of the Subbidder for all Work for the WWTF other than that covered by other items, as specified, the lump sum of

$ - l.s.

2. The Work of the Subbider including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of

$ - l.s.

**TOTAL OF PART I - BASE BID**

$ -

**PART II - ALTERNATIVES**

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

_____ may be used by any General Bidder except:

_____

_____ may only be used by the following General Bidders:

_____

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

_____

Class of Work:

_____

Bid Price:

_____

2 Name:

Class of Work:

Bid Price:

3. Name:

Class of Work:

Bid Price:

4. Name:

Class of Work:

Bid Price:

5. Name:

Class of Work:

Bid Price:

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name _____

2. Ever failed to complete any work awarded? _____

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

b) Project

_____

Engineer or Architect

_____

General Contractor

_____

Amount of Contract

_____

c) Project

Engineer or Architect

General Contractor

Amount of Contract

d) Project

Engineer or Architect

General Contractor

Amount of Contract

e) Project

Engineer or Architect

General Contractor

Amount of Contract

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Signature

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

May 8, 2020

**ADDENDUM NO. 11**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 11 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 6 pages and 65 pages of attachments for a total of 71 pages.

## ATTACHMENTS

1. Results of Subbids
2. Section 00410, Form of General Bid
3. Orleans_MA-2019-01-Bid Form_Add_11-05-07-20
4. Section 13350, SCADA Equipment

## RESULTS OF SUBBIDS

1. Results of May 6, 2020 Sub-Bid Opening, as attached.

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. GENERAL

   A. General Bid Opening – May 13, 2020 at 2:00 p.m.

      General Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive General Bids on May 13, 2020 starting at 8:00 a.m. The General Bids will be taken inside to be opened at 2:00 p.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The General Bid Opening will be broadcast live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

      https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

   B. PDF copies of the General Bids received, not including documents that are not allowed by law, will be available on the Owner's website within 7 calendar days of the bid opening.

2. ADDENDUM NO. 9

   A. Page AD.9-2, Item No. 5., delete Paragraph B. in its entirety and replace with the following new paragraph:

      B. Page 01650-10, ARTICLE 1.12 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING, Paragraph B.14, delete the subparagraph and replace with the following new subparagraph:

         14. Provide an initial full fill of the emergency generator fuel tank to be used for start-up and testing. Refill the fuel tank following start-up and testing. Payment for the cost of the diesel fuel shall be made via the allowance specified in SECTION 01020, ALLOWANCES.

   B. Page AD.9-9, Item No. 18., delete Paragraph A. in its entirety and replace with the following new paragraph:

      A. Sodium Hypochlorite/PACL Room, delete the words “Scale (Typical)” and replace with the words “Scale mounted on FRP Grating (Typical)”.

3. TABLE OF CONTENTS

   A. Page TOC-4, DIVISION 9 – FINISHES, delete SECTION 09681, CARPET TILE.

4. SECTION 00200, INSTRUCTIONS TO BIDDERS

   A. Page 00200-3, ARTICLE 1.03 – PREPARATION OF BID, Paragraph A., delete the paragraph in its entirety and replace with the following new paragraph:

      A. General Bids

         1. Each bid must be submitted on the prescribed form in SECTION 00410, FORM OF GENERAL BID. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures.

         2. Enclosed with the bid shall be the following:

            a. Microsoft Excel Proposal Form (hard copy in Landscape Format). Submit the completed Microsoft Excel Proposal Form in “.xlsm” format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

            b. Bid Security (5%).

            c. Completed and signed Bid Proposal, SECTION 00410, FORM OF GENERAL BID– Page 00410-1 through Page 00410-7, inclusive.

            d. Insurance Requirements for Inclusion in All Specifications and Contracts – Provide a letter from bidder’s insurance company(s) documenting ability to obtain the specified minimum insurance limits.

            e. Statement of State Tax Compliance.

            f. Certificate of Non-Collusion.

            g. Acknowledgement of Principal, if a Corporation.

            h. Acknowledgement of Principal, if a Partnership.

            i. Certification of OSHA 10-Hour Training.

            j. Division of Capital Asset Management and Maintenance

               1) Certificate of Eligibility

               2) Update Statement (Form CQ3)

            k. Massachusetts Department of Environmental Protection’s Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

l. Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

3. Each General Bid must be submitted in a sealed envelope indicating the bidder's name and address and clearly marked "General Bid for Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486".

4. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in Receipt and Opening of Bids, above.

5. SECTION 00410, FORM OF GENERAL BID

A. Delete SECTION 00410, FORM OF GENERAL BID in its entirety and replace with the new section, as attached.

B. Delete "Orleans_MA-2019-01-Bid Form_Add_10-05-01-20" in its entirety and replace with the attached new "Orleans_MA-2019-01-Bid Form_Add_11-05-08-20" in both hard copy and Microsoft Excel format.

6. SECTION 01020, ALLOWANCES

A. Page 01020-2, ARTICLE 1.05 - ALLOWANCES FOR PRODUCTS, Paragraph C., add Item No. 9 as follows:

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 11 | Diesel Fuel for Emergency Generator | $20,000 | 2.S. |

Notes:

11. Item No. 11 - The allowance is for the cost of the providing Diesel Fuel for the Emergency Generator in accordance with SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

7. SECTION 01065, STRUCTURAL TESTS AND INSPECTIONS

A. Page 01065-10, ATTACHMENT NO. 1 – PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS, Section CONTROLLED STRUCTURAL FILL (PREPARED FILL), Agent, Item 2., delete "ITA" and replace with "ITA(C)".

B. Page 01065-10, ATTACHMENT NO. 1 – PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS, Section CONTROLLED STRUCTURAL FILL (PREPARED FILL), Scope, Item 2., delete "ITA" and replace with "ITA(C)".

C. Page 01065-10, ATTACHMENT NO. 1 – PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS, Section CONTROLLED STRUCTURAL FILL (PREPARED FILL), delete the note in its entirety.

8. SECTION 08331, INSULATED OVERHEAD COILING DOORS

A. Page 08331-3, ARTICLE 2.02 – MATERIALS, Paragraph A.1., delete Subparagraph a. in its entirety and replace with the following new subparagraph:

a. Powder Coated Aluminum: 18-guage (0.044 inch) aluminum.

B. Page 08331-3, ARTICLE 2.02 – MATERIALS, Paragraph E., delete the paragraph in its entirety and replace with the following new paragraph:

E. Hood: 24-gauge powder coated aluminum with reinforced top and bottom edges. Provide minimum 1/4-inch steel intermediate support brackets.

C. Page 08331-3, ARTICLE 2.02 – MATERIALS, Paragraph F.2., delete the subparagraph in its entirety and replace with the following new subparagraph:

2. Powder Coated Aluminum: Phosphate treatment followed by baked-on polyester powder coat, color as selected by Design Builder from manufacturer's standard color range, minimum 32 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better.

9. SECTION 09650, RESILIENT FLOORING

A. Page 09650-3, ARTICLE 2.01 – MATERIALS, delete the article in its entirety and replace with the following new article:

2.01 - MATERIALS

A. Vinyl-Composition Floor Tile

1. Non-asbestos formulated and composed of vinyl resins and fillers, free from lumps and unmixed coloring matter and conforming to ASTM F1066, Class 2.

2. Size: 12-in. by 12-in. by 1/8-in. thick.

3. Water-Resistant Type Adhesive: manufacturer's recommended type for installation of vinyl-composition tile over suspended or on-grade concrete subfloors.

4. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns

B. Bases

1. Vinyl Bases

a. 4-inch high by 1/8-inch. thick set-on type cove base with tapered top and ribbed back at tile and concrete; straight base at carpet, conforming to ASTM F1861, Type TV, Group 1. Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

2. Rubber Base

a. 4-inch high by 1/8-inch thick cove base at tile and concrete; straight base at carpet conforming to ASTM F 1861; Type TS or TP Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

3. PVC

a. 4-inch high by 1/8-inch thick cove base at tile and concrete; straight base at carpet conforming to ASTM F1861. Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

10. SECTION 10475, EMERGENCY AND MISCELLANEOUS EQUIPMENT

    A. Page 10475-1, ARTICLE 1.02 – MEASUREMENT AND PAYMENT, add the following new paragraph:

        B. The work of this section shall be provided under the PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, Bid Item 2A.

    B. Page 10475-6, ARTICLE 2.04 - MISCELLANEOUS EQUIPMENT – OTHER INDUSTRIAL SUPPLY CATALOGS, delete Item No. 32 in its entirety and replace with the following new item:

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 32 | 8-in Electrical Long Nose Pliers with Wire Cutter | Craftsman CMHT81645 | 1 |

    C. Page 10475-6, ARTICLE 2.04 - MISCELLANEOUS EQUIPMENT – OTHER INDUSTRIAL SUPPLY CATALOGS, delete Item No. 33 in its entirety and replace with the following new item:

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 33 | Not Used | --- | --- |

11. SECTION 11398, DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

    A. Page 11398-1, ARTICLE 1.01 – SCOPE, delete Paragraph D. in its entirety and replace with the following new paragraph:

        D. The unit shall be provided in an outdoor, weather-proof, walk-in, sound attenuated enclosure with an integral sub-base fuel storage tank with a capacity for 72 hours of standby operation.

12. SECTION 13350, SCADA EQUIPMENT

    A. Delete SECTION 13350, SCADA EQUIPMENT in its entirety and replace with the new section, as attached.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

1. DRAWING 10 A-102, GRADE LEVEL PLAN, Room 110, add the following new note;

   The ceiling access hatch located can be relocated to the south (if need be) so long as the 30”x36” required OSHA clearance is provided and at least one of the double doors allows full access to the ladder.

2. DRAWING 10 A-103, ROOF PLAN, add the following new note:

   The location of the south chimney shall be in accordance with this Drawing. The location of the south chimney shown on DRAWING 10 S-105, ROOF LEVEL PLAN, shall be revised in accordance with this Drawing.

3. DRAWING 99 A-607, PARTITION TYPES, for Ceiling Types C4, add the following new remark:

   No hat channels are required. The C-H stud can be installed directly to the underside of the truss. Since these are rated ceiling assemblies, the GWB is attached directly to the C-H studs and 1-inch liner panel is installed like a shaft wall assembly.

4. DRAWING 99 A-607, PARTITION TYPES, for Ceiling Types C5 and C6, add the following new remark:

   No hat channels are required. The C-H stud can be installed directly to the underside of the truss. Since these are rated ceiling assemblies, the GWB is attached directly to the C-H studs and 1-inch liner panel is installed like a shaft wall assembly.

5. DRAWING 00 D-004, SCHEDULES I

   A. Process Pump Schedule, Notes, Thickened Sludge Pumps, delete Item 2 in its entirety and replace with the following new item:

      Full Speed Secondary Rating Point: 975 GPM at 47 Feet with no more than 8 feet of HPSH3.

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 11**

**DOWNTOWN AREA WASTEWATER TREATMENT FACILITY AND EFFLUENT DISPOSAL**
**SUB-BID RESULTS**
**Wednesday, May 06, 2020**

| Sub-Bidder's Name | Proposal Sum | Alternatives | | | | | | Restrictions / Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Equipment Storage Facility | Fiber Optic Conduits and Handholes | Tracer Wire | SBR Transfer Pump No. 4 | SBR Blower No. 4 | Two SBR Aeration Diffuser Grids (1 per SBR Tank) | |
| **SECTION 04120, STONE VENEER** | | | | | | | | |
| Costa Brothers Masonry | $ 531,000.00 | $ 180,000.00 | $ - | $ - | $ - | $ - | $ - | None |
| Lighthouse Masonry, Inc. | $ 863,000.00 | $ 267,000.00 | $ - | $ - | $ - | $ - | $ - | None |
| Marmelo Bros. Construction Co. | $ 724,000.00 | $ 220,000.00 | $ - | $ - | $ - | $ - | $ - | None |
| **SECTION 05500, MISCELLANEOUS METAL WORK** | | | | | | | | |

**Only one restricted Subbid received.**
**General Contractors to carry an allowance of: (a) Part III - Filed Subbids, Item 3B of $475,000; and (b) Part IV - Alternatives, Item A-1 of $25,000.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **SECTION 07160, BITUMINOUS DAMPPROOFING** | | | | | | | | |
| P.J. Spillane Company, Inc. | $ 364,000.00 | $ 8,000.00 | $ - | $ - | $ - | $ - | $ - | None |
| The Waterproofing Company, Inc. | $ 99,000.00 | $ 16,400.00 | $ - | $ - | $ - | $ - | $ - | None |
| Folan Warterproofing | $ 107,100.00 | $ 8,460.00 | $ - | $ - | $ - | $ - | $ - | None |
| **SECTION 07610, METAL ROOFING** | | | | | | | | |
| Greenwood Industries, Inc. | $ 362,000.00 | $ 152,800.00 | $ - | $ - | $ - | $ - | $ - | None |
| Waterline Industries Corporation | $ 178,177.00 | $ 57,000.00 | $ - | $ - | $ - | $ - | $ - | Restricted to Waterline Industries Corporation |
| **SECTION 08500, FIXED WINDOWS** | | | | | | | | |
| Aluminum & Glass Concepts, Inc. | $ 67,214.00 | $ 27,229.00 | $ - | $ - | $ - | $ - | $ - | None |
| Kapiloff's Glass, Inc. | $ 142,500.00 | $ 24,500.00 | $ - | $ - | $ - | $ - | $ - | None |
| **SECTION 08810, GLASS AND GLAZING** | | | | | | | | |
| Aluminum & Glass Concepts, Inc. | $ 11,464.00 | $ 3,785.00 | $ - | $ - | $ - | $ - | $ - | None |
| Kapiloff's Glass, Inc. | $ 68,000.00 | $ 6,000.00 | $ - | $ - | $ - | $ - | $ - | None |

**DOWNTOWN AREA WASTEWATER TREATMENT FACILITY AND EFFLUENT DISPOSAL**
**SUB-BID RESULTS**
**Wednesday, May 06, 2020**

| Sub-Bidder's Name | Proposal Sum | Alternatives: Equipment Storage Facility | Fiber Optic Conduits and Handholes | Tracer Wire | SBR Transfer Pump No. 4 | SBR Blower No. 4 | Two SBR Aeration Diffuser Grids (1 per SBR Tank) | Restrictions / Remarks |
|---|---|---|---|---|---|---|---|---|
| **SECTION 09300, TILE WORK** | | | | | | | | |
| Pavilion Floors, Inc. | $ 57,000.00 | $ - | $ - | $ - | $ - | $ - | $ - | Not to be Used by GVW; CJM Services; or Enfield Builders |
| **SECTION 09941, FIELD PAINTING** | | | | | | | | |
| John W. Egan Company Co., Inc. | $ 719,690.00 | $ 19,000.00 | $ - | $ - | $ - | $ - | $ - | None |
| Keltic Painting, LLC | $ 987,200.00 | $ 22,000.00 | $ - | $ - | $ 900.00 | $ 300.00 | $ - | None |
| **SECTION 15300, AUTOMATIC WET-PIPE SPRINKLER SYSTEM** | | | | | | | | |

**No Subbids received.**
**General Contractors to carry an allowance under: (a) Part III - Filed Subbids, Item 3I of $200,000.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **SECTION 15499, PLUMBING** | | | | | | | | |
| Araujo Bros. Plumbing & Heating | $ 489,000.00 | $ 34,000.00 | $ - | $ 34,000.00 | $ - | $ - | $ - | Not to be Used by Waterline Industries Corporation |
| Casey Plumbing & Heating, Inc. | $ 458,300.00 | $ 96,800.00 | $ - | $ - | $ - | $ - | $ - | None |
| Waterline Industries Corporation | $ 237,677.00 | $ 53,977.00 | $ - | $ - | $ - | $ - | $ - | Restricted to Waterline Industries Corporation |
| **SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING** | | | | | | | | |

**Only one restricted Subbid and one unresponsive Subbid were received.**
**General Contractors to carry an allowance of: (a) Part III - Filed Subbids, Item 3K of $2,100,000; and (b) Part IV - Alternatives, Item A-1 of $150,000.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **DIVISION 16 - ELECTRCIAL (ALL SECTIONS)** | | | | | | | | |
| Annese Electrical Services | $ 3,386,000.00 | $ 238,000.00 | $ 18,680.00 | $ - | $ 16,868.00 | $ 17,777.00 | $ - | Not to be Used by Waterline Industries Corporation |
| Fall River Electrical Assoc. Co., Inc. | $ 3,418,277.00 | $ 258,106.00 | $ 29,354.00 | $ - | $ 20,751.00 | $ 56,425.00 | $ - | Not to be Used by Waterline Industries Corporation |
| Waterline Industries Corporation | $ 2,979,757.00 | $ 210,177.00 | $ 59,367.00 | $ - | $ 20,967.00 | $ 51,477.00 | $ - | Restricted to Waterline Industries Corporation |

**SECTION 00410**

**FORM OF GENERAL BID**

1. Proposal of _____ (hereinafter called "Bidder")*

   (_) a corporation, organized and existing under the laws of the State of _____

   (_) a partnership

   (_) a joint venture

   (_) a limited liability company

   (_) an individual doing business as _____

   *Check corporation, partnership, joint venture, LLC or individual as applicable.

2. To the Town of Orleans, MA (hereinafter called "Owner") regarding: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486.

   The Bidder, in compliance with your invitation for bids for Downtown Area WWTF and Effluent Disposal having examined the plans and specifications with related documents and the site of the proposed work, attended the mandatory pre-bid conference, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to construct the project in accordance with the contract documents, within the time set forth below, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this bid is a part.

   The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written "Notice to Proceed" given by the Owner to the Contractor and to fully complete the project within 654 calendar days, using not more than 411 working days.

   The Bidder further agrees to pay as liquidated damages the sum of $6,700 for each consecutive calendar day and/or working day thereafter during which the work as not been fully completed, as provided in the "Liquidated Damages" provisions of SECTION 00800 - SUPPLEMENTARY CONDITIONS.

3. Bidder acknowledges receipt of the following addenda:

| No. | Dated | No. | Dated |
|---|---|---|---|
| 1 | | 7 | |
| 2 | | 8 | |
| 3 | | 8 | |
| 4 | | 10 | |
| 5 | | 11 | |
| 6 | | 12 | |

4. Bidder agrees to perform all the work, including all incidental labor, materials and equipment necessary for the satisfactory completion of the work and be in full compliance with the contents and intent of the Specifications and/or Drawings of the work.

5. Bid Proposal

   A. The BID PROPOSAL unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, engineering costs, etc., to cover the finished work of the several kinds called for. The Bidder understands that all bids for this project are subject to the applicable bidding laws of the Commonwealth of Massachusetts, including General Laws Chapter 149, Section 44D and Section 44E, as amended.

   B. Bidder shall complete and submit the Proposal Form. The bidder is not allowed to submit a proposal that has been printed out and priced typewritten or written by hand. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   C. Use of the Microsoft Excel Proposal Form

      1. Upon Opening the Microsoft Excel Proposal Form:

         a) A yellow bar will appear on the top of the screen labeled as "*Security Warning*"

         b) You must select the "*Enable Content*" button in order to properly access the file.

            1) This will enable macros in the excel file, as you must enable macros to properly view the file.

            2) If you do not enable macros, the excel document will be invalid.

         c) Manually enter the Bidder's Name in the blue box.

         d) Manually enter the Date in the blue box.

         e) Manually enter the unit cost in the blue boxes for each bid item. Allowances have already been prepopulated.

         f) The document will automatically update the cost estimates (Unit Price in Words; Extended Totals and Bid Total based on the user's unit cost input into the blue boxes for each bid item).

      2. In Order to Save the Proposal Form Document:

         a) The document must be saved as a file with macros enabled.

         b) Please save as the file type "Excel Macro-Enabled Workbook (*.xlsm)".

         c) If the file is saved incorrectly as a different file type, the document will be invalid.

      This process must be repeated for every time the document is opened and saved.

   D. Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com). The bidder is not allowed to submit a Microsoft Excel Proposal Form that has been priced typewritten or written by hand. The Microsoft Excel Form is not required to be Signed.

   E. In the event of a discrepancy between the price in words and the price in figures, the words shall govern. In the event of a discrepancy between the total of the items and the total stated, the total of the items shall govern.

   F. In the event of a discrepancy between the printed out completed Microsoft Excel Proposal Form and the completed Microsoft Excel Proposal Form in ".xlsm" format, the printed out completed Microsoft Excel Proposal Form shall govern.

   G. Interlineation, alteration or erasure may void the bid.

   H. Bid security is attached in the sum of five percent (5%) of the total bid in accordance with the conditions of SECTION 00200 - INSTRUCTIONS TO BIDDERS. The bid security may become the property of the Owner in the event the contract and bond are not executed within the time set forth above.

   I. The undersigned states that no officer, agent or employees of the Owner directly or indirectly has a financial interest in this Bid.

6. The time period for holding bids, where Federal approval is not required is 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids and where Federal approval is required, the time period for holding bids is 30 days, Saturdays, Sundays and holidays excluded after Federal approval.

7. State Taxes - Pursuant to M.G.L.c.62C, s49A I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all State Taxes required under law.

8. Award

   A. The contract will be awarded to the lowest responsible and eligible bidder.

   B. Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding as deemed to be in the best interest of the Owner.

   C. The Owner reserves the right to reject any bid in the event that any bid item or items are obviously unbalanced or appear to the Owner to be so unbalanced as to affect or to be liable to affect adversely any interest of the Owner.

   D. The Owner reserves the right to reject any or all bids if it deems it to be in its best interest to do so. The Owner reserves the right to award the Contract based on sufficiency of appropriated funds to complete the work.

   E. In the event the lowest bids from responsive and responsible bidders are tied, the following methods of breaking the tie shall be employed unless otherwise provided for in these bid documents: The bidder's names shall be entered on a slip of paper and placed in a hat. The award shall then be made to the bidder whose slip is drawn from the hat. The drawing of the slip from the hat shall be performed in the presence of the tied bidders unless they waive their right to be present in writing.

9. Within 10 days of receipt of the written notice of acceptance of this bid, the Bidder will execute the formal agreement attached in SECTION 00520 - AGREEMENT and provide the requisite payment and performance bonds and certificates of insurance.

10. The selected Contractor shall furnish a performance bond and a payment bond each in an amount at least equal to one hundred percent (100%) of the contract prices in accordance with SECTION 00610 - PERFORMANCE BOND, SECTION 00615 - PAYMENT BOND, and as stipulated in paragraph 5.01 of SECTION 00700 - GENERAL CONDITIONS of these specifications.

11. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.

12. The Undersigned, as Bidder, declares as follows:

   A. The only parties interested in this BID as Principals are named herein;

   B. The Bidder has carefully examined the site of the proposed Work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed Work, the difficulties upon its execution and the accuracy of all estimated quantities stated in this BID, and has carefully read and examined the Drawings, the annexed proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;

   C. This BID is made without collusion with any other person, firm, or corporation;

   D. No officer, agent, or employee of the Owner is directly or indirectly interested in this BID; and

   E. Understands that information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered will be the same as those shown on the Drawings or in any of the other Contract Documents and agrees that the Bidder shall not use or be entitled to use any such information made available to him through the Contract Documents or otherwise or obtained by him in his own examination of the site, as a basis of or ground for any claim against the Owner or the Engineer arising from or by reason of any variance which may exist between the aforesaid information made available to or acquired by him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and has made due allowance therefore in this BID.

13. Equal Employment Opportunity/Affirmative Action Provisions - C.30 s39 (c)

   A. The undersigned bidder hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.

B. The undersigned bidder hereby certifies he/she will comply with the specific affirmative action steps contained in the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these contract provisions. The contractor receiving the award of the contract shall incorporate the EEO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

C. The undersigned bidder hereby certifies he/she will comply with the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract (MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services).

14. Non-Debarment - C.30 s39 (a)

A. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As use in this paragraph the "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

B. The undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

15. Suspension and Debarment

A. The EPA prohibits the use of suspended or debarred contractors and suppliers in SRF financed contracts. All SRF financed contracts and subcontracts must include language indicating compliance with 2 CFR 180 and 2 CFR 1532.

B. Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled responsibilities of Participants Regarding transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

16. Diesel Retrofit Program - The undersigned bidder hereby certifies he/she will comply with the Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply (see Appendix B).

17. The undersigned offers the following information as evidence of its qualifications to perform the work as bid upon according to all the requirements of the plans and specifications:

A. Have been in business under present name for _____years.

B. The Bidder shall state below what work of a similar character to that included in the proposed contract it has done within the last 10 years, and provide references that will enable the Owner to judge its experience, skill and business standing (add supplementary page(s) if necessary).

**Project No. 1**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 2**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 3**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 4**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 5**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

C. The names and addresses of all persons interested in the bid (if made by a partnership or corporation) as Principals, are as follows (add supplementary page(s) if necessary):

| Name | Address |
|---|---|
| | |
| | |
| | |
| | |

18. Pursuant to M.G.L. CH. 62C, Sec 49A, the undersigned Bidder certifies under the penalties of perjury that it is in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

19. The undersigned Bidder hereby certifies that (1) it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; and (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

20. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity which sells materials, equipment or supplies used in or for, or engages in the performance of, the same or similar construction, reconstruction, installation, demolition, maintenance or repair work or any part thereof.

21. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, Section 25C (10) of Chapter 152 (workers' compensation) or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder.

Respectfully submitted:

Date: _____ By: _____

(Signature)

_____

(Name – Typed or Printed)

_____

(Title)

_____

(Business Name)

_____

(Federal ID Number)

_____

(Business Address)

_____

(City and State)

_____

(Telephone Number)

(SEAL - if bid is by a corporation)

22. The following documents are attached to and made a condition of the bid, and shall be submitted with the bid:

    A. Microsoft Excel Proposal Form (hard copy in Landscape Format). Submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

    B. Bid Security (5%).

    C. Completed and signed Bid Proposal herein – Page 00410-1 through Page 00410-7, inclusive.

    D. Insurance Requirements for Inclusion in All Specifications and Contracts – Provide a letter from bidder's insurance company(s) documenting ability to obtain the specified minimum insurance limits.

    E. Statement of State Tax Compliance.

    F. Certificate of Non-Collusion.

G. Acknowledgement of Principal, if a Corporation.

H. Acknowledgement of Principal, if a Partnership.

I. Certification of OSHA 10-Hour Training.

J. Division of Capital Asset Management and Maintenance

1) Certificate of Eligibility

2) Update Statement (Form CQ3)

K. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

L. Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

**END OF TEXT**

SEE ATTACHED PROPOSAL FORM

SEE ATTACHED APPENDIX

MassDEP Appendix B Diesel Retrofit Program

MassDEP Appendix E Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

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# APPENDIX B

## APPENDIX B
## DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

**Diesel Construction Equipment Standard**

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

**Exemptions**

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

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**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

**Contractor Certification**

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

**Recordkeeping**

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

**Project Regulatory Agreement**

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

**APPENDIX B** (cont.)
**DIESEL RETROFIT PROGRAM**

## STATEMENT OF INTENT TO COMPLY

***This form must be signed and submitted by the bidder as part of the bid.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Bidder** _____

**The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:**

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____

**(Signature of Bidder's Authorized Representative)** **(Date)**

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**APPENDIX B** (cont.)
**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

***Each Contractor and its Subcontractor(s) must sign and submit this form to DEP DMS project engineer, 5th Floor, MassDEP, One Winter Street, Boston, MA 02108 and the Municipality within 10 days after the Contractor is notified that it is awarded the Contract.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Contractor** _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

**APPENDIX B** (cont.)

**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

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# APPENDIX E

## APPENDIX E
## CONSTRUCTION BID SPECIFICATIONS
## SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES
## MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
### DIVISION OF MUNICIPAL SERVICES

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM BACKGROUND

In May 2008 a United States Environmental Protection Agency (EPA) rule became effective that changed the Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) Program to a Disadvantaged Business Enterprise (DBE) Program.

For firms to qualify under the old MBE/WBE program they needed to be socially disadvantaged and had to be certified by the Supplier Diversity Office (SDO). Under the new DBE rule, the firms must be both **socially** and **economically** disadvantaged, **citizens of the United States**, and certified as a DBE. Women and certain minorities are presumed to be socially disadvantaged. The economic disadvantage is measured by the owner's initial and continuing personal net worth of less than $1,320,000.

Because the Clean Water Act requires the use of MBEs and WBEs, these firms will still be utilized in the State Revolving Fund (SRF) Loan Program, but they must also be certified as DBEs.

SDO will continue to be the certifying agency for the SRF program. SDO certifies firms under the federal Department of Transportation program, which is acceptable for use in the SRF program. An additional form has been added to the DBE package to verify that DBEs are owned or controlled by United States citizens.

BID SPECIFICATIONS

**I.** In this contract, the percentage of business activity to be performed by disadvantaged business enterprise(s) (DBE) shall not be less than the following percentages of the total contract price or the percentage submitted by the contractor in the Schedule of Participation, whichever is greater:

Disadvantaged MBE (D/MBE) 4.2% Disadvantaged WBE (D/WBE) 4.5%

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## II. DEFINITIONS

For the purpose of these provisions, the following terms are defined as follows:

A. Awarding Authority – Entity that awards a prime contract under a State Revolving Fund loan.

B. Bidder - Any individual, partnership, joint venture, corporation, or firm submitting a price, directly or through an authorized representative, for the purpose of performing construction or construction related activities under a Contract.

C. Certified DBE – A DBE certified by the United States Small Business Administration, under its 8(a) Business Development Program (13 CFR part 124, subpart A) or its Small Disadvantaged Business Program (13 CFR part 124, subpart B); The United States Department of Transportation (DOT), under its regulations for Participation by DBSs in DOT programs (49 CFR parts 23 and 26); or SDO in accordance with 40 CFR part 33; provided that the certification meets the U.S. citizenship requirement under 40 CFR §33.202 or §33.203.

D. Compliance Unit - A subdivision of MassDEP's Affirmative Action Office designated to ensure compliance under these provisions.

E. Contractor - Any business that contracts or subcontracts for construction, demolition, renovation, survey, or maintenance work in the various classifications customarily used in work and that is acting in this capacity under the subject contract.

F. Construction Related Services - Those services performed at the work site ancillary to, and/or in support of, the construction work, such as hauling, trucking, equipment operation, surveying or other technical services, etc. For the purposes hereof, supply and delivery of materials (e.g. pre-cast concrete elements) to the site by a supplier who has manufactured those goods, or substantially altered them before re-sales shall be considered as "construction related services

G. Construction Work - The activities at the work site, or labor and use of materials in the performance of constructing, reconstructing, erecting, demolishing, altering, installing, disassembling, excavating, etc, all or part of the work required by the Contract Documents.

H. Disadvantaged Business Enterprise (DBE) - An entity owned or controlled by a socially and economically disadvantaged individual as described by Public Law 102-389 (42 U.S.C. 4370d) or an entity owned and controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note); a Small Business Enterprise (SBE); a Small Business in a Rural Area (SBRA); or a Labor Surplus Area Firm (LAF), a Historically Underutilized Business (HUB) Zone Small Business Concern, or a concern under a successor program.

I. Equipment Rental Firm - A firm that owns equipment and assumes actual and contractual responsibility for renting said equipment to perform a useful function of the work of the contract consistent with normal industry practice

J. Good Faith Efforts – The race and/or gender neutral measures described in 40 CFR 33, subpart C.

K. HUBZone - A historically underutilized business zone, which is an area located within one or more qualified census tracts, qualified metropolitan counties, or lands within the external boundaries of an Indian reservation.

L. HUBZone small business concern - A small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

M. Joint Venture - An agreement between SDO certified DBE and a non-DBE or non-DBE controlled enterprise.

1. A pairing of companies will be considered a DBE joint venture if the SDO certified DBE which is part of the relationship has more than 51% of the profits that are derived from that project.

2. A joint venture between a certified DBE subcontractor and a non DBE subcontractor, in which the DBE for that proportion of the joint venture's contract equal to the DBE participation in the joint venture.

3. Whenever a general bid is filed by a joint venture with a certified DBE participant in the joint venture that does not exercise more than 51% control over management and profits, that joint venture shall be entitled to credit as a DBE for that portion of the joint venture's contract equal to the DBE participation in the joint venture. Minority As deemed by SDO.

N. Labor surplus area firm (LSAF) - A concern that together with its first-tier subcontractors will perform substantially in labor surplus areas (as identified by the Department of Labor in accordance with 20 CFR part 654). Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.

O. Letter of Intent – Certified document signed by the principal(s) of the DBE with respect to the work to be performed under contract.

P. Local Government Unit (LGU) – A city, town, or municipal district which applies for a loan under the Clean Water Trust Program.

Q. Material Supplier – A vendor certified by SDO as a DBE in sales to supply industry from an established place of business or source of supply, and that vendor.

1. Manufactures goods from raw materials, or substantially utilizes them in the work, or substantially alters them before resale, entitling the general contractor to DBE credit for 100% of the purchase order.

2. Provides and maintains a storage facility for materials utilized in the work, entitling the general contractor to DBE credit for 10% of the purchase order

R. Minority and Women Business Enterprise (M/WBE) – Any business concern certified by the SDO as a bona-fide M/WBE. A bona-fide M/WBE is a business whose minority group/women ownership interests are real, which have at least 51% ownership and control over management and operation.

S. Percent of Total Price – Is the percentage to be paid to the DBE, work they perform, as compared to the total bid price

T. Recipient - An agency, person or political subdivision which has been awarded or received financial assistance by the Trust or MassDEP.

U. Small business, small business concern or small business enterprise (SBE) - A concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR part 121.

V. Small business in a rural area (SBRA) - A small business operating in an area identified as a rural county with a code 6-9 in the Rural-Urban continuum Classification Code developed by the United States Department of Agriculture in 1980.

W. SDO – The Supplier Diversity Office.

X. Subcontractor – A company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Y. Total Contract Price – The total amount of compensation to be paid for all materials, work or services rendered in the performance of the contract

Z. Trust – The Massachusetts Clean Water Trust established by M.G.L. c.29.

## III. REQUIREMENTS FOR CONTRACT AWARD

DBE packages must be submitted by the two lowest bidders on the project. Following bid opening, the LGU shall notify the two lowest bidders to submit DBE packages to the LGU or the LGUs consultant, as directed. By the close of business on the third business day after notification, the two lowest bidders, including a bidder who is a MBE, WBE or DBE, shall submit the following information:

A. A Schedule of Participation (Form EEO-DEP-190). The Schedule of Participation shall list those certified DBEs the bidder intends to use in fulfilling the contract obligations, the nature of the work to be performed by each certified DBE subcontractor and the total price they are to be paid.

1. A listing of bona-fide services such as a professional, technical, consultant or managerial services, assistance in the procurement of essential personnel, facilities, equipment, materials, or supplies required for performance of the contract, and reasonable fees or commissions charged.

2. A listing of haulers, truckers, or delivery services, not the contractors, including reasonable fees for delivery of said materials or supplies to be included on the project.

B. A Letter of Intent (Form EEO-DEP-191) for each DBE the bidder intends to use on the project. The Letter of Intent shall include, among other things, a reasonable description of the work the certified DBE is proposing to perform and the prices the certified DBE proposes to charge for the work. A Letter of Intent shall be jointly signed by the certified DBE and the General Contractor who proposes to use them in the performance of the Contract.

C. Each DBE must also sign and return the DBE Certification of United States Citizenship form to verify that the firm is owned or controlled by a United States citizen.

D. The SDO "DBE Certification" as prepared by each certified DBE.

E. A completed Request for Waiver form and backup documentation should the goals not be achieved (See IV below).

## IV. REQUIREMENTS FOR MODIFICATION OR WAIVERS.

The bidder shall make every possible effort to meet the minimum requirements of certified DBE participation. If the percentage of DBE participation submitted by the bidder on its Schedule of Participation (EEO-DEP-190) does not meet the minimum requirements, the bid may be rejected by the Awarding Authority and found not to be eligible for award of the contract.

In the event that the bidder is unable to meet the minimum requirements of DBE participation, the bidder shall submit with his/her submittal required in Section III. Requirement of Contract Award a Request for Waiver form (EEO-DEP-490). The Awarding Authority shall review the waiver request to determine if the request should proceed. If approved by the Awarding Authority, the Awarding Authority shall submit the waiver request and supporting documentation, with a recommendation to MassDEP within five days of receipt of the Request for Waiver. MassDEP in conjunction with the project manager, Compliance Unit, will determine whether the waiver will be granted.

The waiver request shall include detailed information as specified below to establish that the bidder has made a good faith effort to comply with the minimum requirements of DBE participation specified in Part I. In addition, the bidder must show that such efforts were undertaken well in advance of the time set for opening of bids to allow adequate response. A waiver request shall include the following:

A. A detailed record of the effort made to contact and negotiate with the certified DBE, including, but not limited to:

   1. names, addresses and telephone numbers of all such companies contacted;

   2. copies of written notices(s) which were sent to certified DBE potential subcontractors, prior to bid opening;

   3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

   4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price;

   5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/ women-focused media detailing the opportunities for participation.

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after MassDEP receives all required information and documentation, it shall make a decision in writing, whether the waiver is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing. If the waiver request is denied, the bid shall be rejected by the Awarding Authority, or the contract will be determined ineligible for SRF funding.

   If a Request for Waiver is denied by MassDEP and the bid is rejected by the Awarding Authority, the Awarding Authority may then move to the second bidder on the project. At the Awarding Authority's discretion, it may collect a DBE package from the third bidder on the project.

## V. DISADVANTAGED BUSINESS ENTERPRISES PARTICIPATION

A. Reporting Requirements

1. The Contractor's utilization of certified DBEs will be documented based upon submittal of the LGU's monthly Payment Requisitions as reported on Form-2000. The Form-2000 form will show all certified DBEs performing work on the project regardless of any billing activity for that month. For auditing and accounting purposes, the Contractor periodically may be required to submit copies of canceled checks verifying that payments have been made to the certified DBE as listed on the schedule. The Contractor may also be required to submit current schedules on utilization of all DBEs to indicate when their services will commence and be billed for.

2. During the life of the Contract, the Contractor's fulfillment of the percentage requirements in Part I shall be determined with reference to the Contract price as follows:

   A. If the price in the Contract executed exceeds the base bid price (e.g., because an alternate was selected or because unit prices were used in awarding the Contract), the Contractor shall submit for approval by MassDEP a revised Schedule of Participation by certified DBEs satisfying the percentage requirements and such other information concerning additional DBE participation as may be requested by MassDEP.

   B. If the Contract price increases after execution due to change orders or other adjustments, MassDEP may require the Contractor to subcontract additional work or to purchase additional goods and services from certified DBEs up to the percentages stated in Part I.

## VI. COMPLIANCE

A. If the Schedule or any of the Letters of Intent are materially incomplete or not submitted in a timely manner, the LGU may rescind its vote of award; treat the bid informal as to substance and reject the bid. If the bid is incomplete in any other respect than the Schedule the LGU with the approval of MassDEP may waive the informalities upon satisfactory completion of the required information by the Contractor and the certified DBE as applicable.

B. If the LGU finds that the percentage of certified DBE participation submitted by the contractor on its Schedule does not meet the percentage requirement in Part I, it shall rescind its vote of award and find such contractor not to be eligible for award of the contract.

C. The Contractor shall not perform with its own organization, or subcontract to any other primary or subcontractor any work designated for the named certified DBEs on the schedule submitted by the Contractor under Part III without the approval of MassDEP.

D. A Contractor's compliance with the percentage requirement in Part I shall continue to be determined by reference to the required percentage of the total contract price as stated in Section I even though the total of actual contract payments may be greater or less than the bid price.

E. If the Contractor for reasons beyond its control cannot comply with Part III in accordance with the Schedule submitted under Part III, Section B, the contractor must submit to MassDEP as soon as they are aware of the deficiency, the reason for its inability to comply. Proposed revisions to the Schedule stating how the contractor intends to meet its obligations under these conditions must be submitted within ten (10) working days of notification.

F. If the Contractor is becomes aware by any means that that DBE is no longer certified, the Contractor shall immediately notify MassDEP. The Contractor shall use good faith efforts to retain a substitute certified DBE.

G. If a certified DBE listed by the bidder in its Schedule of M/WBE contractors fails to obtain a performance or payment bond requested by the bidder, said failure shall not entitle the bidder to avoid the requirements of Part III (A). After a bidder has been awarded the contract, he shall not change the certified DBE listed in its Schedule at the time of the award or make any other such substitutions without the written approval of MassDEP.

## VII. SANCTIONS

A. If the Contractor does not comply with the terms of these Special Provisions, the Awarding Authority may (1) suspend any payment for the work that should have been performed by a certified DBE pursuant to the schedule, or (2) require specific performance of the Contractor's obligation by requiring the Contractor to subcontract with a DBE for any contract or specialty item at the contract price established for that item in the proposal submitted by the Contractor.

B. To the extent that the Contractor has not complied with the terms of these Special Provisions, the Awarding Authority may retain in connection with Estimates and Payments an amount determined by multiplying the bid price of this contract by the percentage in Section I, less the amount paid to DBE's for work performed under the contract and any payments already suspended under VII A.

C. The Awarding Authority may suspend, terminate or cancel this contract, in whole or in part, or may call upon the Contractor's surety to perform all terms and conditions in the contract, unless the contractor is able to demonstrate his compliance with the terms

of these Special Provisions, and further deny to the Contractor, the right to participate in any future contracts awarded by the Awarding Authority for a period of up to three years.

D. In any proceeding involving the imposition of sanctions by the Awarding Authority, no sanctions shall be imposed if the Awarding Authority finds that the contractor has taken every possible measure to comply with these Special Provisions or that some other justifiable reason exists for waiving these Special Provisions in whole or in part.

E. The contract shall provide such information as is necessary in the judgment of the Awarding Authority to ascertain its compliance with the terms of these Special Provisions.

F. A contractor shall have the right to request suspension of any sanctions imposed under this section upon demonstrating that he is in compliance with these Special Provisions.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## SCHEDULE OF PARTICIPATION FOR SRF CONSTRUCTION

**Project Title:** _____ **Project Location:** _____

**Disadvantaged Minority Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/MBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/MBE Commitment:** | **$** |
| **Percentage D/MBE Participation** = (Total D/MBE Commitment) / (Bid Price) = | | **%** |

**Disadvantaged Women Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/WBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/WBE Commitment:** | **$** |
| **Percentage D/WBE Participation** = (Total D/WBE Commitment) / ( Bid Price) = | | **%** |

The Bidder agrees to furnish implementation reports as required by MassDEP to indicate the D/MBEs and D/WBE(s) which it has used or intends to use. Breach of this commitment constitutes a breach of the contract.

Name of Bidder: _____

Date: _____ By: _____
Signature

NOTE: Participation of a DBE may be counted in only their certified category; the same dollar participation cannot be used in computing the percentage of D/MBE participation and again of D/WBE participation.

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## LETTER OF INTENT FOR SRF CONSTRUCTION

This form is to be completed by the D/MBE and D/WBE and must be submitted by the Bidder no later than close of business on the third business day after notification by the LGU. A separate form must be completed for each D/MBE and D/WBE involved in the project.

Project Title: _____ Project Location: _____

**TO:** _____
(Name of Bidder)

**FROM:** _____
(Please Indicate Status [ ] D/MBE or [ ] D/WBE)

° I/we intend to perform work in connection with the above project as (check one):

[ ] An individual
[ ] A corporation
[ ] Other (explain): _____
[ ] A partnership
[ ] A joint venture with: _____

° It is understood that if you are awarded the contract, you intend to enter into an agreement to perform the activity described below for the prices indicated.

**DBE PARTICIPATION**

| Description of Activity | Date of Project Commencement | $ Amount | % Bid Price |
|---|---|---|---|
| | | **$** | **%** |

° The undersigned certify that they will enter into a formal agreement upon execution of the contract for the above referenced project.

| **BIDDER** | **DBE** |
|---|---|
| (Authorized Original Signature) Date<br>ADDRESS: | (Authorized Original Signature) Date<br>ADDRESS: |
| TELEPHONE #: | TELEPHONE #: |
| FEIN: | FEIN: |
| EMAIL ADDRESS: | EMAIL ADDRESS: |

**ORIGINALS:**

- **Compliance Mgr. City/Town Project Location**
- **DEP Program Manager for DEP's AAO Director**

*** Attach a copy of current (within 2 years) DBE Certification**

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## DBE CERTIFICATION OF UNITED STATES CITIZENSHIP

For the SRF program, under the EPA Disadvantage Business Enterprise (DBE) Rule, a DBE must be owned or controlled by a socially and economically disadvantaged person that is also a **citizen of the United States** (*See* 40 CFR 33.202). "Ownership" is defined at 13 CFR 124.105 and "control" is defined at 13 CFR 124.106.

DBEs are certified for the SRF program through the Supplier Diversity Office using the federal Department of Transportation (DOT) DBE rules. EPA allows the use of DBEs certified under the DOT rules as long as they are also United States citizens. To ensure compliance with the EPA rule, MassDEP must verify United States citizenship through the completion of the following form for each DBE used on the project.

SRF Project Number _____

Contract Number _____

Contract Title _____

DBE Subcontractor _____

The undersigned, on behalf of the above named DBE subcontractor, hereby certifies that the DBE firm is either owned or controlled by a person or persons that are citizens of the United States.

_____
Printed Name and Title of DBE Signatory

_____
DBE Signature

_____
Date



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**DISADVANTAGED BUSINESS ENTERPRISE**
**PROGRAM DBE SUBCONTRACTOR PARTICIPATION**
**FORM**

The United States Environmental Protection Agency (EPA) requires that this form be provided to all subcontractors on the project. At the option of the subcontractor, this form may be filled out and submitted directly to the EPA DBE Coordinator.

| | |
|---|---|
| NAME OF SUBCONTRACTOR | PROJECT NAME |
| ADDRESS | CONTRACT NO. |
| TELEPHONE NO. | E-MAIL ADDRESS |
| PRIME CONTRACTOR NAME: | |

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

_____

_____

_____

_____

_____

| CONTRACT ITEM NO. | ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR | AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR |
|---|---|---|
| | | |

_____ _____
Subcontractor Signature Title/Date

Equivalent to EPA form 6100-2

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**REQUEST FOR WAIVER FOR SRF CONSTRUCTION**

Upon exhausting all known sources and making every possible effort to meet the minimum requirements for DBE participation, the Bidder may seek relief either partially or entirely from these requirements by submitting a completed waiver package by the close of business on the third business day after notification by the LGU. Failure to comply with this process shall be cause to reject the bid thereby rendering the Bidder not eligible for award of the contract.

General Information

Project Title: _____ Project Location: _____

Bid Opening (time/date) _____

Bidder: _____

Mailing Address: _____

Contact Person: _____ Telephone No. (  ) _____ Ext. _____

Minimum Requirements

The bidder must demonstrate that good faith efforts were undertaken to comply with the percentage goals as specified. The firm seeking relief must show that such efforts were taken appropriately in advance of the time set for opening bid proposals to allow adequate time for response(s) by submitting the following:

A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:

1. names, addresses, telephone numbers and contact dates of all such companies contacted;

2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;

3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/women-focused media detailing the opportunities for participation;

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after submission of all required information and documentation, MassDEP shall make a determination, in writing, whether the waiver request is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing.

CERTIFICATION

The undersigned herewith certifies that the above information and appropriate attachments are true and accurate to the best of my knowledge and that I have been authorized to act on behalf of the bidder in this matter.

_____ _____

(authorized original signature) DATE

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## STATE REVOLVING FUND LOAN PROGRAM – SCHEDULE OF SUBCONTRACTOR PARTICIPATION

Local Governmental Unit _____

Project Name _____

SRF Identification Number _____

General Contractor _____

Contract Value _____

The United States Environmental Protection Agency (EPA) requires that all SRF borrowers develop and maintain a list of all MBE/WBE and non MBE/WBE subcontractors on the project.

This form must be completed and returned to MassDEP within 90 days of award of the contract.

| Subcontractor | Point of Contact | Mailing Address | Telephone Number | E-Mail Address | MBE | WBE | DBE | Subcontract Value |
|---|---|---|---|---|---|---|---|---|
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Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART I - MOBILIZATION/DEMOBILIZATION** | | | | |
| 1 | For Mobilization/Demobilization, the lump sum of (not to exceed five (5) percent of the sum of all Bid Items - Part II and Part III and excluding Part I). | | | |
| | $ - | l.s. | 1 | $ - |
| | **TOTAL OF PART I - MOBILIZATION/DEMOBILIZATION** | | | **$ -** |
| **PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK** | | | | |
| 2A. | The Work of the General Contractor including all Work for the WWTF other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2B. | The Work of the General Contractor including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of | | | |
| | $ - | l.s. | 1 | $ - |
| 2C. | For rock and/or boulder excavation including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 20 | $ - |
| 2D. | For excavation of unsuitable material below trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of | | | |
| | $ - | per c.y. | 500 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 2E. | For excavation of unsuitable material above trench grade and/or subgrade of structures and pipes including replacement with suitable fill material, as specified, the sum of<br>$ - | per c.y. | 500 | $ - |
| 2F. | For experimental excavation and backfill, as specified, the sum of<br>$ - | per c.y. | 200 | $ - |
| 2G. | Sheeting and shoring left in place - Not Used | | | |
| 2H. | For repairs to the Existing Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2I. | For Site Perimeter Fence located at the WWTF, as specified, the sum of<br>$ - | per l.s. | 1 | $ - |
| 2.J. | For Electric Company Connection/Service Fee, as specified, the sum of<br>One Hundred Twenty Five Thousand Dollars and No Cents<br>$ 125,000.00 | Allowance | 1 | $ - |
| 2.K. | For Telephone Company Connection/Service Fee, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |
| 2.L. | For Gas Company Connection/Service Fee, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |

Company's Name

Date

Company's Address

**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|---|
| 2.M. | For furnishing planting materials and conducting Planting Operations, as specified, the sum of | | | | |
| | Thirty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 30,000.00 | Allowance | | |
| 2.N. | For furnishing Section 11333 - Septage Receiving Station, as specified, the sum of | | | | |
| | Four Hundred Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 400,000.00 | Allowance | | |
| 2.O. | For furnishing Section 11399 - Effluent Disk Filters, as specified, the sum of | | | | |
| | Four Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 450,000.00 | Allowance | | |
| 2.P. | For furnishing Section 11600 - Sequencing Batch Reactors, as specified, the sum of | | | | |
| | Five Hundred Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 550,000.00 | Allowance | | |
| 2.Q. | For furnishing Section 11365 - Rotary Drum Thickeners, as specified, the sum of | | | | |
| | Two Hundred Twenty Five Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 225,000.00 | Allowance | | |
| 2.R. | For conducting Performance Testing, as specified, the sum of | | | | |
| | Fifty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 50,000.00 | Allowance | | |
| 2.S. | For providing Diesel Fuel, as specified, the sum of | | | | |
| | Twenty Thousand Dollars and No Cents | | | 1 | $ - |
| | $ | 20,000.00 | Allowance | | |
| | | | **TOTAL OF PART II - WWTF RELATED WORK** | | **$ -** |

Company's Name

Date

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|

**PART III - FILED SUBBIDS**

| Item | Subbid Description | Name of Sub bidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | Allowance | $ 475,000.00 |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | Allowance | $ 200,000.00 |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | Allowance | $ 2,100,000.00 |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **TOTAL OF PART III - FILED SUBBIDS** | **$ -** |

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| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| **PART IV - ALTERNATIVES** | | | | |
| A-1 | For Addition of the Equipment Storage Facility, as specified, the sum of | | | $ - |
| A-2 | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | $ - |
| A-3 | For Addition of Tracer Wire, as specified, the sum of | | | $ - |
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | $ - |
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | $ - |
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | $ - |

**BASIS OF AWARD - The OWNER's goal is to accomplish the work identified in Base Bid (Part I, Part II and Part III) plus as many of the Alternatives (Part IV) as its funding constraints will allow. The BASIS OF AWARD, therefore, is the lowest bid for the sum of Part I, Part II and Part III plus the cost of the greatest number of Alternatives not exceeding its funding constraints. The Alternatives are listed in the order of their priority for award. Bidders must provide a bid figure for each alternative required regardless of the cost. Additional Funding may be obtained at the Annual Town Meeting proposed to be held in June 2020.**

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, and PART III - FILED SUBBIDS, inclusive)**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1), inclusive**

**$** -

**TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1 and Item A-2), inclusive**

**$** -

Company's Name

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**Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, and Item A-3), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, and Item A-4), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4 and Item A-5), inclusive** | | | **$ -** |
| | **TOTAL AMOUNT OF BASE BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES: (Sum total of PART I - MOBILIZATION/DEMOBILIZATION, PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, PART III - FILED SUBBIDS, and PART IV - ALTERNATIVES (Item A-1, Item A-2, Item A-3, Item A-4, Item A-5 and Item A-6), inclusive** | | | **$ -** |

Company's Name

Date

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-1A | For Addition of the Equipment Storage Facility, as specified, the sum of<br>$ - | l.s. | 1 | $ - |
| A-1B | For providing Compressed Air System, as specified, the sum of<br>Thirty Thousand Dollars and No Cents<br>$ 30,000.00 | Allowance | 1 | $ - |
| | | | **Total of Bid Items A-1A. Through A-1B., inclusive** | **$ -** |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | Allowance | $ 25,000.00 |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| 3G | Section 09300, Tile Work | | | $ - |
| 3H | Section 09941, Field Painting | | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | | $ - |
| 3J | Section 15400, Plumbing | | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | Allowance | | $ 150,000.00 |
| 3L | Division 16 – Electrical (All Sections) | | | $ - |
| | | | **Total of Subbids** | **$ -** |
| | | | **Total of Alternative A-1** | **$ -** |

Company's Name

Date

Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-2. | For Addition of Fiber Optic Conduits and Handholes, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-2** | **$ -** |

Company's Name

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Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-3. | For Addition of Tracer Wire, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-3** | **$ -** |

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-4 | For Addition of SBR Transfer Pump No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-4** | **$ -** |

Company's Name

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-5 | For Addition of the SBR Blower No. 4, as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-5** | **$ -** |

Company's Name

Date

Company's Address

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**PART IV - ALTERNATIVES**

| Item | Description | Unit of Measure | Quantity | Extended Total |
|---|---|---|---|---|
| A-6 | For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of | | | |
| | $ - | l.s. | 1 | $ - |

| Item | Subbid Description | Name of Subbidder | Amount of Subbid |
|---|---|---|---|
| 3A | Section 04120, Stone Veneer | | $ - |
| 3B | Section 05500, Miscellaneous Metal Work | | $ - |
| 3C | Section 07160, Bituminous Dampproofing | | $ - |
| 3D | Section 07610, Metal Roofing | | $ - |
| 3E | Section 08500, Fixed Windows | | $ - |
| 3F | Section 08810, Glass and Glazing | | $ - |
| 3G | Section 09300, Tile Work | | $ - |
| 3H | Section 09941, Field Painting | | $ - |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems | | $ - |
| 3J | Section 15400, Plumbing | | $ - |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning | | $ - |
| 3L | Division 16 – Electrical (All Sections) | | $ - |
| | | **Total of Subbids** | **$ -** |
| | | **Total of Alternative A-6** | **$ -** |

**SECTION 13350**

**SCADA EQUIPMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide SCADA equipment as specified and in accordance with the Contract Documents. The equipment shall include, but not limited to, servers, uninterruptable power supplies (UPSs), human machine interface (HMI) equipment, and all software packages required to provide a complete and functional control and communication system.

B. Equipment Product Sheets are in 13350 Attachment A.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to, the following.

1. SCADA Network Hardware

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

D. Submit Manufacturer Product Data Sheets, with the information noted below and other data pertinent to the equipment and the application.

1. The product manufacturer technical data sheets.

2. The complete model or catalogue number(s) including any special options.

E. Licensing documentations for all software packages.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTIONS 01610, DELIVERY, STORAGE AND HANDLING and SECTION 13300, PROCESS INSTRUMENTS.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**PART 2 - PRODUCTS**

**2.01 - SOFTWARE**

A. All software shall be of the latest version available at the time of submittal review.

B. Rockwell Automation Factory Talk View SE to match software in use at the Water Department. Provide two software clients.

C. WIN 911 software for plant alarm management.

D. A SQL database and XL Reporter will be utilized to develop the plant reports. Reports shall be archived daily but shall be readily accessible to plant operators for one week after generation.

E. Data applications will be stored on external drivers provided by SI with one-touch backup initiation

**2.02 - UNINTRUPTABLE POWER SUPPLY (UPS)**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.03 - THIN CLIENT**

A. General:

1. The Thin Client system shall be based on Microsoft terminal services (remote desktop services) solution, with applications presented to user stations based on thin client hardware. The management of this architecture, including servers, thin client terminals, users, applications and security shall be centrally and securely handled by the proposed Management Software.

2. The Thin Client software will operate on the SCADA server as a virtual machine. Provide Thin Client in the Primary Server and backup Thin Client in the SCADA backup server.

B. Thin Client Hardware shall conform to the following:

1. Thin Client hardware shall be Thin Manager ready and shall not require modification from the manufacturer's standard offering.

2. Hardware shall be capable of using Microsoft Remote Desktop Protocol (RDP) and the associated data compression and encryption.

3. Hardware shall be capable of supporting Network Level Authentication (NLA).

4. Hardware shall be compatible with the supplied Management software.

5. Hardware shall support terminal side USB mouse and keyboard.

6. Hardware shall support local serial ports.

7. Hardware shall support high color, high resolution, and be capable of supporting screen resolutions up to 3840x2160 (UHD).

8. Hardware shall neither require nor contain cooling fans.

9. Hardware shall neither require nor contain local permanent storage (i.e. no flash or hard drive shall be necessary or installed).

10. Hardware shall not require a local operating system to boot.

11. Hardware shall have the ability to boot from the server over a standard network.

12. Hardware shall support standard Ethernet network infrastructures.

13. Hardware shall support using either DHCP, static IP configuration, or terminal profile based IP assignment.

14. In conjunction with the Management Software, the ability to configure hardware shall be supported.

15. Hardware shall support the ability to utilize a single keyboard and mouse to control multiple thin clients.

16. Hardware shall support the ability to utilize a single thin client with up to 5 monitors to drive multiple stations, each with their own display, keyboard and mouse.

17. Hardware shall support the ability to move applications from one monitor to another with a thin client that supports multiple monitors. This should be fully configurable.

18. Hardware shall support automatic login to a predetermined terminal server and start a session without operator input.

19. Hardware shall be capable of interfacing with smart card readers.

20. Hardware shall be capable of redundant networking.

21. Hardware shall be able to utilize multiple network interfaces on the Thin Client for different LAN segments.

22. Hardware shall be capable of interfacing with any touch screen controller.

23. Thin Client Terminals:

    a. Thin Clients shall be set-up to run a terminal session of the HMI by connecting to the SCADA Terminal Server.

C. Thin Client Terminals

1. Compact, fanless, tower form factor with flexible mounting options; desktop or panel mount as indicated on the Contract Drawings.
2. 500 MHz processor minimum.
3. 256 MB of RAM minimum.
4. Video graphics card capable of 1600 x 900 pixels, 60Hz refresh rate and 16-bit color minimum. VGA output.
5. Operating temperature of 10 degrees Celsius to 50 degrees C
6. 110 Ports & devices

    a. Minimum of two USB 2.0 ports supporting USB mouse and keyboard.

D. Interface devices

1. Generic USB keyboard, no hot keys or number pad onboard
2. Two button USB optical mouse with scroll wheel
3. Monitor

    a. LCD flat panel 20-inch nominal size minimum
    b. UHD support for 3840 x 2160 resolution
    c. 16 ms response time maximum
    d. 250 nits (cd/m2) brightness
    e. 400 to 1 contrast ratio minimum
    f. Vertica1 viewing angle of 85 degrees minimum
    g. Horizontal viewing angle of 85 degrees minimum
    h. Analog GRB, Digital DVI-D
    i. Adjustable height stand for desktop applications
    j. Panel mount option for installations in PLC panels as indicated with screen minimum size of 15 inches. Screen shall be touch type unit.

E. Networking:

1. The onboard network interface shall have the following features

    a. Support for latest Microsoft operating system.
    b. Fast Ethernet port accepting standard CAT-6 cables for Ethernet communications
    c. IEEE 802.3ab support for gigabit networking standard
    d. IEEE 802.Q VLAN support
    e. Auto sensing 10/100 Mbps or faster
    f. Support either DHCP or static IP configuration.

F. Power supply shall be capable of providing necessary power. Thin Client and monitor shall be I20VAC from UPS.

G. Thin Client Hardware

1. Thin Client Terminals shall be Arista; Microbox 7824B-B01-003-DR or equal.
2. Provide client terminals for the following services:
    a. OWS-01
    b. OWS-02
    c. Flat Screen TV in Conference Room
    d. Flat Screen TV in Control Room

**2.05 - MANAGEMENT SOFTWARE:**

A. The Management Software shall be able to support configuration of Servers, Thin Clients ('terminals') and Applications from a central interface.

1. Software shall allow centralized configuration of all aspects of the proposed architecture. No client based configuration shall be required.
2. Software shall support connectivity, configuration and interoperability with Microsoft Terminal Services operating systems from Windows 2003 Server through to the latest offering (currently Windows Server 2016).
3. Management software shall be capable of running on the operating systems specified.
4. Software shall support management of the overall terminal services architecture.
5. Software shall permit terminals to be remotely configured and reset from the central interface without the need for the administrator to be at the physical location of the terminal.
6. Software shall permit Windows authentication with auto-login features.
7. Software shall permit automatic login to a predetermined terminal server and start a session without operator input.
8. It shall be possible to configure multiple terminal servers to be used in a load balancing manner without implementing clustering.
9. Load balancing shall be automatically handled by the software and shall be tunable based on CPU utilization, Memory usage and Process usage on the server.
10. Software shall support the ability to queue access requests to the server and complete when resources are available.
11. Software shall support the ability to configure multiple terminal servers to be used and provide the ability to 'failover' to the backup terminal server if the current terminal server fails.
12. Software shall support Shadowing of terminals from management software (Shadowing refers to the ability to view, with authorization, any terminal screen on the managed network).
13. Software shall support the ability to Shadow one terminal on one or more terminals.
14. Software shall have monitoring capabilities to detect and display terminal server assignment, login status, terminal load, and terminal server load.
15. Should a thin client fail, the software should provide the ability to allow quick replacement of the failed client with a spare, with no required configuration changes.
16. Should a thin client fail, the replacement terminal shall be automatically reconnected to the existing (disconnected) terminal session.
17. Software shall support the automatic logout of a session after a configurable period of inactivity.
18. Software shall support the integration of IP camera video as either an overlay on an existing terminal screen or as a separate client application.

19. Software shall support software decoding of IP camera streams as well as hardware decoding (with appropriate thin client hardware).
20. Multiple video streams shall be able to be configured onto a single client display.
21. Software shall permit configuration permitting sound from an application, or from multiple applications, to be played from the thin client device.
22. Software shall support easy backup and restoration of the configured architecture.
23. Software shall be extensible, preferably utilizing an ActiveX control or .NET component.
24. Software shall support the delivery of applications from multiple terminal servers to a single thin client, and visualize the sessions simultaneously.
25. Software shall support the management of applications being delivered to a PC based platform.
26. Software shall support industrial and commercially available thin client hardware.
27. The Management Software shall be able to be used from a portable, network connected mobile device.
28. Software shall support remote configuration with an iOS device such as an iPad or iPhone, or Android device.
29. Thin client emulation software shall be available to provide operator level functionality from a network connected iOS or Android devices.
30. The thin client emulation software shall not permit the operator to configure or otherwise interact in an administrative capacity with the network.
31. The thin client emulation software shall support delivery of applications to the mobile device based on location.
32. The thin client emulation software shall support location based resolvers including Quick Response (QR) Codes, Bluetooth Beacons, Global Positioning System (GPS) and WiFi Access Points.
33. Upon location based resolution, the thin client emulation software shall support different actions based on the user's access group, including Interactive Shadow, Non-interactive Shadow, Manual Transfer, Force Transfer and Clone.
34. The thin client emulation software shall support the combination of location resolvers to create a geo-fence for application delivery.
35. Security of the configuration and access to servers shall be managed and configured with the Management Software.
36. Software shall support but not require different levels of access for security based on user identity.
37. Users shall be able to be placed into security groups for easy management.
38. Software shall support Application access based on user identity.
39. Software shall support configuring of Applications such that only the Application window is presented to the user (i.e. no desktop or Start menu), thereby denying access to unauthorized programs.
40. User level access shall be able to be configured independent of any operating system based authentication, such as Active Directory, and shall not require access to such for configuration.
41. User level access using Microsoft Active Directory or other operating system based authentication shall however be supported.
42. The software shall support synchronization with Microsoft Active Directory organization units (OU).
43. Software shall support the storage of credentials that can be pushed to Microsoft Active Directory.
44. Software shall support automatic password generation at a configurable interval while maintaining Microsoft Active Directory complexity requirements.

45. Software shall support the delivery of applications based on a user's assignment to a Microsoft Active Directory security group.
46. Software shall permit automatic launching of programs without operator input.
47. Software shall support the ability for a supervisor to access their authorized applications and desktop from any configured terminal.
48. Software shall support the ability to permit or deny users, or groups of users, access to applications unless suitably authorized and authenticated.
49. Software shall support blocking of interrupt key sequences such as CTL+ALT+DEL and CTL+ESC.
50. Local terminal USB ports shall not be connected to the server.
51. The Management Software shall be able to manage licensing within the central interface.
52. Licensing shall be flexible based on the number of clients managed on the network.
53. The number of servers managed as a part of the architecture shall not be restricted by the management software license.
54. It shall be possible to add more client licenses to the network without disturbing the connected clients.
55. There shall be a level of licensing which permits an unlimited number of clients to be connected and managed without the need to purchase additional client licenses.

**2.06 – COMPUTER WORK STATIONS**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.07 – PRINTERS**

A. Quantity

1. Provide quantity as shown on Contract Drawing 00 DI-601.

B. All printers shall be Laser type color printer with scanner except one printer will be dot matrix type printer for alarms processing

C. Printers shall be capable of printing on letter (8.5” x 11”) or tabloid (11”x17”) sheets of paper. The printer shall accept paper fed manually or from one of two paper trays, each with a minimum capacity of 200 sheets. The printer shall print at least 35 pages of text per minute at a resolution of 1200 dpi or greater. The printer shall contain a minimum of 48 MB of on-board RAM, expandable to 320 MB. The report printer shall be a Hewlett Packard LaserJet P4015 series or equal.

D. Report printer(s) shall be provided with a 10/100/1000 Base-TX interface to provide connectivity to the computers over the Ethernet network

2.10 – NETWORK SERVERS

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.11 – SCADA EQUIPMENT RACK**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.12 – TV MONITOR**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.13 - SPARE PARTS**

A. Provide recommended spare parts list with unit prices.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Provide, install, test and commission SCADA Equipment and all peripheral devices necessary in accordance with the Contracts Documents.

B. The SI shall install, configure and setup all software packages provided.

### 3.02 - FIELD TESTING

A. Demonstrate system functional operation after completion of installation and prior to plant start up. Refer to SECTION 13331, CONTROL SYSTEM INTEGRATION for control system field testing requirements.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**See Attachment A, Product Sheets**

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**ATTACHMENT A**

**PRODUCT SHEETS**

| | |
|---|---|
| DATA SHEET 583.1 | SOFTWARE |
| DATA SHEET 702.1 | UNINTERUPTIBLE POWER SUPPL |
| DATA SHEET 706.1 | FULL SCADA NODE - COMPUTER DESK TOP WORK STATION |
| DATA SHEET 706.2 | FULL SCADA NODE – DEVELOPER COMPUTER LAPTOP WORKSTATION |
| DATA SHEET 712.1 | NETWORK SERVER |
| DATA SHEET 712.2 | NETWORK SERVER |
| DATA SHEET 750.1 | SCADA EQUIPMENT RACK |
| DATA SHEET 900.1 | TV MONITOR |

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**SOFTWARE**

---

DATA SHEET NO. 583.1 . 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Function | : | INTEGRATION OF PLC, HMI, NETOWRK, WORKSTATIONS & PERIPHERALS |
| 2. | Location | : | PART OF CONTROL SYSTEM |

SOFTWARE

| | | | |
|---|---|---|---|
| 3. | PLC Config | : | RSLOGIX 5000 STUDIO PROFESSIONAL EDITION. |
| 4. | HMI Config | : | ROCKWELL FACTORY TALK VIEW SE TO MATCH WHAT IS IN USE AT THE WATER DEPARTMENT. INCLUDE 5 YEARS SUPPORT STARTING 30 DAYS FROM CONTRACT NOTICE TO PROCEED |
| 5. | Historian | : | FACTORYTALK HISTORIAN SITE EDITION, 5000 ACTIVE POINTS |
| 6. | Virtual Software | : | VIRTUAL MACHINE VM WARE OR HYPER V |
| 7. | Thin Client | : | THIN MANAGER |
| 8. | Microsoft: | : | Microsoft Windows Server OEI-16 Core CAL – Data Center Version |

NOTES:

a. Provide all softwares as the most current release available at time of shop drawings submittals.

**UNINTERRUPTIBLE POWER SUPPLY**

---

DATA SHEET NO. 702.1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | LINE POWER CONDITIONING AND BACKUP POWER FOR PLC/SCADA SYSTEM |
| 2. | Location | : | SERVER RACK, WWTF-PLC, WW.PS-1-PLC, WW.PS-2-PLC, WW.PS.3-PLC, WDV-PLC |
| 3. | Input Voltage | : | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 20% |
| 4. | Output Voltage | : | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 3% SINE WAVE, +/- 1% VOLTAGE BALANCE |
| 5. | Input Current Total Harmonic Distortion (THD): 3% AT 100% LOAD – 5% AT 50% LOAD | | |
| 6. | Output Voltage Harmonic Distortion: 2% MAX. AT 100% LOAD – 5% MAX. AT 50% LOAD | | |
| 7. | Power Factor | : | 0.90 AT 100% LOAD – 0.90 AT 50% LOAD |
| 8. | Operating Temp. | : | 50 TO 104 DEG. F. |
| 9. | Surge Protection | : | 6000 VOLT AND MEET IEEE C62.41 CATEGORIES A AND B |
| 10. | Backup Time | : | MINIMUM OF 10 MINUTES MINIMUM AT 120% OF FULL LOAD |
| 11. | KVA Size: | : | 10 KVA MINIMUM AND IN ACCORDANCE WITH SIZING CALCULATIONS REQUIREMENT SPECIFIED. |
| 12. | Low Battery Ind. | : | REQUIRED |
| 13. | Brownout Protection | : | REQUIRED |
| 14. | UPS Type | : | VOLTAGE REGULATION LINE INTERACTIVE |
| 15. | Efficiency | : | 92% MINIMUM |
| 16. | Transfer Time | : | LESS THAN ONE MILLISECOND |
| 17. | Communication | : | RS-232 AND MODBUS ETHERNET COMMINUCATION |
| 18. | Digital Display | : | TOUCH SCREEN |
| 19. | Local Alarms | : | LEDs AND AUDITABLE |
| 20. | Digital Alarm Contacts: | : | LOW BACKUP TIME, OVERLOAD, REPLACE BATTERY, LOW BATTERY, LOAD ON INVERTER, LOAD ON BYPASS LCD FAULT, UPS FUALT |
| 21. | Audible Noise | : | LESS THAN 50 dB @ 3 FT |
| 22. | Certificate | : | UL LISTING |

BATTERY

| | | | |
|---|---|---|---|
| 1. | Type | : | SEALED, LEAD ACID MAINTENANCE FREE |
| 2. | Battery Protection | : | THERMAL, OVERVOLTAGE AND OVERCURRENT |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 1. | Manufacturer(s) | : | EATON, BEST, SOLA, APC OR EQUAL |

NOTES.

a. Provide UPS system such that upon failure of the UPS feeder, batteries provided with UPS immediately take over as the power source.

b. Provide external bypass switch with three circuit breakers Make-Before-Break system. Provide bypass to isolate the UPS equipment for maintenance. Provide bypass with switch test so the switch may be tested without the risk of dropping the load caused by static switch failure.

c. Provide static transfer switch to transfer load upon loss of power at the output of the UPS.

d. Provide UPS sizing documentations in the shop drawing submittal. UPS shall supply power to PLCs, RIOs, SCADA severs, Thin Client nodes, network communications equipment workstations and field instruments. Provide sizing documentations analysis which are based on required load plus minimum of 10% spare capacity.

**FULL SCADA NODE - COMPUTER DESK TOP WORKSTATION**

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DATA SHEET NO. 706.1 1

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | DESKTOP |
| 2. | Location | : | CONTROL ROOM |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | FULL TOWER CHASSIS |
| 4. | Fans | : | PROVIDE 2-120mm CASE FANS, DUAL BALL BEARINGS, 80 CFM MIN 30,000 HR MTBF |
| 5. | Processor | : | INTEL i7QUAD CORE PROCESSOR 2.6 GHz MINIMUM |
| 6. | Memory | : | 64 GB DDR4 |
| 7. | RAM Cashe | : | L2 512KB |
| 8. | Hard Disk | : | 2-500GB SATA (3GB/S) 7,200 RPM RAID 1 |
| 9. | Controller | : | INTEGRATED |
| 10. | CD-RW | : | CD RW/DVD COMBO |
| 11. | Graphics | : | 2-NVIDIA GTX 260 PCIX 2.0 (MINIMUM 2 DVI PORT) ADAPTERS |
| 12. | Monitor | : | 20 -INCH, LED FLAT PANEL WIDE SCREEN (DVI CABLING) |
| 13. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1 HDMI 1-KEYBOARD (PS/2), 1-PS/2 MOUSE |
| 14. | Expansion Slots | : | 4-PCIX 2.0, 1-PCIX 1.0, 2-PCI, 1-PATA, 6-SATA (3 GB/S) |
| 15. | Keyboard | : | 104 KEY ENHANCED PS/2 KEYBOARD |
| 16. | Mouse | : | MICROSOFT WIRELESS MOUSE |
| 17. | Network Interface | : | 10/100/1000Mbps |
| 18. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz 800 W MIN |
| 19. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 20. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 21. | Software | : | MICROSOFT OFFICE PROFESSIONAL, ADOBE ACROBAT PROFESSIONAL, HMI SOFTWARE CONFIGURATION PACKAGE, CONTROL SYSTEM PROGRAMMING SOFTWARE |
| 22. | Operating System | : | MICROSOFT WINDOWS PROFESSIONAL LATEST VERSION OR LATEST OR WINDOWS SERVER BASED ON CONFIGURATION |
| 23. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 24. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

NOTES.

a. Provide all software as the most current release at time of shop drawings submittal.

b. Provide software keys for each workstation so that control system and HMI software development and configuration will be possible from any workstation.

**FULL SCADA NODE – DEVELOPER COMPUTER LAPTOP WORKSTATION**

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DATA SHEET NO. 706.2 1

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | TOUCHSCREEN LAPTOP |
| 2. | Location | : | CONTROL ROOM |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | LAPTOP |
| 5. | Processor | : | INTEL i7 QUAD CORE PROCESSOR 2.6 GHz MINIMUM |
| 6. | Memory | : | 32 GB DDR4 |
| 7. | RAM Cashe | : | L2 512KB |
| 8. | Hard Disk | : | 1 – 1 TB SSD |
| 9. | Controller | : | INTEGRATED |
| 10. | CD-RW | : | CD RW/DVD COMBO |
| 11. | Graphics | : | NVIDIA GFORCE |
| 12. | Monitor | : | 15-INCH, FULL HD PANEL |
| 13. | I/O Ports | : | 1-PARALLEL, 3-USB, 1-SERIAL, 1 HDMI 1-KEYBOARD (PS/2), 1-PS/2 MOUSE |
| 14. | Keyboard | : | 104 KEY ENHANCED PS/2 KEYBOARD |
| 15. | Mouse | : | MOUSE TOUCH PAD |
| 16. | Network Interface | : | 10/100/1000Mbps |
| 17. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 18. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 19. | Software | : | MICROSOFT OFFICE PROFESSIONAL, ADOBE ACROBAT PROFESSIONAL, HMI SOFTWARE CONFIGURATION PACKAGE, PLC CONTROL SYSTEM PROGRAMMING SOFTWARE |
| 20. | Operating System | : | MICROSOFT WINDOWS PROFESSIONAL LATEST VERSION OR LATEST OR WINDOWS SERVER BASED ON CONFIGURATION |
| 21. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

NOTES.

a. Purchase the Laptop at the end of the project (1 year prior to substantial completion) of the most current hardware at that time.
b. Provide all software as the most current release at time of shop drawings submittal.
c. Provide software keys.

**NETWORK SERVER**

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DATA SHEET NO. 712-1. 1

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | SCADA/THIN CLIENT PRIMARY SERVER AND SCADA/THIN CLIENT BACKUP SERVER |
| 2. | Location | : | SERVER RACK |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | RACK MOUNTED |
| 4. | Processor | : | LATEST INTEL XEON E5-4600 Series, MIN. 12 CORES, 2.4 GHz PROCESSOR (OR EQUIVALENT LATEST AVAILABLE PROCESSOR AT TIME OF BID) |
| 5. | Memory | : | EIGHT MODULES, EACH – 16 GB DDR4 DIMMs |
| 6. | Hard Disk | : | TWO - 1 TB SATA (3 GB/S) 7200 RPM AND TWO 500 GB SSD |
| 7. | Controller | : | EMBEDDED RAID |
| 8. | Network | : | DUAL GIGABIT ETHERNET ADAPTER |
| 9. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1-KEYBOARD (PS/2), 1-MOUSE (PS/2) |
| 10. | Expansion Slots | : | UP TO 6-PCIe, 1-PATA, 6-SATA (3GB/S) |
| 11. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 12. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 13. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 14. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

SERVER SOFTWARE

| | | | |
|---|---|---|---|
| 15. | Operating System | : | MICROSOFT WINDOWS SERVER 2012 (OR LATEST AVAILABLE AT TIME OF BID) |
| 16. | Software | : | CONTROL SYSTEM PROGRAMMING SOFTWARE, HMI SOFTWARE CONFIGURATION PACKAGE, VIRTUAL MACHINE (VM) SOFTWARE. |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 17. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |

NOTES.

a. Provide all software as the most current release available at the time of shop drawings submittals.
b. Provide advanced system monitoring, management and alerting for reliable and consistent server operation.
c. System monitoring and management features shall include fault monitoring of voltage, fan, and thermal conditions, tracks memory errors, automatic server recovery to reboot and restart the server if the operating system hangs without user intervention.

**NETWORK SERVER**

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DATA SHEET NO. 712-2. 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | HISTORIAN SERVER AND BACKUP HISTORIAN SERVER |
| 2. | Location | : | SERVER RACK |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | RACK MOUNTED |
| 4. | Processor | : | LATEST INTEL XEON E5-2600 Series, MIN. 8 CORES, 2.4 GHz PROCESSOR (OR EQUIVALENT LATEST AVAILABLE PROCESSOR AT TIME OF BID) |
| 5. | Memory | : | FOUR MODUELS, EACH – 16 GB DDR4 DIMMs |
| 6. | Hard Disk | : | TWO - 1 TB SATA (3 GB/S) 7200 RPM AND TWO 500 GB SSD |
| 7. | Controller | : | EMBEDDED RAID |
| 8. | Network | : | DUAL GIGABIT ETHERNET ADAPTER |
| 9. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1-KEYBOARD (PS/2), 1-MOUSE (PS/2) |
| 10. | Expansion Slots | : | UP TO 4-PCIe, 1-PATA, 2-SATA (3GB/S) |
| 11. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 12. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 13. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 14. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

SERVER SOFTWARE

| | | | |
|---|---|---|---|
| 15. | Operating System | : | MICROSOFT WINDOWS SERVER 2012 (OR LATEST AVAILABLE AT TIME OF BID) |
| 16. | Software | : | HISTORIAN SOFTWARE, MICROSOFT OFFICE SOFTWARE. |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 17. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE |

NOTES.

a. Provide all software as the most current release available at the time of shop drawing submittals.
b. Provide advanced system monitoring, management and alerting for reliable and consistent server operation.
c. System monitoring and management features shall include fault monitoring of voltage, fan, and thermal conditions, tracks memory errors, automatic server recovery to reboot and restart the server if the operating system hangs without user intervention.

**SCADA Equipment Rack**

---

DATA SHEET NO. 750.1 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | SCADA EQUIPMENT |
| 2. | Location | : | ELECTRICAL ROOM (108) |

RACK

| | | | |
|---|---|---|---|
| 3. | Type | : | EIA-310-D, 19 INCH RACK |
| 4. | Front and Rear Doors | : | 80% PERFRATION ON FRONT AND REAR DOORS, SECURITY LOCKS, TOOLLESS DOOR REMOVAL, SPLIT DOOR, MAXIMIZED AIR FLOW SYSTEM. |
| 5. | Side Panels | : | SPLIT, LIGHTWEIGHT, 2 PIECES |
| 6. | Top Panel | : | VENTILATED TOP PANEL |
| 7. | Mounting | : | FLOOR |
| 8. | Cable Management System | : | YES |
| 9. | Standard | : | UL 60950.1 COMPLIANT |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 10. | Manufacturer(s) | : | CISCO R SERIES OR EQUAL |

**TV MONITOR**

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DATA SHEET NO. 900.1 1

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag | : | TV-1, TV-2 |
| 2. | Location | : | CONFERENCE ROOM (105), CONTROL ROOM (106) |

TV MONITOR

| | | | |
|---|---|---|---|
| 3. | Type | : | LED LCD 4K ULTRA HIGH DEFINTION FLAT PANEL |
| 4. | Size | : | 55 INCH |
| 5. | I/O Ports | : | 6-USB, 3 HDMI |
| 6. | Power Supply | : | 115 VAC/60 Hz |
| 7. | Mounting | : | WALL |
| 8. | Mounting Hardware | : | WALL MOUNTING EASY ADJUSTABLE BRAKET SETUP |
| 9. | Surge Protection | : | YES |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 10. | Manufacturer(s) | : | SONY, SAMSUNG, LG OR EQUAL |

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May 12, 2020

**ADDENDUM NO. 12**

**TO**

**DOCUMENTS AND SPECIFICATIONS**

**FOR**

**Downtown Area Wastewater Treatment Facility and Effluent Disposal**

**Contract No. 2019-01 and SRF No. 4486**

**Town of Orleans, MA**

**Department of Public Works & Natural Resources**

This Addendum No. 12 forms a part of the Contract Documents and modifies the Bidding Documents dated January 2020 as noted below. Acknowledge receipt of this Addendum in the space provided in SECTION 00410, FORM OF GENERAL BID. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 2 pages and 0 pages of attachments for a total of 2 pages.

## ATTACHMENTS

None

## RESULTS OF SUBBIDS

1. Results of May 6, 2020 Sub-Bid Opening, as attached.

## CHANGES TO BE MADE TO THE CONTRACT SPECIFICATIONS

1. GENERAL

   A. General Bid Opening – May 13, 2020 at 2:00 p.m.

      General Bids will be received outside of Orleans' Town Hall. The Owner and/or their representatives will be outside the building to receive General Bids on May 13, 2020 starting at 8:00 a.m. The General Bids will be taken inside to be opened at 2:00 p.m. Access to the Orleans' Town Hall is restricted to the Owner and their representatives. The General Bid Opening will be broadcast live on Channel 18. The Channel 18 feed is also sent to the Owner's livestream on the Owner's webpage. Anyone can access the live feed using the link below.

      https://www.town.orleans.ma.us/orleans-18/pages/ch-18-vod-and-live-streaming-player

   B. PDF copies of the General Bids received, not including documents that are not allowed by law, will be available on the Owner's website within 7 calendar days of the bid opening.

2. SECTION 00410, FORM OF GENERAL BID

   A. Bidder shall complete, printout in Landscape Format, and submit the Proposal Form with a combination of typed and handwritten entries. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   B. Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

3. SECTION 01025, MEASUREMENT AND PAYMENT

   A. Page 01025-7, PART IV - ALTERNATIVES, ITEM A-2 - FIBER OPTIC CONDUITS AND HANDHOLES,

      ITEM A-2 - FIBER OPTIC CONDUITS AND HANDHOLES

      A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include placement of conduits, handholes, fiber optic cable, radio communications as shown on the contract drawings and all other incidental Work relative thereto in place of providing radio communications at the WWTF, Pump Station No. 2 and Pump Station No. 3 as shown on the contract drawings and Pump Station No. 1 and Effluent Disposal Site (Addendum No. 5).

      B. Measurement. Measurement shall be made based on providing the Fiber Optic Conduits and Handholes, as approved by the Engineer. Contractor shall include: (a) the cost to provide (i.e. furnish, install, terminate and test fiber optic cable, etc.) fiber optic conduits, handholes and fiber optic cable at the WWTF Site and Effluent Disposal Site; and (b) the cost to provide (i.e. furnish, install, terminate and test fiber optic cable, etc.) fiber optic cable in the fiber optic conduits and handholes installed as part of Contract No. 2019-02 , Downtown Area Collection System and Pumping Stations.

      C. Payment. Payment for Fiber Optic Conduits, Handholes and Fiber Optic Cable listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

4. SECTION 02520, WICK CONSTRUCTION AND TESTING

   A. Page 02520-6, ARTICLE 1.07 – WARRANTY, Paragraph C., delete the paragraph in its entirety and replace with the following new paragraph:

      C. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

**CHANGES TO BE MADE TO THE CONTRACT DRAWINGS**

None

**CHANGES TO BE MADE TO THE CONTRACT ATTACHMENTS**

None

**END OF ADDENDUM NO. 12**

**SECTION 00100**

**ADVERTISEMENT FOR BIDS**

**TOWN OF ORLEANS, MASSACHUSETTS**

**DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL**

**CONTRACT NO. 2019-01 AND SRF NO. 4486**

1. The Town of Orleans, MA acting through the Town of Orleans Town Administrator will receive sealed bids for Downtown Area WWTF and Effluent Disposal, Contract No.2019-01 and SRF No. 4486. The scope of work includes constructing: (a) 350,000 gpd Sequence Batch Reactor Wastewater Treatment Facility located at 20 Overland Way; (b) effluent disposal with five 5 wick wells located at 34 Lots Hollow Road; and (c) and all appurtenances as specified and/or as shown on the drawings in order to provide wastewater service to the Downtown Area of Orleans, MA.

2. The Work of the Project shall be completed shall be completed within 654 calendar days following execution of the Contract Document using not more than 411 working days.

3. Bids

   a. Sealed General Bids from pre-qualified General Contractors will be received at the Town Administrator's Office, Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 2:00 p.m. prevailing time, on May 13, 2020 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

      Unforeseen Office Closure – if, at the time of the scheduled bid opening, Orleans Town Hall is closed due to uncontrolled events such as fire, snow, ice, wind, or building evacuation, the bid opening will be postponed until 2:00 p.m. on the next normal business day. Bids will be accepted until that date and time.

      Bids must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "General Bid for "Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486".

      In accordance with MGL c.149, s44D, Bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the category of Sewage Treatment Plant Contractor. An Update Statement (Form CQ3) covering the period from the date of the Bidder's most recently filed Contractor Qualification Statement (CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT.

      Only Bids from pre-qualified General Contractors shall be accepted by the Awarding Authority.

   b. Sealed Sub-Bids from pre-qualified Subcontractors will be received at the Town Administrator's Office, Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 11:00 a.m. prevailing time, on May 6, 2020 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

      Unforeseen Office Closure – if, at the time of the scheduled bid opening, Orleans Town Hall is closed due to uncontrolled events such as fire, snow, ice, wind, or building evacuation, the bid opening will be postponed until 2:00 p.m. on the next normal business day. Bids will be accepted until that date and time.

      Bids must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "Sub-Bid for "Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486". In addition, the sealed envelope shall indicate the applicable Sub-Bid Category.

      In accordance with MGL c.149, s44D, Sub-bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the applicable subbid category noted below. An Update Statement (Form CQ3) covering the period from the date of the Subbidder's most recently filed Contractor Qualification Statement

(CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT.

Only Sub-Bids from prequalified Filed Sub-Bid Subcontractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

- Masonry
- Miscellaneous Metal Work
- Roofing and Flashing
- Metal Windows
- Glass and Glazing
- Painting
- Plumbing
- Heating, Ventilating and Air Conditioning
- Electrical Work

Sub-Bids from Filed Sub-Bid Subcontractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

- Waterproofing and Dampproofing
- Tile
- Fire Protection

4. Bidding Documents may be obtained electronically from the office of the Tighe & Bond, Inc.'s (Owner's Project Manager) website at: http://www.tighebond.com/Projects_Out_to_Bid.php.

   Prospective bidders must complete a one-time registration process on the web site in order to receive log-in credentials. Bidders must log in to the web site to download bidding documents for the project. Bidders will be added to the "plan holders" or prospective bidders list upon downloading the bidding documents for the project.

   Partial sets of Bidding Documents will not be provided by the Owner, Owner's Project Manager nor Engineer. Neither OWNER, Owner's Project Manager nor Engineer will be responsible for full or partial sets of the Contract Documents, including Addenda, if any, obtained from sources other than the Issuing Office. Contract Documents will be available for distribution on February 5, 2020.

   The Instructions to Bidders, Form of General Bid, Agreement, Plans, Specifications, Performance and Payment Bond, and other Contract Documents may be examined between the hours of 9:00 am and 3:00 pm at AECOM Technical Services, Inc., 9 Jonathan Bourne Drive, Pocasset, Massachusetts 02559.

   Interpretations or clarifications to questions (submitted through Tighe & Bond, Inc.'s website in writing - typed, not handwritten), considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered.

5. A non-mandatory Pre-bid Conference will be held on February 20, 2020 at the Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 at 1:00 p.m. prevailing time. Bidders will have an opportunity to view the site of the work during the non-mandatory Pre-bid Conference.

6. Each bid must be accompanied by a five (5) Percent Bid Security in the form of a bid bond, cash, certified check, treasurer's or cashier's check payable to the Owner in the amount of five percent of the bid, in accordance with SECTION 00200 - INSTRUCTIONS TO BIDDERS. If, upon acceptance of a Bid, a Bidder fails to enter into a Contract with the Town of Orleans, MA, the bid security shall be forfeited to and become the property of the Town of Orleans, MA.

   Contract payment will be by the unit price method and the lump sum price method as indicated on the Bid Proposal. No Bidder may withdraw his/her Bid prior to June 30, 2020 or the date of award whichever shall occur first.

   The successful Bidder must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company satisfactory to the Town of Orleans, MA and conforming to SECTION 00610, PERFORMANCE BOND and SECTION 00615, PAYMENT BOND.

All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all subbid categories including the categories in which less than three subcontractors were prequalified. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

All bids for this project are subject to applicable bidding laws of Massachusetts, including General Laws Chapter 149, Section 44A through Section 44J, as amended.

7. Prevailing Wage Rates as determined by the Commissioner of Department of Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project.

   The Prevailing Wage Rates for those trades people who may be employed for the proposed installation work under this contract is included in the Bid documents. Prevailing Wage Rates for this project were obtain and are included in Document 00830 under Attachment A.

   A weekly certified payroll submittal shall be required of the successful bidder in accordance with MGL C149, S27B. No payments will be made by the Town of Orleans, MA until all payroll information necessary for the Town to determine compliance with prevailing wage law requirements for the time period of the payment request have been submitted.

8. Bidders are not to include in their Bid Proposal sales and compensating use taxes on materials and supplies purchased for this project. All materials used are tax exempt.

9. This Contract to be awarded as the result of this Advertisement for Bids is funded in part through the Massachusetts Department of Environmental Protection, Bureau of Resource Protection, by loans from the Massachusetts Clean Water Trust. This Contract will be subject to the Department of Environmental Protection regulations contained in 310 CMR 44.00, "DEP Selection, Approval and Regulation of Water Pollution Abatement Projects Receiving Financial Assistance from the State Revolving Fund" in effect on the date of issuance of the assistance award (DEP Project Approval Certificate) by the Department.

10. Disadvantaged Business Enterprise (DBE) goals are applicable to the total dollars paid to the construction contract. The goals for this project are a minimum of 4.2 percent D/MBE participation and 4.5 percent D/WBE participation by certified DBEs. The two low bidders shall submit completed DBE forms (EEO-DEP-190C, EEO-DEP-191C and the DBE Certification of United States Citizenship form) by the close of business on the third business day after bid opening. Failure to comply with the requirements of this paragraph may be deemed to render a proposal non-responsive. No waiver of any provision of this section will be granted unless approved by the Department of Environmental Protection (MassDEP)."

11. Bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the category of Sewage Treatment Plant Contractor. An Update Statement form covering the period from the date of the Bidder's most recently filed Contractor Qualification Statement (CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT. The project does not require the Contractor to have MassDOT Highway Division Certification.

12. The Project requires compliance with the Massachusetts Diesel Retrofit Program (MDRP) by use of engine emission controls that are EPA certified, or their equivalent, on the off-road (non-registered) diesel vehicles/equipment used at the job site. Bidders must submit a signed and dated Statement of Intent to Comply as part of their Bid Proposal Document. Failure to comply with these MassDEP requirements may be deemed to render a proposal nonresponsive. No waiver of any provision of these MassDEP requirements will be granted unless approved by the MassDEP.

13. The Contractor shall not discriminate about the personnel employed on this project on the basis of race, color, creed, national origin, gender, sexual preference, handicap or age.

14. The Owner reserves the right to award the Project subject to appropriation.

15. The Town of Orleans, MA reserves the right to accept and/or reject any and all bids and to waive any informalities to the extent allowed by law, and to make the award as deemed to be in the best interest of the Town.

Town of Orleans, MA

John F. Kelly, Orleans Town Administrator

**END OF SECTION**

**SECTION 00200**

**INSTRUCTIONS TO BIDDERS**

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**1.01 RECEIPT AMD OPENING OF BIDS**

A. Town of Orleans, MA herein called the OWNER, will receive sealed Bids for the Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486.

B. Sealed General Bids from pre-qualified General Contractors will be received at the Town Administrator's Office, Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 2:00 p.m. prevailing time, on May 13, 2020 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

Bids must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "General Bid for Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486".

Bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the category of Sewage Treatment Plant Contractor. An Update Statement form covering the period from the date of the Bidder's most recently filed Contractor Qualification Statement (CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT.

Only Bids from pre-qualified General Contractors shall be accepted by the Awarding Authority.

C. Sealed Sub-Bids from pre-qualified Subcontractors will be received at the Town Administrator's Office, Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 11:00 a.m. prevailing time, on May 6, 2020 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

Bids must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "Sub-Bid for Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486". In addition, the sealed envelope shall indicate the applicable Sub-Bid Category.

Sub-bidders are advised that their Bids must be accompanied by a copy of their Certificate of Eligibility issued by the Commissioner of the Division of Capital Asset Management and Maintenance. The Certificate of Eligibility shall be for the applicable subbid category. An Update Statement form covering the period from the date of the Sub-bidder's most recently filed Contractor Qualification Statement (CQS) to the Bid date shall also be submitted with the Bid. A form for the Update Statement is provided in the Contract Documents, as DOCUMENT 00305, UPDATE STATEMENT.

Only Sub-Bids from prequalified Filed Sub-Bid Subcontractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

- Masonry
- Miscellaneous Metal Work
- Roofing and Flashing
- Metal Windows
- Glass and Glazing
- Painting
- Plumbing
- Heating, Ventilating and Air Conditioning
- Electrical Work

Sub-Bids from Prequalified Filed Subcontractors and Other DCAM Certified Sub-Contractors shall be accepted by the Awarding Authority for the following Sub-Bid Categories:

- Waterproofing and Dampproofing
- Fire Protection
- Tile

D. Unforeseen Office Closure – if, at the time of the scheduled bid opening, Orleans Town Hall is closed due to uncontrolled events such as fire, snow, ice, wind, or building evacuation, the bid opening will be postponed until 9:00 a.m. on the next normal business day. Bids will be accepted until that date and time.

E. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified will not be considered. By submission of a bid, the bidder agrees that this bid shall be good and may not be withdrawn for the number of days, after the opening of bids, as stipulated in the FORM OF GENERAL BID.

F. A non-mandatory Pre-Bid Conference will be held on February 20, 2020 at 9:00 am at the Town of Orleans, 19 School Road, Orleans, MA 02653. Refer to the attached Attendance List

**1.02 LOCATION AND WORK TO BE DONE**

A. The location, general characteristics, and principal details of the Work are indicated on a set of drawings titled "Downtown Area WWTF and Effluent Disposal".

B. Additional drawings showing details in accordance with which the Work is to be done may be furnished by addendum from time to time during the bidding period by the Engineer and shall then become a part of the Contract Documents.

C. The Contractor shall furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to do all work required for the completion of each item of the Work and as herein specified.

D. The Work to be done and paid for under any item shall not be limited to the exact extent mentioned or described but shall include all incidental work necessary or customarily done for the completion of that item.

**1.03 PREPARATION OF BID**

A. General Bids

1. Each bid must be submitted on the prescribed form in SECTION 00410, FORM OF GENERAL BID. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures.

2. Enclosed with the bid shall be the following:

a. Microsoft Excel Proposal Form (hard copy in Landscape Format). Submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

b. Bid Security (5%).

c. Completed and signed Bid Proposal, SECTION 00410, FORM OF GENERAL BID– Page 00410-1 through Page 00410-7, inclusive.

d. Insurance Requirements for Inclusion in All Specifications and Contracts – Provide a letter from bidder's insurance company(s) documenting ability to obtain the specified minimum insurance limits.

e. Statement of State Tax Compliance.

f. Certificate of Non-Collusion.

g. Acknowledgement of Principal, if a Corporation.

h. Acknowledgement of Principal, if a Partnership.

i. Certification of OSHA 10-Hour Training.

j. Division of Capital Asset Management and Maintenance

1) Certificate of Eligibility

2) Update Statement (Form CQ3)

k. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

l. Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

3. Each General Bid must be submitted in a sealed envelope indicating the bidder's name and address and clearly marked "General Bid for Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486".

4. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in Receipt and Opening of Bids, above.

B. Sub-Bids

1. Each sib-bid must be submitted on the prescribed form in SECTION 00420, FORM OF SUB- BID. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures.

2. Enclosed with the bid shall be the following:

a. Microsoft Excel Proposal Form (hard copy in Landscape Format and ".xlsm" format copy on Thumb Drive);

b. Bid Security (5%);

c. Completed and signed Bid Proposal and Project Reference List;

d. Not Used

e. Statement of State Tax Compliance;

f. Certificate of Non-Collusion;

g. Acknowledgement of Principal, if a Corporation;

h. Acknowledgement of Principal, if a Partnership; and

i. Certification of OSHA 10-Hour Training.

j. Division of Capital Asset Management and Maintenance

1) Certificate of Eligibility

2) Update Statement (Form CQ3)

3) Contractor Qualification Statement (CQS)

k. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program

l. Not used

3. Each Sub-Bid must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "Sub-Bid for Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486". In addition, the sealed envelope shall indicate the applicable Sub-Bid Category.

4. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in Receipt and Opening of Bids, above.

C. In accordance with M.G.L. Chapter 149 Section 44D-1/2 and 44 D-3/4, the following General Contractors and Filed Subcontractors have been prequalified to submit Bids on this Project:

**General Contractors**

| | |
|---|---|
| C.H. Nickerson & Co., Inc. | MWH Constructors, Inc. |
| Daniel O'Connell's Sons, Inc. | RH White Construction |
| Methuen Construction Company, Inc. | Waterline Industries Corporation |

**Filed Subcontractors**

| Category | Subcontractors |
|---|---|
| Masonry | Costa Brothers Masonry<br>Lighthouse Masonry, Inc.<br>Marmelo Bros. Construction Co., Inc. |
| Miscellaneous Metal Work | C.H. Nickerson & Co., Inc.<br>EDM Construction, Inc.<br>Methuen Construction Company, Inc.<br>SMJ Metal Company, Inc.<br>Waterline Industries Corporation |
| Waterproofing & Dampproofing | P.J. Spillane Company, Inc.<br>The Waterproofing Company, Inc.<br>Any Other DCAM Certified Subcontractor |
| Roofing & Flashing | Greenwood Industries, Inc.<br>Silktown Roofing, Inc.<br>Waterline Industries Corporation |
| Metal Windows | A&A Window Products, Inc.<br>Aluminum & Glass Concepts, Inc.<br>G.V.W., Inc.<br>Kapiloff's Glass, Inc. |
| Glass and Glazing | A&A Window Products, Inc.<br>Aluminum & Glass Concepts, Inc. |

| Filed Subcontractors | |
|---|---|
| **Category** | **Subcontractors** |
| | G.V.W., Inc.<br>Kapiloff's Glass, Inc. |
| Tile | Capital Carpet & Flooring Specialists, Inc.<br>Pavilion Floors, Inc.<br>Any Other DCAM Certified Subcontractor |
| Painting | Dandis Contracting<br>John W. Egan Company Co., Inc.<br>Keltic Painting, LLC |
| Fire Protection | Any DCAM Certified Subcontractor |
| Plumbing | Araujo Bros. Plumbing & Heating, Inc.<br>Casey Plumbing & Heating, Inc.<br>Harding & Smith, LLC<br>Waterline Industries Corporation |
| HVAC | General Mechanical Contractors, Inc.<br>Harding & Smith, LLC<br>Waterline Industries Corporation |
| Electrical | Annese Electrical Services<br>Fall River Electrical Associates Co., Inc.<br>Waterline Industries Corporation<br>Wayne J. Griffin Electric, Inc. |

**1.04 MODIFICATION OF BIDS**

A. Any bidder may modify its bid by email at any time prior to the scheduled closing time for receipt of bids, provided such transmission is received by the OWNER prior to the closing time, and, provided further, the OWNER is satisfied that a written confirmation of the modification over the signature of the bidder was mailed prior to the closing time. Email bid modifications to jkelly@town.orleans.ma.us.

B. The modification communication shall not reveal the bid price but shall provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two days prior to the closing time, no consideration will be given to the email transmission.

**1.05 OBLIGATION OF BIDDER**

A. At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any bidder to examine any form, instrument, or document shall in no way relieve any bidder from any obligation in respect of its bid.

**1.06 INFORMATION NOT GUARANTEED**

A. All information given in the Contract Documents relating to subsurface and other conditions, natural phenomena, existing pipes, and other structures is from the best sources at present available to the Owner. All such information is furnished only for the information and convenience of bidders and is not guaranteed.

B. It is agreed and understood that the OWNER does not warrant or guarantee that the subsurface or other conditions, natural phenomena, existing pipes, or other structures encountered during construction will be the same as those indicated in the Contract Documents.

C. It is further agreed and understood that no bidder or Contractor shall use or be entitled to use any of the information made available to it or obtained in any examination made by it in any manner as a basis of or grounds for any claim or demand against the Owner or the Engineer, arising from or by reason of any variance which may exist between the information made available and the actual subsurface or other conditions, natural phenomena, existing pipes or other structures actually encountered during the construction work, except as may otherwise be expressly provided for in the Contract Documents.

**1.07 BID SECURITY**

A. Each bid must be accompanied by a certified check, a bid bond, cash, a treasurer's or cashier's check, payable to the OWNER, in the amount stated in SECTION 00100 - ADVERTISEMENT FOR BIDS. Such deposits will be returned to all except the three lowest responsible and eligible bidders within five days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids, and the remaining deposits will be returned promptly after the OWNER and the accepted bidder have executed the Contract, or if no notice of intent to award has been presented to any bidder within 30 days, Saturdays, Sundays and legal holidays excluded, after the date of the opening of bids, upon demand of the bidder at any time thereafter.

**1.08 TIME FOR COMPLETION**

A. The bidder must agree to commence work on or before a date to be specified in the written "Notice to Proceed" from the OWNER and to fully complete the project within the time limit stated in SECTION 00410, FORM OF GENERAL BID.

**1.09 ADDENDA AND INTERPRETATIONS**

A. No interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally, and if provided orally, shall not be relied upon by bidders unless confirmed in a written addendum. All information given to bidders other than by means of the plans, specifications, or by addenda, as described below, is given informally and shall not be used as the basis of a claim against the OWNER or the ENGINEER.

B. Every request for such interpretation should be in writing (typed, not handwritten) addressed to AECOM, Attention: Martin “Reggie” Donoghue, P.E.,9 Jonathan Bourne Drive, Pocasset, Massachusetts 02559, , or sent via email at Martin.Donoghue@aecom.com and to be given consideration must be received at least seven working days prior to the date fixed for the opening of bids.

C. Addenda will be emailed to all prospective bidders to email addresses furnished by them for such purposes. Bidders picking up sets of bid documents will be given all addenda issued to date and will be required to sign for all documents, acknowledging receipt.

D. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under its bid as submitted and each bidder must confirm for itself that it has received all addenda. All addenda so issued shall become part of the Contract Documents.

**1.10 BID OPENING PROCEDURE**

A. The following list of requirements shall be met by each filed bid.

B. Bids shall be filed at the place and before the time specified in Receipt and Opening of Bids, above.

C. The bid and all accompanying documents so required shall be signed by the Bidder or its authorized representative before submission.

D. All bidders shall include with their bids written acknowledgment of receipt of all addenda. Refer to acknowledgment form provided in SECTION 00410, FORM OF GENERAL BID or SECTION 00420, FORM OF SUB-BID.

E. The total dollar amount of each bid will be read, and the three apparent lowest bids will be selected for further consideration. These three apparent low bids will be read aloud for the benefit of the other bidders and the bid opening procedure will be closed. All those present at the bid opening may examine all bids after the bid opening and after the reading of the three apparent low bids.

**1.11 COMPARISON OF BIDS**

A. General Bids

1) General Bids will be compared on the basis of the quantities and unit and lump sum prices stated in the bid forms.

2) In the event that there is a discrepancy in SECTION 00410, FORM OF GENERAL BID between the lump sum or unit prices written in words and figures, the prices written in words will govern.

3) The Owner agrees to examine and consider each SECTION 00410, FORM OF GENERAL BID submitted in accordance with the terms and conditions set forth herein and as set forth in SECTION 00410, FORM OF GENERAL BID.

B. Sub-Bids

1) Sub-Bids will be compared on the basis of the quantities and unit and lump sum prices stated in the bid forms.

2) In the event that there is a discrepancy in SECTION 00420, FORM OF SUB-BID between the lump sum or unit prices written in words and figures, the prices written in words will govern.

3) The Owner agrees to examine and consider each SECTION 00420, FORM OF SUB-BID submitted in accordance with the terms and conditions set forth herein and as set forth in SECTION 00420, FORM OF SUB-BID.

**1.12 STATUTES REGULATING COMPETITIVE BIDDING**

A. Any bid, which does not comply with the provisions of Massachusetts, including General Laws Chapter 149, Section 44A through Section 44J, as amended, need not be accepted and the OWNER may reject every such bid.

**1.13 RIGHT TO REJECT BID**

A. The OWNER may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids, should the OWNER deem it to be in the public interest to do so.

B. The OWNER may also reject bids which in its sole judgment are either incomplete, conditional, obscure or not responsive or which contain additions not called for, erasures not properly initialed, alterations, or similar irregularities, and may reject bids for any other reason permitted by law, or the OWNER may waive such omissions, conditions or irregularities.

**1.14 ABILITY AND EXPERIENCE OF BIDDER**

A. No award will be made to any bidder who cannot satisfy the OWNER that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the work successfully within the time named. The OWNER's decision or judgment on these matters will be final, conclusive, and binding to the fullest extent permitted by law.

B. The OWNER may make such investigations as it deems necessary, and the bidder shall furnish to the OWNER, under oath if so required, all such information and data for this purpose as the OWNER may request.

**1.15 CONDITIONS OF WORK**

A. Each bidder must inform itself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of its obligation to furnish all material and labor necessary to carry out the provisions of its contract. Insofar as possible the CONTRACTOR, in carrying out its work, must employ such methods or means as will not cause any interruption of or interference with the work of any other contractor.

**1.16 SECURITY FOR FAITHFUL PERFORMANCE**

A. Simultaneously with his delivery of the executed Contract, the CONTRACTOR shall furnish a surety bond or bonds as security for faithful performance of this Contract and for the payment of all persons performing labor and materials under this Contract as specified in SECTION - 00700, GENERAL CONDITIONS included herein, each in the amount of 100 percent of its bid. The surety on such bond or bonds shall be a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the OWNER. The bonds shall remain in force for one year after final acceptance of the work by the OWNER, unless the OWNER, in writing, releases the CONTRACTOR from the obligation sooner.

**1.17 POWER OF ATTORNEY**

A. Attorneys-in-fact who sign Contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

**1.18 LAWS AND REGULATIONS**

A. Applicable provisions of Massachusetts General Laws and Regulations and/or the United States Code and Code of Federal Regulations govern this Contract and any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflict between Code of Federal Regulations and State Laws and Regulations exist, the more stringent requirement shall apply

B. The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

C. Attention is directed to SECTION 00830 - STATE REGULATIONS and to other applicable sections of this specification. In the event of any conflict between provisions of law or regulation quoted or paraphrased in the Contract Documents, the actual provisions of law or regulation shall control.

D. Whenever it is written that an equipment manufacturer must have a specified period of experience with its product, equipment which does not meet the specified experience period can be considered, if the equipment supplier or manufacturer is willing to provide an Letter of Credit or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

**1.19 LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT**

A. The successful bidder, upon its failure or refusal to execute and deliver the Contract, Bonds and Certificates of Insurance required within 10 days after receipt of notice of the acceptance of the bid, shall, except as otherwise provided by applicable law, forfeit to the OWNER, as liquidated damages for such failure or refusal, the security deposited with its bid, provided that the amount forfeited shall not exceed the difference between its bid price and the bid price of the next lowest responsible and eligible bidder.

B. In case of death, disability, bonafide clerical or mechanical error of a substantial nature, or other similar unforeseen circumstances affecting the bidder, its bid deposit will be returned.

**1.20 INDETERMINATE ITEMS AND ESTIMATED QUANTITIES**

A. The work to be done under this Contract has been divided into parts or items, if applicable, to enable each bidder to bid on different portions of the work in accordance with its estimate of their cost and so that the actual quantity of work executed under each item may be paid for at the price bid for that particular item, even though each bidder may have judged that such quantity may be greater or less than the estimated quantity stated in SECTION 00410 - FORM OF GENERAL BID.

**1.21 CONTRACTOR RECORDS**

A. The CONTRACTOR shall comply with the provisions of Massachusetts General Laws, Chapter 30, Section 39R, concerning CONTRACTOR records. This section has been reprinted in Section 00830, STATE REGULATIONS.

**1.22 MINIMUM WAGE RATES – BIDDER'S RESPONSIBILITY**

A. Minimum Wage Rates as determined by the Commissioner of Department of Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project. It is the responsibility of the contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those

trades people who may be employed for the proposed work under this contract. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

B. It is the responsibility of the Bidder, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this contract.

**1.23 BIDDER CERTIFICATION – OSHA TRAINING**

A. All employees who work on Massachusetts public works construction sites, on projects estimated to cost more than $10,000, must have no less than ten (10) hours of OSHA- approved safety and health training.

B. The Massachusetts Attorney General is authorized to restrain award of construction contracts to any contractor who is in violation of this requirement and to restrain the performance of these contracts by non-complying contractors.

C. Noncompliance with this law will disqualify contractors from bidding on public contracts.

**1.24 SALES TAX EXEMPTION**

A. Materials and equipment purchased for permanent installation in this project will be exempt from the Massachusetts Sales and Use Tax. The exemption certificate number will be furnished to the Contractor. Each bidder shall take exemption into account in calculating his/her bid for the work.

**1.25 GUARANTEE**

A. The Contractor guarantees that the Work and Services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other contract documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of completion and acceptance of the Work as stated in the final estimate. If part of the Work is accepted in accordance with that subsection of this AGREEMENT titled "Partial Acceptance", the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

B. If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, correction or replacements. If the Contractor neglects to commence making such repairs, corrections or replacements to the satisfaction of the Owner within seven (7) days from the date of receipt of such notice, or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make said repairs, correction or replacements, and charge the costs, including compensation for additional professional services, to the Contractor.

C. It is expressly understood, however, that these guarantee provisions shall not absolve the Contractor from any liability to the Owner arising out of a failure to substantially complete the work in accordance with the Drawings and Specifications.

**1.26 BONDING AND INSURANCE**

A. The Contractor must furnish Performance and Payment Bonds, each of which shall be in an amount not less than one hundred (100) percent of the contract price. Contractors should obtain such construction insurance (e.g., Fire and Extended Coverage, Workmen's Compensation, Public Liability and Property Damage, and "All Risk" Builder's Risk) as indicated in the Supplemental Conditions (Section 00800).

**1.27 HEALTH AND SAFETY REGULATIONS**

A. This project is subject to all the Health and Safety Regulations (CFR 29 Part 1926 and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors are urged to become familiar with the requirements of these regulations, as well as the Occupational Safety and Health Administration's (OSHA) 29 CFR 1910.120.

**1.28 BUY AMERICAN**

A. This project is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.29 ACCESS TO THE PROJECT**

A. The successful Bidder shall provide full and complete access to the project site or any portion thereof by any authorized agent of the Town of Orleans any time during normal working hours throughout the duration of the Contract.

**1.30 TRAFFIC POLICE**

A. Traffic control, when required by the Chief of Police or the Owner, will be paid for by the Owner. The Contractor is required to directly coordinate all Police details.

B. Any police overtime expenses incurred by the Town due to the Contractor working longer than the specified normal workday (ten consecutive hours, Sundays, or holidays) shall be the responsibility of the Contractor, the cost of which will be deducted from the monthly pay requisition. The Contractor will also be charged for any police expenses when police coverage is requested or scheduled in advance by the Contractor, but the Contractor does not work.

**1.31 THIRD PARTY WORK**

A. The Contractor is responsible for maintaining a safe and secure worksite at all times, and for expeditiously repairing any damage done to private property. If, in the opinion of the Owner, the Contractor is negligent in these duties the Owner shall have the right to employ a third party to remedy the problem.

B. Situations which develop and require the services of and payment to a third party will be handled in the following manner:

1) The Contractor will be given a reasonable period of time determined at the discretion of the Owner to remedy the situation without third party involvement. If the Contractor is unavailable, the Owner will authorize work by a third party on the Contractor's behalf;

2) Third party work authorized on the Contractor's behalf by the Owner shall be paid for by the Contractor within a reasonable time period (generally two weeks). If payment is not made within a reasonable time period the Owner will make payment and deduct the cost from the next pay requisition; and

3) In the case of inadequately secured worksites necessitating extra or increase police details or other public safety personnel, the following procedure will be followed. The Contractor (if available) will be notified that the worksite needs to be secured in order to prevent the need for weekend/night police coverage. If the area is not immediately secured as determined by the Owner or Engineer, a police, fire, or highway department detail will be used and the Contractor will be charged for the cost. It is understood that in many instances worksites cannot realistically be secured to a point where police or other safety personnel are not needed. In these instances, the Owner will continue to pay for the coverages.

**1.32 AWARDING AUTHORITY AND PROJECT ADMINISTRATOR**

A. The Awarding Authority for this Project is the Town of Orleans, MA, acting through John Kelly, Town Administrator, 19 School Road, Orleans, MA 02653.

B. The Project Administrator for this Project is the Town of Orleans acting through Thomas Daley, Director of Public Works & Natural Resources, 40 Giddiah Hill Road, Orleans, MA 02653.

**1.33 SAFETY AND HEALTH REGULATIONS**

A. This project is subject to the Safety and Health Regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments, and to any applicable Massachusetts regulations. Contractors shall be familiar with the requirements of these regulations.

**1.34 MANUFACTURER'S EXPERIENCE**

A. Whenever it is written that an equipment manufacturer must have a specified period of experience with his product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide an "Efficiency Guarantee Bond" or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

**1.35 DIESEL RETROFIT PROGRAM**

A. This project is subject to the requirements of the Department of Environmental Protection's Diesel Retrofit Program. Bidders must submit a signed and dated Statement of Intent to Comply form as part of their bid proposal documents.

**END OF SECTION**

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

**SECTION 00310**

**BID BOND**

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name— Include Location)*:

BOND
Bond Number:
Date:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

| **BIDDER** | **SURETY** |
|---|---|
| _____ (Seal) | _____ (Seal) |
| Bidder's Name and Corporate Seal | Surety's Name and Corporate Seal |
| By: _____ | By: _____ |
| Signature | Signature (Attach Power of Attorney) |
| _____ | _____ |
| Print Name | Print Name |
| _____ | _____ |
| Title | Title |
| Attest: _____ | Attest: _____ |
| Signature | Signature |
| Title | Title |

*Note: Addresses are to be used for giving any required notice.*
*Provide execution by any additional parties, such as joint venturers, if necessary.*

Note: The Bidder may submit their standard Bid Bond as long as it fully complies with the requirements of DOCUMENT C-430.

EJCDC ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

   3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

   3.2 All Bids are rejected by Owner, or

   3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

**END OF DOCUMENT**

**SECTION 00410**

**FORM OF GENERAL BID**

1. Proposal of _____ (hereinafter called "Bidder")*

   (_) a corporation, organized and existing under the laws of the State of _____

   (_) a partnership

   (_) a joint venture

   (_) a limited liability company

   (_) an individual doing business as _____

   *Check corporation, partnership, joint venture, LLC or individual as applicable.

2. To the Town of Orleans, MA (hereinafter called "Owner") regarding: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486.

   The Bidder, in compliance with your invitation for bids for Downtown Area WWTF and Effluent Disposal having examined the plans and specifications with related documents and the site of the proposed work, attended the mandatory pre-bid conference, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to construct the project in accordance with the contract documents, within the time set forth below, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this bid is a part.

   The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written "Notice to Proceed" given by the Owner to the Contractor and to fully complete the project within 654 calendar days, using not more than 411 working days.

   The Bidder further agrees to pay as liquidated damages the sum of $6,700 for each consecutive calendar day and/or working day thereafter during which the work as not been fully completed, as provided in the "Liquidated Damages" provisions of SECTION 00800 - SUPPLEMENTARY CONDITIONS.

3. Bidder acknowledges receipt of the following addenda:

| No. | Dated | No. | Dated |
|---|---|---|---|
| 1 | | 7 | |
| 2 | | 8 | |
| 3 | | 8 | |
| 4 | | 10 | |
| 5 | | 11 | |
| 6 | | 12 | |

4. Bidder agrees to perform all the work, including all incidental labor, materials and equipment necessary for the satisfactory completion of the work and be in full compliance with the contents and intent of the Specifications and/or Drawings of the work.

5. Bid Proposal

   A. The BID PROPOSAL unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, engineering costs, etc., to cover the finished work of the several kinds called for. The Bidder understands that all bids for this project are subject to the applicable bidding laws of the Commonwealth of Massachusetts, including General Laws Chapter 149, Section 44D and Section 44E, as amended.

   B. Bidder shall complete and submit the Proposal Form. The bidder is not allowed to submit a proposal that has been printed out and priced typewritten or written by hand. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   C. Use of the Microsoft Excel Proposal Form

      1. Upon Opening the Microsoft Excel Proposal Form:

         a) A yellow bar will appear on the top of the screen labeled as "*Security Warning*"

         b) You must select the "*Enable Content*" button in order to properly access the file.

            1) This will enable macros in the excel file, as you must enable macros to properly view the file.

            2) If you do not enable macros, the excel document will be invalid.

         c) Manually enter the Bidder's Name in the blue box.

         d) Manually enter the Date in the blue box.

         e) Manually enter the unit cost in the blue boxes for each bid item. Allowances have already been prepopulated.

         f) The document will automatically update the cost estimates (Unit Price in Words; Extended Totals and Bid Total based on the user's unit cost input into the blue boxes for each bid item).

      2. In Order to Save the Proposal Form Document:

         a) The document must be saved as a file with macros enabled.

         b) Please save as the file type "Excel Macro-Enabled Workbook (*.xlsm)".

         c) If the file is saved incorrectly as a different file type, the document will be invalid.

      This process must be repeated for every time the document is opened and saved.

   D. Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com). The bidder is not allowed to submit a Microsoft Excel Proposal Form that has been priced typewritten or written by hand. The Microsoft Excel Form is not required to be Signed.

   E. In the event of a discrepancy between the price in words and the price in figures, the words shall govern. In the event of a discrepancy between the total of the items and the total stated, the total of the items shall govern.

   F. In the event of a discrepancy between the printed out completed Microsoft Excel Proposal Form and the completed Microsoft Excel Proposal Form in ".xlsm" format, the printed out completed Microsoft Excel Proposal Form shall govern.

   G. Interlineation, alteration or erasure may void the bid.

   H. Bid security is attached in the sum of five percent (5%) of the total bid in accordance with the conditions of SECTION 00200 - INSTRUCTIONS TO BIDDERS. The bid security may become the property of the Owner in the event the contract and bond are not executed within the time set forth above.

   I. The undersigned states that no officer, agent or employees of the Owner directly or indirectly has a financial interest in this Bid.

6. The time period for holding bids, where Federal approval is not required is 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids and where Federal approval is required, the time period for holding bids is 30 days, Saturdays, Sundays and holidays excluded after Federal approval.

7. State Taxes - Pursuant to M.G.L.c.62C, s49A I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all State Taxes required under law.

8. Award

   A. The contract will be awarded to the lowest responsible and eligible bidder.

   B. Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding as deemed to be in the best interest of the Owner.

   C. The Owner reserves the right to reject any bid in the event that any bid item or items are obviously unbalanced or appear to the Owner to be so unbalanced as to affect or to be liable to affect adversely any interest of the Owner.

   D. The Owner reserves the right to reject any or all bids if it deems it to be in its best interest to do so. The Owner reserves the right to award the Contract based on sufficiency of appropriated funds to complete the work.

   E. In the event the lowest bids from responsive and responsible bidders are tied, the following methods of breaking the tie shall be employed unless otherwise provided for in these bid documents: The bidder's names shall be entered on a slip of paper and placed in a hat. The award shall then be made to the bidder whose slip is drawn from the hat. The drawing of the slip from the hat shall be performed in the presence of the tied bidders unless they waive their right to be present in writing.

9. Within 10 days of receipt of the written notice of acceptance of this bid, the Bidder will execute the formal agreement attached in SECTION 00520 - AGREEMENT and provide the requisite payment and performance bonds and certificates of insurance.

10. The selected Contractor shall furnish a performance bond and a payment bond each in an amount at least equal to one hundred percent (100%) of the contract prices in accordance with SECTION 00610 - PERFORMANCE BOND, SECTION 00615 - PAYMENT BOND, and as stipulated in paragraph 5.01 of SECTION 00700 - GENERAL CONDITIONS of these specifications.

11. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.

12. The Undersigned, as Bidder, declares as follows:

   A. The only parties interested in this BID as Principals are named herein;

   B. The Bidder has carefully examined the site of the proposed Work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed Work, the difficulties upon its execution and the accuracy of all estimated quantities stated in this BID, and has carefully read and examined the Drawings, the annexed proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;

   C. This BID is made without collusion with any other person, firm, or corporation;

   D. No officer, agent, or employee of the Owner is directly or indirectly interested in this BID; and

   E. Understands that information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered will be the same as those shown on the Drawings or in any of the other Contract Documents and agrees that the Bidder shall not use or be entitled to use any such information made available to him through the Contract Documents or otherwise or obtained by him in his own examination of the site, as a basis of or ground for any claim against the Owner or the Engineer arising from or by reason of any variance which may exist between the aforesaid information made available to or acquired by him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and has made due allowance therefore in this BID.

13. Equal Employment Opportunity/Affirmative Action Provisions - C.30 s39 (c)

   A. The undersigned bidder hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.

B. The undersigned bidder hereby certifies he/she will comply with the specific affirmative action steps contained in the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these contract provisions. The contractor receiving the award of the contract shall incorporate the EEO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

C. The undersigned bidder hereby certifies he/she will comply with the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract (MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services).

14. Non-Debarment - C.30 s39 (a)

A. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As use in this paragraph the "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

B. The undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

15. Suspension and Debarment

A. The EPA prohibits the use of suspended or debarred contractors and suppliers in SRF financed contracts. All SRF financed contracts and subcontracts must include language indicating compliance with 2 CFR 180 and 2 CFR 1532.

B. Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled responsibilities of Participants Regarding transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

16. Diesel Retrofit Program - The undersigned bidder hereby certifies he/she will comply with the Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply (see Appendix B).

17. The undersigned offers the following information as evidence of its qualifications to perform the work as bid upon according to all the requirements of the plans and specifications:

A. Have been in business under present name for _____years.

B. The Bidder shall state below what work of a similar character to that included in the proposed contract it has done within the last 10 years, and provide references that will enable the Owner to judge its experience, skill and business standing (add supplementary page(s) if necessary).

**Project No. 1**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| | | |
| **Design Engineer** | **Reference Name** | **Telephone No.** |
| | | |

**Project No. 2**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 3**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 4**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

**Project No. 5**

| Completion Date | Project Name | Contract Amount |
|---|---|---|
| Design Engineer | Reference Name | Telephone No. |

C. The names and addresses of all persons interested in the bid (if made by a partnership or corporation) as Principals, are as follows (add supplementary page(s) if necessary):

| Name | Address |
|---|---|
| | |
| | |
| | |
| | |

18. Pursuant to M.G.L. CH. 62C, Sec 49A, the undersigned Bidder certifies under the penalties of perjury that it is in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

19. The undersigned Bidder hereby certifies that (1) it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; and (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

20. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity which sells materials, equipment or supplies used in or for, or engages in the performance of, the same or similar construction, reconstruction, installation, demolition, maintenance or repair work or any part thereof.

21. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, Section 25C (10) of Chapter 152 (workers' compensation) or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder.

Respectfully submitted:

Date: _____ By: _____

(Signature)

_____

(Name – Typed or Printed)

_____

(Title)

_____

(Business Name)

_____

(Federal ID Number)

_____

(Business Address)

_____

(City and State)

_____

(Telephone Number)

(SEAL - if bid is by a corporation)

22. The following documents are attached to and made a condition of the bid, and shall be submitted with the bid:

    A. Microsoft Excel Proposal Form (hard copy in Landscape Format). Submit the completed Microsoft Excel Proposal Form in ".xlsm" format within 24-hours of the Bid Opening to Tess Laffer via e-mail (tess.laffer@aecom.com).

    B. Bid Security (5%).

    C. Completed and signed Bid Proposal herein – Page 00410-1 through Page 00410-7, inclusive.

    D. Insurance Requirements for Inclusion in All Specifications and Contracts – Provide a letter from bidder's insurance company(s) documenting ability to obtain the specified minimum insurance limits.

    E. Statement of State Tax Compliance.

    F. Certificate of Non-Collusion.

G. Acknowledgement of Principal, if a Corporation.

H. Acknowledgement of Principal, if a Partnership.

I. Certification of OSHA 10-Hour Training.

J. Division of Capital Asset Management and Maintenance

1) Certificate of Eligibility

2) Update Statement (Form CQ3)

K. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply - Appendix B - Diesel Retrofit Program. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

L. Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services. To be provided by the Lowest Responsive and Responsible Bidder within five business days of the bid opening.

**END OF TEXT**

SEE ATTACHED PROPOSAL FORM

SEE ATTACHED APPENDIX

MassDEP Appendix B Diesel Retrofit Program

MassDEP Appendix E Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

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# APPENDIX B

## APPENDIX B
## DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

**Diesel Construction Equipment Standard**

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

**Exemptions**

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

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**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

**Contractor Certification**

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

**Recordkeeping**

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

**APPENDIX B (cont.)**
**DIESEL RETROFIT PROGRAM**

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

**Project Regulatory Agreement**

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

**APPENDIX B** (cont.)
**DIESEL RETROFIT PROGRAM**

## STATEMENT OF INTENT TO COMPLY

***This form must be signed and submitted by the bidder as part of the bid.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Bidder** _____

**The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:**

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____

**(Signature of Bidder's Authorized Representative)** **(Date)**

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**APPENDIX B** (cont.)
**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

***Each Contractor and its Subcontractor(s) must sign and submit this form to DEP DMS project engineer, 5th Floor, MassDEP, One Winter Street, Boston, MA 02108 and the Municipality within 10 days after the Contractor is notified that it is awarded the Contract.***

**Local Governmental Unit** _____ **SRF Project No.** _____

**Contract No.** _____ **Contact Title** _____

**Contractor** _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

**APPENDIX B** (cont.)

**DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION**

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

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# APPENDIX E

## APPENDIX E
## CONSTRUCTION BID SPECIFICATIONS
## SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES
## MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
### DIVISION OF MUNICIPAL SERVICES

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM BACKGROUND

In May 2008 a United States Environmental Protection Agency (EPA) rule became effective that changed the Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) Program to a Disadvantaged Business Enterprise (DBE) Program.

For firms to qualify under the old MBE/WBE program they needed to be socially disadvantaged and had to be certified by the Supplier Diversity Office (SDO). Under the new DBE rule, the firms must be both **socially** and **economically** disadvantaged, **citizens of the United States**, and certified as a DBE. Women and certain minorities are presumed to be socially disadvantaged. The economic disadvantage is measured by the owner's initial and continuing personal net worth of less than $1,320,000.

Because the Clean Water Act requires the use of MBEs and WBEs, these firms will still be utilized in the State Revolving Fund (SRF) Loan Program, but they must also be certified as DBEs.

SDO will continue to be the certifying agency for the SRF program. SDO certifies firms under the federal Department of Transportation program, which is acceptable for use in the SRF program. An additional form has been added to the DBE package to verify that DBEs are owned or controlled by United States citizens.

BID SPECIFICATIONS

**I.** In this contract, the percentage of business activity to be performed by disadvantaged business enterprise(s) (DBE) shall not be less than the following percentages of the total contract price or the percentage submitted by the contractor in the Schedule of Participation, whichever is greater:

Disadvantaged MBE (D/MBE) 4.2% Disadvantaged WBE (D/WBE) 4.5%

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## II. DEFINITIONS

For the purpose of these provisions, the following terms are defined as follows:

A. Awarding Authority – Entity that awards a prime contract under a State Revolving Fund loan.

B. Bidder - Any individual, partnership, joint venture, corporation, or firm submitting a price, directly or through an authorized representative, for the purpose of performing construction or construction related activities under a Contract.

C. Certified DBE – A DBE certified by the United States Small Business Administration, under its 8(a) Business Development Program (13 CFR part 124, subpart A) or its Small Disadvantaged Business Program (13 CFR part 124, subpart B); The United States Department of Transportation (DOT), under its regulations for Participation by DBSs in DOT programs (49 CFR parts 23 and 26); or SDO in accordance with 40 CFR part 33; provided that the certification meets the U.S. citizenship requirement under 40 CFR §33.202 or §33.203.

D. Compliance Unit - A subdivision of MassDEP's Affirmative Action Office designated to ensure compliance under these provisions.

E. Contractor - Any business that contracts or subcontracts for construction, demolition, renovation, survey, or maintenance work in the various classifications customarily used in work and that is acting in this capacity under the subject contract.

F. Construction Related Services - Those services performed at the work site ancillary to, and/or in support of, the construction work, such as hauling, trucking, equipment operation, surveying or other technical services, etc. For the purposes hereof, supply and delivery of materials (e.g. pre-cast concrete elements) to the site by a supplier who has manufactured those goods, or substantially altered them before re-sales shall be considered as "construction related services

G. Construction Work - The activities at the work site, or labor and use of materials in the performance of constructing, reconstructing, erecting, demolishing, altering, installing, disassembling, excavating, etc, all or part of the work required by the Contract Documents.

H. Disadvantaged Business Enterprise (DBE) - An entity owned or controlled by a socially and economically disadvantaged individual as described by Public Law 102-389 (42 U.S.C. 4370d) or an entity owned and controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note); a Small Business Enterprise (SBE); a Small Business in a Rural Area (SBRA); or a Labor Surplus Area Firm (LAF), a Historically Underutilized Business (HUB) Zone Small Business Concern, or a concern under a successor program.

I. Equipment Rental Firm - A firm that owns equipment and assumes actual and contractual responsibility for renting said equipment to perform a useful function of the work of the contract consistent with normal industry practice

J. Good Faith Efforts – The race and/or gender neutral measures described in 40 CFR 33, subpart C.

K. HUBZone - A historically underutilized business zone, which is an area located within one or more qualified census tracts, qualified metropolitan counties, or lands within the external boundaries of an Indian reservation.

L. HUBZone small business concern - A small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

M. Joint Venture - An agreement between SDO certified DBE and a non-DBE or non-DBE controlled enterprise.

1. A pairing of companies will be considered a DBE joint venture if the SDO certified DBE which is part of the relationship has more than 51% of the profits that are derived from that project.

2. A joint venture between a certified DBE subcontractor and a non DBE subcontractor, in which the DBE for that proportion of the joint venture's contract equal to the DBE participation in the joint venture.

3. Whenever a general bid is filed by a joint venture with a certified DBE participant in the joint venture that does not exercise more than 51% control over management and profits, that joint venture shall be entitled to credit as a DBE for that portion of the joint venture's contract equal to the DBE participation in the joint venture. Minority As deemed by SDO.

N. Labor surplus area firm (LSAF) - A concern that together with its first-tier subcontractors will perform substantially in labor surplus areas (as identified by the Department of Labor in accordance with 20 CFR part 654). Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.

O. Letter of Intent – Certified document signed by the principal(s) of the DBE with respect to the work to be performed under contract.

P. Local Government Unit (LGU) – A city, town, or municipal district which applies for a loan under the Clean Water Trust Program.

Q. Material Supplier – A vendor certified by SDO as a DBE in sales to supply industry from an established place of business or source of supply, and that vendor.

1. Manufactures goods from raw materials, or substantially utilizes them in the work, or substantially alters them before resale, entitling the general contractor to DBE credit for 100% of the purchase order.

2. Provides and maintains a storage facility for materials utilized in the work, entitling the general contractor to DBE credit for 10% of the purchase order

R. Minority and Women Business Enterprise (M/WBE) – Any business concern certified by the SDO as a bona-fide M/WBE. A bona-fide M/WBE is a business whose minority group/women ownership interests are real, which have at least 51% ownership and control over management and operation.

S. Percent of Total Price – Is the percentage to be paid to the DBE, work they perform, as compared to the total bid price

T. Recipient - An agency, person or political subdivision which has been awarded or received financial assistance by the Trust or MassDEP.

U. Small business, small business concern or small business enterprise (SBE) - A concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR part 121.

V. Small business in a rural area (SBRA) - A small business operating in an area identified as a rural county with a code 6-9 in the Rural-Urban continuum Classification Code developed by the United States Department of Agriculture in 1980.

W. SDO – The Supplier Diversity Office.

X. Subcontractor – A company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Y. Total Contract Price – The total amount of compensation to be paid for all materials, work or services rendered in the performance of the contract

Z. Trust – The Massachusetts Clean Water Trust established by M.G.L. c.29.

## III. REQUIREMENTS FOR CONTRACT AWARD

DBE packages must be submitted by the two lowest bidders on the project. Following bid opening, the LGU shall notify the two lowest bidders to submit DBE packages to the LGU or the LGUs consultant, as directed. By the close of business on the third business day after notification, the two lowest bidders, including a bidder who is a MBE, WBE or DBE, shall submit the following information:

A. A Schedule of Participation (Form EEO-DEP-190). The Schedule of Participation shall list those certified DBEs the bidder intends to use in fulfilling the contract obligations, the nature of the work to be performed by each certified DBE subcontractor and the total price they are to be paid.

1. A listing of bona-fide services such as a professional, technical, consultant or managerial services, assistance in the procurement of essential personnel, facilities, equipment, materials, or supplies required for performance of the contract, and reasonable fees or commissions charged.

2. A listing of haulers, truckers, or delivery services, not the contractors, including reasonable fees for delivery of said materials or supplies to be included on the project.

B. A Letter of Intent (Form EEO-DEP-191) for each DBE the bidder intends to use on the project. The Letter of Intent shall include, among other things, a reasonable description of the work the certified DBE is proposing to perform and the prices the certified DBE proposes to charge for the work. A Letter of Intent shall be jointly signed by the certified DBE and the General Contractor who proposes to use them in the performance of the Contract.

C. Each DBE must also sign and return the DBE Certification of United States Citizenship form to verify that the firm is owned or controlled by a United States citizen.

D. The SDO "DBE Certification" as prepared by each certified DBE.

E. A completed Request for Waiver form and backup documentation should the goals not be achieved (See IV below).

## IV. REQUIREMENTS FOR MODIFICATION OR WAIVERS.

The bidder shall make every possible effort to meet the minimum requirements of certified DBE participation. If the percentage of DBE participation submitted by the bidder on its Schedule of Participation (EEO-DEP-190) does not meet the minimum requirements, the bid may be rejected by the Awarding Authority and found not to be eligible for award of the contract.

In the event that the bidder is unable to meet the minimum requirements of DBE participation, the bidder shall submit with his/her submittal required in Section III. Requirement of Contract Award a Request for Waiver form (EEO-DEP-490). The Awarding Authority shall review the waiver request to determine if the request should proceed. If approved by the Awarding Authority, the Awarding Authority shall submit the waiver request and supporting documentation, with a recommendation to MassDEP within five days of receipt of the Request for Waiver. MassDEP in conjunction with the project manager, Compliance Unit, will determine whether the waiver will be granted.

The waiver request shall include detailed information as specified below to establish that the bidder has made a good faith effort to comply with the minimum requirements of DBE participation specified in Part I. In addition, the bidder must show that such efforts were undertaken well in advance of the time set for opening of bids to allow adequate response. A waiver request shall include the following:

A. A detailed record of the effort made to contact and negotiate with the certified DBE, including, but not limited to:

   1. names, addresses and telephone numbers of all such companies contacted;

   2. copies of written notices(s) which were sent to certified DBE potential subcontractors, prior to bid opening;

   3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

   4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price;

   5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/ women-focused media detailing the opportunities for participation.

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after MassDEP receives all required information and documentation, it shall make a decision in writing, whether the waiver is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing. If the waiver request is denied, the bid shall be rejected by the Awarding Authority, or the contract will be determined ineligible for SRF funding.

   If a Request for Waiver is denied by MassDEP and the bid is rejected by the Awarding Authority, the Awarding Authority may then move to the second bidder on the project. At the Awarding Authority's discretion, it may collect a DBE package from the third bidder on the project.

## V. DISADVANTAGED BUSINESS ENTERPRISES PARTICIPATION

A. Reporting Requirements

1. The Contractor's utilization of certified DBEs will be documented based upon submittal of the LGU's monthly Payment Requisitions as reported on Form-2000. The Form-2000 form will show all certified DBEs performing work on the project regardless of any billing activity for that month. For auditing and accounting purposes, the Contractor periodically may be required to submit copies of canceled checks verifying that payments have been made to the certified DBE as listed on the schedule. The Contractor may also be required to submit current schedules on utilization of all DBEs to indicate when their services will commence and be billed for.

2. During the life of the Contract, the Contractor's fulfillment of the percentage requirements in Part I shall be determined with reference to the Contract price as follows:

   A. If the price in the Contract executed exceeds the base bid price (e.g., because an alternate was selected or because unit prices were used in awarding the Contract), the Contractor shall submit for approval by MassDEP a revised Schedule of Participation by certified DBEs satisfying the percentage requirements and such other information concerning additional DBE participation as may be requested by MassDEP.

   B. If the Contract price increases after execution due to change orders or other adjustments, MassDEP may require the Contractor to subcontract additional work or to purchase additional goods and services from certified DBEs up to the percentages stated in Part I.

## VI. COMPLIANCE

A. If the Schedule or any of the Letters of Intent are materially incomplete or not submitted in a timely manner, the LGU may rescind its vote of award; treat the bid informal as to substance and reject the bid. If the bid is incomplete in any other respect than the Schedule the LGU with the approval of MassDEP may waive the informalities upon satisfactory completion of the required information by the Contractor and the certified DBE as applicable.

B. If the LGU finds that the percentage of certified DBE participation submitted by the contractor on its Schedule does not meet the percentage requirement in Part I, it shall rescind its vote of award and find such contractor not to be eligible for award of the contract.

C. The Contractor shall not perform with its own organization, or subcontract to any other primary or subcontractor any work designated for the named certified DBEs on the schedule submitted by the Contractor under Part III without the approval of MassDEP.

D. A Contractor's compliance with the percentage requirement in Part I shall continue to be determined by reference to the required percentage of the total contract price as stated in Section I even though the total of actual contract payments may be greater or less than the bid price.

E. If the Contractor for reasons beyond its control cannot comply with Part III in accordance with the Schedule submitted under Part III, Section B, the contractor must submit to MassDEP as soon as they are aware of the deficiency, the reason for its inability to comply. Proposed revisions to the Schedule stating how the contractor intends to meet its obligations under these conditions must be submitted within ten (10) working days of notification.

F. If the Contractor is becomes aware by any means that that DBE is no longer certified, the Contractor shall immediately notify MassDEP. The Contractor shall use good faith efforts to retain a substitute certified DBE.

G. If a certified DBE listed by the bidder in its Schedule of M/WBE contractors fails to obtain a performance or payment bond requested by the bidder, said failure shall not entitle the bidder to avoid the requirements of Part III (A). After a bidder has been awarded the contract, he shall not change the certified DBE listed in its Schedule at the time of the award or make any other such substitutions without the written approval of MassDEP.

## VII. SANCTIONS

A. If the Contractor does not comply with the terms of these Special Provisions, the Awarding Authority may (1) suspend any payment for the work that should have been performed by a certified DBE pursuant to the schedule, or (2) require specific performance of the Contractor's obligation by requiring the Contractor to subcontract with a DBE for any contract or specialty item at the contract price established for that item in the proposal submitted by the Contractor.

B. To the extent that the Contractor has not complied with the terms of these Special Provisions, the Awarding Authority may retain in connection with Estimates and Payments an amount determined by multiplying the bid price of this contract by the percentage in Section I, less the amount paid to DBE's for work performed under the contract and any payments already suspended under VII A.

C. The Awarding Authority may suspend, terminate or cancel this contract, in whole or in part, or may call upon the Contractor's surety to perform all terms and conditions in the contract, unless the contractor is able to demonstrate his compliance with the terms

of these Special Provisions, and further deny to the Contractor, the right to participate in any future contracts awarded by the Awarding Authority for a period of up to three years.

D. In any proceeding involving the imposition of sanctions by the Awarding Authority, no sanctions shall be imposed if the Awarding Authority finds that the contractor has taken every possible measure to comply with these Special Provisions or that some other justifiable reason exists for waiving these Special Provisions in whole or in part.

E. The contract shall provide such information as is necessary in the judgment of the Awarding Authority to ascertain its compliance with the terms of these Special Provisions.

F. A contractor shall have the right to request suspension of any sanctions imposed under this section upon demonstrating that he is in compliance with these Special Provisions.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## SCHEDULE OF PARTICIPATION FOR SRF CONSTRUCTION

**Project Title:** _____ **Project Location:** _____

**Disadvantaged Minority Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/MBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/MBE Commitment:** | **$** |
| **Percentage D/MBE Participation** = (Total D/MBE Commitment) / (Bid Price) = | | **%** |

**Disadvantaged Women Business Enterprise Participation in the SRF Loan Work**

| Name & Address of D/WBE | Nature of Participation | Dollar Value of Participation |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| | **Total D/WBE Commitment:** | **$** |
| **Percentage D/WBE Participation** = (Total D/WBE Commitment) / ( Bid Price) = | | **%** |

The Bidder agrees to furnish implementation reports as required by MassDEP to indicate the D/MBEs and D/WBE(s) which it has used or intends to use. Breach of this commitment constitutes a breach of the contract.

Name of Bidder: _____

Date: _____ By: _____
Signature

NOTE: Participation of a DBE may be counted in only their certified category; the same dollar participation cannot be used in computing the percentage of D/MBE participation and again of D/WBE participation.

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## LETTER OF INTENT FOR SRF CONSTRUCTION

This form is to be completed by the D/MBE and D/WBE and must be submitted by the Bidder no later than close of business on the third business day after notification by the LGU. A separate form must be completed for each D/MBE and D/WBE involved in the project.

Project Title: _____ Project Location: _____

**TO:** _____
(Name of Bidder)

**FROM:** _____
(Please Indicate Status [ ] D/MBE or [ ] D/WBE)

° I/we intend to perform work in connection with the above project as (check one):

[ ] An individual
[ ] A corporation
[ ] Other (explain): _____
[ ] A partnership
[ ] A joint venture with: _____

° It is understood that if you are awarded the contract, you intend to enter into an agreement to perform the activity described below for the prices indicated.

**DBE PARTICIPATION**

| Description of Activity | Date of Project Commencement | $ Amount | % Bid Price |
|---|---|---|---|
| | | **$** | **%** |

° The undersigned certify that they will enter into a formal agreement upon execution of the contract for the above referenced project.

| **BIDDER** | **DBE** |
|---|---|
| (Authorized Original Signature) Date<br>ADDRESS: | (Authorized Original Signature) Date<br>ADDRESS: |
| TELEPHONE #: | TELEPHONE #: |
| FEIN: | FEIN: |
| EMAIL ADDRESS: | EMAIL ADDRESS: |

**ORIGINALS:**

- **Compliance Mgr. City/Town Project Location**
- **DEP Program Manager for DEP's AAO Director**

*** Attach a copy of current (within 2 years) DBE Certification**

EEO-DEP-191C

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## DBE CERTIFICATION OF UNITED STATES CITIZENSHIP

For the SRF program, under the EPA Disadvantage Business Enterprise (DBE) Rule, a DBE must be owned or controlled by a socially and economically disadvantaged person that is also a **citizen of the United States** (*See* 40 CFR 33.202). "Ownership" is defined at 13 CFR 124.105 and "control" is defined at 13 CFR 124.106.

DBEs are certified for the SRF program through the Supplier Diversity Office using the federal Department of Transportation (DOT) DBE rules. EPA allows the use of DBEs certified under the DOT rules as long as they are also United States citizens. To ensure compliance with the EPA rule, MassDEP must verify United States citizenship through the completion of the following form for each DBE used on the project.

SRF Project Number _____

Contract Number _____

Contract Title _____

DBE Subcontractor _____

The undersigned, on behalf of the above named DBE subcontractor, hereby certifies that the DBE firm is either owned or controlled by a person or persons that are citizens of the United States.

_____
Printed Name and Title of DBE Signatory

_____
DBE Signature

_____
Date



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**DISADVANTAGED BUSINESS ENTERPRISE**
**PROGRAM DBE SUBCONTRACTOR PARTICIPATION**
**FORM**

The United States Environmental Protection Agency (EPA) requires that this form be provided to all subcontractors on the project. At the option of the subcontractor, this form may be filled out and submitted directly to the EPA DBE Coordinator.

| | |
|---|---|
| NAME OF SUBCONTRACTOR | PROJECT NAME |
| ADDRESS | CONTRACT NO. |
| TELEPHONE NO. | E-MAIL ADDRESS |
| PRIME CONTRACTOR NAME: | |

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

_____

_____

_____

_____

_____

| CONTRACT ITEM NO. | ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR | AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR |
|---|---|---|
| | | |

_____ _____
Subcontractor Signature Title/Date

Equivalent to EPA form 6100-2

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**REQUEST FOR WAIVER FOR SRF CONSTRUCTION**

Upon exhausting all known sources and making every possible effort to meet the minimum requirements for DBE participation, the Bidder may seek relief either partially or entirely from these requirements by submitting a completed waiver package by the close of business on the third business day after notification by the LGU. Failure to comply with this process shall be cause to reject the bid thereby rendering the Bidder not eligible for award of the contract.

General Information

Project Title: _____ Project Location: _____

Bid Opening (time/date) _____

Bidder: _____

Mailing Address: _____

Contact Person: _____ Telephone No. (  ) _____ Ext. _____

Minimum Requirements

The bidder must demonstrate that good faith efforts were undertaken to comply with the percentage goals as specified. The firm seeking relief must show that such efforts were taken appropriately in advance of the time set for opening bid proposals to allow adequate time for response(s) by submitting the following:

A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:

1. names, addresses, telephone numbers and contact dates of all such companies contacted;

2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;

3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/women-focused media detailing the opportunities for participation;

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after submission of all required information and documentation, MassDEP shall make a determination, in writing, whether the waiver request is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing.

CERTIFICATION

The undersigned herewith certifies that the above information and appropriate attachments are true and accurate to the best of my knowledge and that I have been authorized to act on behalf of the bidder in this matter.

_____ _____

(authorized original signature) DATE

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

## STATE REVOLVING FUND LOAN PROGRAM – SCHEDULE OF SUBCONTRACTOR PARTICIPATION

Local Governmental Unit _____

Project Name _____

SRF Identification Number _____

General Contractor _____

Contract Value _____

The United States Environmental Protection Agency (EPA) requires that all SRF borrowers develop and maintain a list of all MBE/WBE and non MBE/WBE subcontractors on the project.

This form must be completed and returned to MassDEP within 90 days of award of the contract.

| Subcontractor | Point of Contact | Mailing Address | Telephone Number | E-Mail Address | MBE | WBE | DBE | Subcontract Value |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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| Company's Name | Date |
|---|---|
| Company's Address | **Refer to the Instructions in SECTION 00410, Page 2 - Bid Proposal in filling out this Proposal Form.** |

Date:

TO: ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described Drawings, Specifications and Addenda, all the Work specified in Section No.

of the Specifications and in any Drawings as specified in such section contained in the Contract Documents titled Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486 prepared by AECOM, 9 Jonathan Bourne Drive, Pocasset, MA 02559.

| Item No. | Description |
|---|---|

**PART I - BASE BID**

1. The work of the Subbidder for all Work for the WWTF other than that covered by other items, as specified, the lump sum of

$ - l.s.

2. The Work of the Subbider including all Work for Effluent Disposal Facility other than that covered by other items, as specified, the lump sum of

$ - l.s.

**TOTAL OF PART I - BASE BID**

$ -

**PART II - ALTERNATIVES**

A-1 For Addition of the Equipment Storage Facility, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-2 For Addition of the Fiber Optic Conduits and Handholes, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-3 For Addition of the Tracer Wire, as specified, the lump sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-4 For Addition of SBR Transfer Pump No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-5 For Addition of SBR Blower No. 4, as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

A-6 For Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank), as specified, the sum of

| | | |
|---|---|---|
| $ | - | l.s. |

B. This Subbid includes Addenda numbered _____ through _____ inclusive.

C. This Sub-bid:

_____ may be used by any General Bidder except:

_____

_____ may only be used by the following General Bidders:

_____

(To exclude Gneral Bidders, instert "X" in one box only and fill in blank following that box. Do not answer "C" if no General Bidders are excluded.)

D. The undersigned agrees that, if it is selected as Subbidder, it will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation of a Subcontract by the General Bidder selected as General Contractor, execute with such General Bidder a Subcontract in accordance with the terms of this Subbid, and contingent upon the execution of the General Contract and, if requested so to do in the general bid by such General Bidder, who shall pay the premiums therefor, furnish a Performance and Payment Bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority, in the full sum of the Subcontract Price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of Work for which the provisions of the section of the Specifications for this subtrade require a listing in this paragraph, including the undersigned if customarily furnished by persons on its own payroll and in the absence of a contrary provision in the Specifications, the name of each such class of Work or part thereto and the Bid Price for each such class of Work or part thereof are:

1. Name:

_____

Class of Work:

_____

Bid Price:

_____

2 Name:

Class of Work:

Bid Price:

3. Name:

Class of Work:

Bid Price:

4. Name:

Class of Work:

Bid Price:

5. Name:

Class of Work:

Bid Price:

Note: Do not give Bid Price for any class or part thereof furnished by the undersigned.

F. The undersigned agrees that the above list of Bids to the undersigned represents bona fide Bids based on the hereinbefore described Drawings, Specifications and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications, including all general conditions stated therein, and Addenda, and to assume toward it all the obligations and responsibilities that it, by those documents, assumes toward the Owner.

H. The undersigned offers the following information as evidence of its qualifications to perform the Work as Bid upon according to all requirements of the Drawings and Specifications:

1. Number of Years have been in business under present business name _____

2. Ever failed to complete any work awarded? _____

3. List one or more recent buildings with names of general contractor and engineer or architect on which you served as subcontractor for work of similar character as required for the above-named building.

a) Project
_____
Engineer or Architect
_____
General Contractor
_____
Amount of Contract
_____

b) Project
_____
Engineer or Architect
_____
General Contractor
_____
Amount of Contract
_____

c) Project

Engineer or Architect

General Contractor

Amount of Contract

d) Project

Engineer or Architect

General Contractor

Amount of Contract

e) Project

Engineer or Architect

General Contractor

Amount of Contract

4. Bank Reference:

Bank Reference:

Bank Reference:

I. The undersigned hereby certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee and that it will comply fully with all laws and regulations applicable to awards of Subcontracts subject to M.G.L. c.149, s44F, as amended.

The undersigned further certifies under the penalties of perjury that this Subbid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used herein, the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c29, s29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

J. All Subcontractors on this Project in categories subject to the pre-qualification procedures of MGL c. 149 §44 D3/4 shall be required to assume the cost of Payment and Performance Bonds and are directed to incorporate the costs of those bonds in their Bid prices. This requirement applies to all categories subject to pre-qualification. General Contractors should not include said costs for Subcontractor bonds in their Bid prices for those Subcontractors required to provide bonds pursuant to MGL c. 149 §44D3/4.

Date

Name of Subbidder

By:

Signature

Name and Title of Person Signing Bid

Business Address

City, State and Zip Code

Business Telephone No.

Business Fax No.

e-Mail

**SECTION 00520**

**AGREEMENT**

Made in triplicate this the _____ day of _____, 20____ between the Town of Orleans, MA

AND

hereafter the "Contractor".

**WITNESSETH:** That for and in consideration of the following mutual covenants contained herein the parties agree with each other as follows:

**ARTICLE I:** The Contractor agrees to sell and/or deliver to the Town of Orleans, MA materials and/or services in accordance with the following: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL, Contract No. 2019-01 and SRF No. 4486:

Exhibit 1. Quote/bid dated

Exhibit 2. Certificate of Non-Collusion

Exhibit 3. Statement of State Tax Compliance

Exhibit 4. Acknowledgement of Principal

Exhibit 5. Certificate of Insurance

Exhibit 6. Certification of OSHA 10-Hour Training

**ARTICLE II:** The Town of Orleans, MA agrees to process the bills for payment to the Contractor upon the execution of the contract, satisfactory completion of the services as outlined in the specifications and approval by the appropriate Department Manager, Town Administrator and Town Accountant in the amount of _____-- and 00/100 ($____.00) Dollars.

**ARTICLE III**

1. The Contractor agrees that it will fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). The Contractor shall not award any subcontracts or purchase any materials from suppliers that appear on the Excluded Parties List System.

   The Contractor shall include this requirement in each subcontract and require it to be included in all subcontracts regardless of tier. The Contractor shall maintain reasonable records to demonstrate compliance with these requirements.

2. The fair share goals for disadvantaged business enterprise (DBE) participation for this contract are a minimum of 4.2 percent Disadvantaged Minority Business Enterprise (D/MBE) participation and 4.5 percent Disadvantaged Women Business Enterprise(D/WBE) participation, applicable to the total dollar amount paid for the construction contract. The Contractor shall take all affirmative steps necessary to achieve this goal, and shall provide reports documenting the portion of contract and subcontract dollars paid to DBEs, and its efforts to achieve the goals, with each invoice submitted or at such greater intervals as specified by the (municipality). The contractor shall require similar reports from its subcontractors.

3. Equal Employment Opportunity/Affirmative Action (EEO/AA) Requirements - During the performance of this contract, the contractor agrees as follows:

   A. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

   B. The contractor will, in all solicitations or advancements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

C. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The contractor will comply with all provisions of Executive Order No. 11246 of Sept. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

E. The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders. Comp., p. 684, EO 12086 of Oct. 5, 1978, 43 FR 46501, 3 CFR, 1978 Comp., p. 230

F. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of Sept. 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

G. The contractor will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the contractor may request the United States to enter into such litigation to protect the interests of the United States." [Sec. 202 amended by EO 11375 of Oct. 13, 1967, 32 FR 14303, 3 CFR, 1966- 1970”

4. The contractor shall not participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue code 1986, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

5. The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written “Notice to Proceed” given by the Owner to the Contractor and to fully complete the project within 654 calendar days, using not more than 411 working days split into four phases.

6. The Bidder further agrees to pay as liquidated damages the sum of $6,700 for each consecutive calendar day and/or working day thereafter during which the work as not been fully completed, as provided in the “Liquidated Damages” provisions of SECTION 00800, SUPPLEMENTARY CONDITIONS.

7. As per MassDEP’s Policy Memorandum #10 – the agreed upon DIRECT LABOR MARKUP (percentage) for Change Orders on this project shall be ___ percent.

8. American Iron and Steel (AIS) Requirements - The Contractor acknowledges to and for the benefit of the Town of Orleans (“Purchaser”) and the Commonwealth of Massachusetts (the “State”) that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as “American Iron and Steel;” that requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”) including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a)the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation

attorney's fees)incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

9. All contracts for water and sewer projects awarded as a result of a proposal or invitation for bids under MGL Chapter 30 section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and Portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 percent.

10. All construction contracts are subject to the Davis Bacon wage rate requirements.

11. The Contractor agrees that it will fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). The Contractor shall not award any subcontracts or purchase any materials from suppliers that appear on the Excluded Parties List System. The Contractor shall include this requirement in each subcontract and require it to be included in all subcontracts regardless of tier. The Contractor shall maintain reasonable records to demonstrate compliance with these requirements.

**IN WITNESS:** Whereof the respective parties hereto have caused this instrument to be duly subscribed and sealed.

**TOWN OF ORLEANS, MA**

_____
John Kelly
Orleans Town Administrator

**(INSERT VENDOR'S NAME)**

_____
Signature of Individual or
Corporate Name (Mandatory)

APPROVED AS TO APPROPRIATIONS: Pursuant to M.G.L. c.44, s31C, I certify that an appropriation has been made in the total amount of the contract.

_____
Cathy Doane
Finance Director

SOURCE: _____

_____
Corporate Officer

(Mandatory, If applicable)

EIN # (Mandatory) _____

Not to Exceed: $_____

**END OF SECTION**

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**SECTION 00520**

**ATTACHMENT A**

**ADDITIONAL FORMS TO BE SUBMITTED WITH THE BID**

A. INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS

B. STATEMENT OF STATE TAX COMPLIANCE

C. CERTIFICATE OF NON-COLLUSION

D. ACKNOWLEDGEMENT OF PRINCIPAL, IF A CORPORATION

E. ACKNOWLEDGEMENT OF PRINCIPAL, IF A PARTNERSHIP

F. CERTIFICATION OF OSHA 10-HOUR TRAINING

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**INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS**

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

Insurance. The Contractor shall carry and maintain in effect during the entire currency of the contract, at his own expense, the following kinds and minimum amounts of insurance in a company or companies approved by the Town of Orleans, MA. Such insurance shall cover claims and suits which arise out of or result from the Contractor's execution of the contract work whether such execution by the Contractor himself or by any Subcontractor.

1) X - Worker's Compensation as required by the Worker's Compensation Laws of the Commonwealth of Massachusetts and, in conjunction therewith, Employer's Liability with a minimum limit as required by statute.

2) X - "Broad Form" Comprehensive General Liability including, but not limited to, Bodily Injury, Personal Injury and Property Damage Liability, Full Contractual Liability and liability arising from Explosion, Collapse and Underground Damage and all other applicable insurance necessary to carry out the contractual obligation to proceed under the contract. Provide a minimum limit of liability of $5,000,000.00 utilizing: (a) a standalone certificate or (b) a minimum $2,000,000.00 General Liability Policy combined with Umbrella Policy.

3) X - Automobile Bodily Injury and Property Damage Liability for all owned, non-owned and hired automobiles operated in connection with the performance of the contract. Minimum limits of liability: Single limits of Property Damage and Bodily Injury $1,000,000.

4) X - Builder's Risk - Amount of the General Contractor's Contract including a flood sublimit of $1,000,000

5) ___ - Professional Liability/ Errors and Omissions - Not Required.

Certificate of Insurance - Prior to beginning work under the contract, the Contractor shall furnish the Town of Orleans, MA a Certificate of Insurance naming the Town of Orleans, MA and AECOM Technical Services, Inc. as additional insured. Such Certificate also shall provide that the Town of Orleans, MA will be notified at least 30 days in advance of the cancellation or non-renewal of any insurance covered by the Certificate.

**END OF SECTION**

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**STATEMENT OF STATE TAX COMPLIANCE**

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

Pursuant to Ch. 233 of the Acts of 1983, §49A(b), I, _____, acknowledge that I am the authorized signatory for _____, whose principal place of business is at _____ , and as such, do hereby certify under the pains of penalties of perjury that this company has complied with all laws of the Commonwealth relating to taxes.

Social Security or Federal ID Number: _____

Subscribed and sworn to this _____day of _____, 20____.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

**END OF SECTION**

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## CERTIFICATE OF NON-COLLUSION

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

Pursuant to M.G.L. Ch. 30, the undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word "person" shall mean any natural person, business, partnership, corporation, union, committee, club, or other organization, entity, or group of individuals.

_____

Name of business

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

**END OF SECTION**

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**ACKNOWLEDGEMENT OF PRINCIPAL, IF A CORPORATION**

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared to me who, being by me duly sworn, did depose and say to me that he resides at _____ that he is of _____, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the impressions affixed to said instrument is an impression of such seal; that it was so affixed by the order of the directors of said corporation, and that he signed his name thereto by like order.

_____
Contractor's Signature

_____
Notary Public Signature

(Seal)

My Commission expires on: _____

**END OF SECTION**

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**ACKNOWLEDGEMENT OF PRINCIPAL, IF A PARTNERSHIP**

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared _____ to me known, and known to me to be one of the members of the firm described in and which executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

**END OF SECTION**

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**CERTIFICATION OF OSHA 10-HOUR TRAINING**

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Downtown Area WWTF and Effluent Disposal, Contract No. 2019-01 and SRF No. 4486

A contractor will not be eligible for award of a contract unless such contractor has submitted the following certification, which is deemed a part of the resulting contract.

All employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared _____ to me known, and known to me to be one of the members of the firm described in and which executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

**END OF SECTION**

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**SECTION 00610**

**PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Name of Contractor)

a _____ hereinafter called "Principal" and
(Corporation, Partnership, Joint Venture, LLC or Individual)

_____ of _____, State of _____
(Surety) (City)

hereinafter called the "Surety" and licensed by the State Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are held and firmly bound to the Town of Orleans, MA, Orleans, Massachusetts, hereinafter called "Owner", in the penal sum of _____Dollars and _____Cents ($) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal has entered into a certain contract with the Owner (the "Construction Contract"), dated the _____ day of _____, 20____, for the construction described as follows:

**DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL**

**Contract No. 2019-01 and SRF No. 4486**

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of the Construction Contract during the original term thereof, and any extensions thereof which may be granted by the Owner, with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under the Construction Contract, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be void; otherwise, this obligation shall remain in full force and effect.

PROVIDED, FURTHER, that the Surety's obligation under this Bond shall arise after (1) the Owner has declared the Principal in default of the Construction Contract or any provision thereof, or (2) has declared that the Principal has failed, or is otherwise unable or unwilling, to execute the work consistent with, and in conformance to, the Construction Contract (collectively referred to as a "Contractor Default"). The determination of a Contractor Default shall be made solely by the Owner. The Owner need not terminate the Construction Contract to declare a Contractor Default or to invoke its rights under this Bond, and Contractor hereby agrees not to assert any claims against Surety under any indemnity or similar agreements on the grounds that Surety has interfered with the Construction Contract by fulfilling its obligations hereunder in the absence of a termination of said contract.

When the Surety's obligation under this Bond arises, the Surety, at its sole expense and at the consent and election of the Owner, shall promptly take one of following steps: (1) arrange for the Principal to perform and complete the work of the Construction Contract; (2) arrange for a contractor other than the Principal to perform and complete the work of the Construction Contract;
(3) reimburse the Owner, in a manner and at such time as the Owner shall reasonably decide, for all costs and expenses incurred by the Owner in performing and completing the work of the Construction Contract. Surety will keep Owner reasonably informed of the progress, status and results of any investigation of any claim of the Owner.

If the Surety does not proceed as provided in this Bond with due diligence and all deliberate speed, the Surety shall be deemed to be in default of this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner.

After the Surety's obligation under this Bond arises, the Surety is obligated, to the limit of the amounts of this Bond, for (1) the correction of defective work and completion of the Construction Contract; (2) additional design, professional services, and legal costs, including attorney's fees, resulting from the Contractor Default or from the default of the Surety under this Bond; (3) any additional work beyond the Construction Contract made necessary by the Contractor Default or default of the Surety under this Bond; (4) indemnification obligations of the Principal, if any, as provided in the Construction Contract; and (5) liquidated damages as provided in the Construction Contract, or if no such damages are specified, actual damages and consequential damages resulting from the Contractor Default or any default of the Surety under this Bond.

Any proceeding, legal or equitable, under this Bond shall be instituted in any court of competent jurisdiction in the Commonwealth of Massachusetts.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Construction Contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Construction Contract or to the work or to the specifications.

The Surety providing the Bond shall have a rating of A or better within Best's Key Rating Guide.

IN WITNESS WHEREOF, this instrument is executed in three (3) counterparts, each one of which shall be deemed an original, this _____ day of _____, 20____.

ATTEST:

| | |
|---|---|
| Principal | Witness |
| Principal Signature | Witness as to Principal Signature |
| Name and Title | Name and Title |
| Address | Address |
| City and State | City and State |

(SEAL)

ATTEST:

| | |
|---|---|
| Surety | Witness |
| Attorney-in-Fact Signature | Witness as to Surety Signature |
| Name and Title | Name and Title |
| Address | Address |
| City and State | City and State |

(SEAL)

NOTES: Date of Bond must not be prior to date of Contract.
If Contractor is a Partnership, all partners shall execute Bond.

**END OF SECTION**

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**SECTION 00615**

**PAYMENT BOND**

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Name of Contractor)

a _____ hereinafter called "Principal" and
(Corporation, Partnership, Joint Venture, LLC or Individual)

_____ of _____, State of _____
(Surety) (City)

hereinafter called the "Surety" and licensed by the State Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are held and firmly bound to the Town of Orleans, MA, Orleans, Massachusetts, hereinafter called "Owner", in the penal sum of _____Dollars and _____Cents ($) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal has entered into a certain contract with the Owner (the "Construction Contract"), dated the _____ day of _____, 20____, for the construction described as follows:

**DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL**

**CONTRACT NO. 2019-01 AND SRF NO. 4486**

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such work, and all insurance premiums on said work, and for all labor, performed in such work whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of this contract or to the work or to the specifications. The Surety Company providing the bond shall have a rating of A or better within the Best Key Rating Guide.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____ ( ) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20__.

ATTEST:

| | |
|---|---|
| Principal | Witness |
| Principal Signature | Witness as to Principal Signature |
| Name and Title | Name and Title |
| Address | Address |
| City and State | City and State |

ATTEST:

| | |
|---|---|
| Surety | Witness |
| Attorney-in-Fact Signature | Witness as to Surety Signature |
| Name and Title | Name and Title |
| Address | Address |
| City and State | City and State |

(SEAL)

NOTES: Date of Bond must not be prior to date of Contract.
If Contractor is a Partnership, all partners shall execute Bond.

**END OF SECTION**

**STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT**

Prepared by

**ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE**

and

Issued and Published Jointly By

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NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

_____

AMERICAN CONSULTING ENGINEERS COUNCIL

_____

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# GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

*1.01* Defined Terms

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between OWNER and CONTRACTOR covering the Work.

3. *Application for Payment*--The form acceptable to ENGINEER which is to be used by CON- TRACTOR during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a bidder submit- ted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

7. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, Bid security form, if any, and the Bid form with any supplements.

8. *Bonds*--Performance and payment bonds and other instruments of security.

9. *Change Order*--A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by OWNER or CONTRACTOR seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the OWNER and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

*****12. *Contract Documents*--The Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Con- tract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

13. *Contract Price*--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment.

15. *CONTRACTOR*--The individual or entity with whom OWNER has entered into the Agreement.

16. *Cost of the Work*--See paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

*****19. *ENGINEER*--The individual or entity named as such in the Agreement.

*****20. *ENGINEER's Consultant*--An individual or entity having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

21. *Field Order*--A written order issued by ENGINEER which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

22. General Requirements--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

25. *Laws and Regulations; Laws or Regulations*-- Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. *Notice of Award*--The written notice by OWNER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the conditions precedent listed therein, OWNER will sign and deliver the Agreement.

29. *Notice to Proceed*--A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform the Work under the Contract Documents.

**30. *OWNER*--The individual, entity, public body, or authority with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

31. *Partial Utilization*--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

32. *PCBs*--Polychlorinated *biphenyls.*

33. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

34. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part as may be indicated elsewhere in the Contract Documents.

35. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Resident Project Representative*--The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

40. *Site*--Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of CONTRACTOR.

*41. *Specifications*~~--That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.~~

42. *Subcontractor*--An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

**43. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

44. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

45. *Supplier*--A manufacturer, fabricator, supplier, distributor, material-man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

46. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

47. *Unit Price Work*--Work to be paid for on the basis of unit prices.

48. *Work*--The entire completed construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

49. *Work Change Directive*--A written statement to CONTRACTOR issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

50. *Written Amendment*--A written statement modifying the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

*1.02 Terminology*

A. Intent of Certain Terms or Adjectives

1. Whenever in the Contract Documents the terms "as allowed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of ENGINEER as to the Work, it is intended that such action or determination will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise).

The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

B. Day

1. The word "day" shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

C. Defective

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.04 or 14.05).

D. Furnish, Install, Perform, Provide

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, "provide" is implied.

E. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

*2.01 Delivery of Bonds*

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish.

*2.02 Copies of Documents*

A. OWNER shall furnish to CONTRACTOR up to ten copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

*2.03 Commencement of Contract Times; Notice to* Proceed *

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

*2.04 Starting the Work*

A. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

*2.05 Before Starting Construction*

A. *CONTRACTOR's Review of Contract Documents:* Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless CONTRACTOR knew or reasonably should have known thereof.

B. *Preliminary Schedules:* Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for its timely review:

1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing, and processing such submittal; and
3. a preliminary schedule of values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

*****C. *Evidence of Insurance*~~: Before any Work at the Site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with Article 5.~~

*2.06 Preconstruction Conference*

A. Within 20 days after the Contract Times start to run, but before any Work at the Site is started, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.B, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

*2.07 Initial Acceptance of Schedules*

A. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CON- TRACTOR, ENGINEER, and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.05.B. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until acceptable schedules are submitted to ENGINEER.

1. The progress schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within any specified Mile- stones and the Contract Times. Such acceptance will not impose on ENGINEER responsibility for the progress schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor.
2. CONTRACTOR's schedule of Shop Drawing and Sample submittals will be acceptable to ENGINEER if it provides a workable arrangement for reviewing and processing the required submittals.
3. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

*3.01 Intent*

*****A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to OWNER.

C. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in Article 9.

*3.02 Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to OWNER, ENGINEER, or any of ENGINEER's Consultants, agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

*3.03 Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once. CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as required by paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.04; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity, or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

*3.04 Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways: (i) a Written Amendment; (ii) a Change Order; or (iii) a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways: (i) a Field Order; (ii) ENGINEER's approval of a Shop Drawing or Sample; or (iii) ENGINEER's written interpretation or clarification.

*3.05 Reuse of Documents*

A. CONTRACTOR and any Subcontractor or Supplier or other individual or entity performing or furnishing any of the Work under a direct or indirect contract with OWNER: (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, including electronic media editions; and (ii) shall not reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER. This prohibition will survive final payment, completion, and acceptance of the Work, or termination or completion of the Contract. Nothing herein shall preclude CONTRACTOR from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – AVAILABILITY OF LANDS, SUBSURFACE AND PHYSICAL CONDITIONS, REFERENCE POINTS REFERENCE POINTS

*4.01 Availability of Lands*

A. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application but specifically related to use of the Site with which CONTRACTOR must comply in performing the Work. OWNER will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If CONTRACTOR and OWNER are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in OWNER's furnishing the Site, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

B. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

*4.02 Subsurface and Physical Conditions*

* A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER, or any of ENGINEER's Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

*4.03 Differing Subsurface or Physical Conditions*

A. *Notice:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

** B. *ENGINEER's Review:* After receipt of written notice as required by paragraph 4.03.A, ENGINEER will promptly review the pertinent condition, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto, and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of para- graphs 9.08 and 11.03.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract

Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

c. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by CONTRACTOR on or in connection with any other project or anticipated project.

*4.04 Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, including OWNER, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

c. coordination of the Work with the owners of such Underground Facilities, including OWNER, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

2. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable *adjustment shall be made i n the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or *indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, OWNER or CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

*4.05 Reference Points*

A. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.**

*4.06 Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those** reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the ENGINEER in the preparation of the Contract Documents. *

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make

any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. CONTRACTOR shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. CONTRACTOR shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by CONTRACTOR, Subcontractors, Suppliers, or anyone else for whom CONTRACTOR is responsible.

D. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. CONTRACTOR shall not be required to resume Work in connection with such condition or in any affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stop- page or such special conditions under which Work is agreed to be resumed by CONTRACTOR, either party may make a Claim therefor as provided in paragraph 10.05.

F. If after receipt of such written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 10.05. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.E shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.F shall obligate CONTRACTOR to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of paragraphs 4.02, 4.03, and 4.04 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

~~any other additional insured) which OWNER is required to purchase and maintain.~~

ARTICLE 5 - BONDS AND INSURANCE

*5.01 Performance, Payment, and Other Bonds*

A. CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Contract Documents.*

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

C. If the surety on any Bond furnished by CON- TRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B, CONTRACTOR shall within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

*5.02 Licensed Sureties and Insurers*

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

*5.03 Certificates of Insurance*

A. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to *****purchase and maintain. ~~OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or~~

*5.04 CONTRACTOR's Liability Insurance*

*****A. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;
4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance so required by this paragraph 5.04 to be purchased and maintained shall:

*1. with respect to insurance required by para- graphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.07, 6.11, and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective Work in accordance with paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).*

~~*5.05 OWNER's Liability Insurance*~~

~~*****A. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.04, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.~~

~~*5.06 Property Insurance*~~

~~***** A. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:~~

~~1. include the interests of OWNER, CON- TRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;~~

~~2. be written on a Builder's Risk "all-risk" or open-peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water dam- age, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;~~

~~3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);~~

~~4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;~~

~~5. allow for partial utilization of the Work by OWNER;~~

~~6. include testing and startup; and~~

~~7. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.~~

~~*****B. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.~~

~~***** C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph *5.07*.~~

~~*D. OWNER shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of CONTRACTOR, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary~~

~~Conditions. The risk of loss within such identified deductible amount will be borne by CONTRACTOR, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.~~

~~*E. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraph 5.06, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the Site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.~~

*5.07 Waiver of Rights*

*****A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.06 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance * ~~held by OWNER as trustee or~~ otherwise payable under any policy so issued.

B. OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of, or resulting from fire or other peril whether or not insured by OWNER; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.05, after Substantial Completion pursuant to paragraph 14.04, or after final payment pursuant to paragraph 14.07.

C. Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against CONTRACTOR, Subcontractors, ENGINEER, or ENGINEER's Consultants and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

*5.08 Receipt and Application of Insurance Proceeds*

~~*****A. Any insured loss under the policies of insurance required by paragraph 5.06 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. OWNER shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.~~

~~*****B. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.~~

*5.09 Acceptance of Bonds and Insurance; Option to Replace*

~~*****A. If either OWNER or CONTRACTOR has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by paragraph 2.05.C. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such~~

~~other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.~~

*5.10 Partial Utilization, Acknowledgment of Property Insurer*

A. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

*6.01 Supervision and Superintendence*

A. CONTRACTOR shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of OWNER or ENGINEER in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

~~*B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to or received from the superintendent shall be binding on CONTRACTOR.~~

*6.02 Labor; Working Hours*

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out, and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without OWNER's written consent (which will not be unreasonably withheld) given after prior written notice to ENGINEER.

*6.03 Services, Materials, and Equipment*

A. Unless otherwise specified in the General Requirements, CONTRACTOR shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

*6.04 Progress Schedule*

A. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.07 as it may be adjusted from time to time as provided below.

1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.07) proposed adjustments in the progress schedule that will not result in changing the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

**6.05 Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may

be submitted to ENGINEER for review under the circumstances described below.

1. "Or-Equal" Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

    a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

    b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

    a. If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.05.A.1, it will be considered a proposed substitute item.

    b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CON- TRACTOR.

    c. The procedure for review by ENGINEER will be as set forth in paragraph 6.05.A.2.d, as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances.

    d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CON- TRACTOR may furnish or utilize a substitute means, meth- od, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.05.A.2.

C. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.05.A and 6.05.B. ENGINEER will be the sole judge of accept- ability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. *Special Guarantee:* OWNER may require CON- TRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. *ENGINEER's Cost Reimbursement:* ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.05.A.2 and 6.05.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with

OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute.

F. *CONTRACTOR's Expense:* CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

*6.06 Concerning Subcontractors, Suppliers, and Others*

A. CONTRACTOR shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to OWNER as indicated in paragraph 6.06.B), whether initially or as a replacement, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to OWNER in advance for acceptance by OWNER by a specified date prior to the Effective Date of the Agreement, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation.

CONTRACTOR shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

C. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other individual or entity, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR.

E. CONTRACTOR shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

**F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.06, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

*6.07 Patent Fees and Royalties*

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees or agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any

invention, design, process, product, or device not specified in the Contract Documents.

*6.08 Permits*

******A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto, such as plant investment fees.

*6.09 Laws and Regulations*

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

B. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work may be the subject of an adjustment in Contract Price or Contract Times. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in paragraph 10.05.

*6.10 Taxes ***

**A.** CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

*6.11 Use of Site and Other Areas ***

A Limitation on Use of Site and Other Areas

1. CONTRACTOR shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant, and the officers, directors, partners, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER, or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work CONTRACTOR shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and Disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work CONTRACTOR shall clean the Site and make it ready for

utilization by OWNER. At the completion of the Work CONTRACTOR shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

*6.12 Record Documents*

A. CONTRACTOR shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to ENGINEER for OWNER.

*6.13 Safety and Protection*

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Under- ground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant, or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

*6.14 Safety Representative*

A. CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

*6.15 Hazard Communication Programs*

A. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

*6.16 Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR is obligated to act to prevent threatened damage, injury, or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued.

*6.17 Shop Drawings and Samples*

A. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop

Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show ENGINEER the services, materials, and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.17.E.

B. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.17.E. The numbers of each Sample to be submitted will be as specified in the Specifications.

C. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER as required by paragraph 2.07, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

D. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and

d. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

3. At the time of each submittal, CONTRAC- TOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

E. ENGINEER's Review

*1. ENGINEER will ~~timely~~ review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. ENGINEER's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of each submittal as required by paragraph 6.17.D.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.17.D.1.

F. Resubmittal Procedures

1. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

*6.18 Continuing the Work*

A. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.04 or as OWNER and CONTRACTOR may otherwise agree in writing.

*6.19 CONTRACTOR's General Warranty and Guarantee*

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER's Consultants that all Work

will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or any other individual or entity for whom CONTRACTOR is responsible; or

2. normal wear and tear under normal usage. B. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

   a. observations by ENGINEER;
   b. recommendation by ENGINEER or payment by OWNER of any progress or final payment;
   c. the issuance of a certificate of Substantial Completion by ENGINEER or any payment related thereto by OWNER;
   d. use or occupancy of the Work or any part thereof by OWNER;
   e. any acceptance by OWNER or any failure to do so;
   f. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER;
   g. any inspection, test, or approval by others; or
   h. any correction of defective Work by OWNER.

*6.20 Indemnification*

~~*A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage:~~

~~1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and~~

~~2. is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such individual or entity.~~

B. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

~~*C. The indemnification obligations of CONTRACTOR under paragraph 6.20.A shall not extend to the liability of ENGINEER and ENGINEER's Consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them arising out of:~~

~~1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or~~ Specifications~~; or~~

~~2. giving directions or instructions, or failing to give them, if that is the primary cause of the~~ injury ~~or damage.~~

ARTICLE 7 - OTHER WORK

*7.01 Related Work at Site*

A. OWNER may perform other work related to the Project at the Site by OWNER's employees, or let other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

   1. written notice thereof will be given to CONTRACTOR prior to starting any such other work; and

   2. if OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in paragraph 10.05.

B. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the other work with OWNER's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their

work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

C. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure to so report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent defects and deficiencies in such other work.

*7.02 Coordination*

A. If OWNER intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility for such coordination.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

*8.01 Communications to Contractor*

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

*8.02 Replacement of ENGINEER*

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer to whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

*8.03 Furnish Data*

A. OWNER shall promptly furnish the data required of OWNER under the Contract Documents.

*8.04 Pay Promptly When Due*

A. OWNER shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.02.C and 14.07.C.

*8.05 Lands and Easements; Reports and Tests*

A. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by ENGINEER in preparing the Contract Documents.

*8.06 Insurance*

~~*A. OWNER's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.~~

*8.07 Change Orders*

A. OWNER is obligated to execute Change Orders as indicated in paragraph 10.03.

*8.08 Inspections, Tests, and Approvals*

A. OWNER's responsibility in respect to certain inspections, tests, and approvals is set forth in paragraph 13.03.B.

*8.09 Limitations on OWNER's Responsibilities*

A. The OWNER shall not supervise, direct, or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

*8.10 Undisclosed Hazardous Environmental Condition*

A. OWNER's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in paragraph 4.06.

*8.11 Evidence of Financial Arrangements*

A. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

*9.01 OWNER'S Representative*

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and will not be changed without written consent of OWNER and ENGINEER.

**9.02 Visits to Site*

A. ENGINEER will make visits to the Site at intervals appropriate to the various stages of construction as

ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER, for the benefit of OWNER, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work.

B. ENGINEER's visits and observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.10, and particularly, but without limitation, during or as a result of ENGINEER's visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

*9.03 Project Representative*

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more extensive observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.10 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the Site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

*9.04 Clarifications and Interpretations*

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents as ENGINEER may deter- mine necessary, which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a written clarification or interpretation, a Claim may be made therefor as provided in paragraph 10.05.

***9.05 Authorized Variations in Work*

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR, who shall perform the Work involved promptly. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of a Field Order, a Claim may be made therefor as provided in paragraph 10.05.

*9.06 Rejecting Defective Work*

A. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

*9.07 Shop Drawings, Change Orders and Payments*

A. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraph 6.17.

B. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

C. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

*9.08 Determinations for Unit Price Work*

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CON- TRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.05.

*9.09 Decisions on Requirements of Contract Documents and Acceptability of Work*

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters

relating to the acceptability of the Work, the quantities and classifications of Unit Price Work, the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, and Claims seeking changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing, in accordance with the provisions of paragraph 10.05, with a request for a formal decision.

B. When functioning as interpreter and judge under this paragraph 9.09, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to this paragraph 9.09 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.07) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

*9.10 Limitations on ENGINEER's Authority and Responsibilities*

A. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this paragraph 9.10 shall also apply to ENGINEER's Consultants, Resident Project Representative, and assistants.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

*10.01 Authorized Changes in the Work*

A. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in paragraph 10.05.

*10.02 Unauthorized Changes in the Work*

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in paragraph 3.04, except in the case of an emergency as provided in paragraph 6.16 or in the case of uncovering Work as provided in paragraph 13.04.B.

*10.03 Execution of Change Orders*

A. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

1. changes in the Work which are: (i) ordered by OWNER pursuant to paragraph 10.01.A, (ii) required because of acceptance of defective Work under paragraph 13.08.A or OWNER's correction of defective Work under paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to para- graph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.18.A.

*10.04 Notification to Surety*

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility. The amount of each applicable Bond will be adjusted to reflect the effect of any such change.

*10.05 Claims and Disputes*

A. *Notice:* Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the claimant to ENGINEER and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. Notice of the amount or extent of the Claim, dispute, or other matter with supporting data shall be delivered to the ENGINEER and the other party to the Contract within 60 days after the start of such event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of such Claim, dispute, or other matter). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to ENGINEER and the claimant within 30 days after receipt of the claimant's last submittal (unless ENGINEER allows additional time).

B. *ENGINEER's Decision:* ENGINEER will render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. ENGINEER's written decision on such Claim, dispute, or other matter will be final and binding upon OWNER and CONTRACTOR unless:

1. an appeal from ENGINEER's decision is taken within the time limits and in accordance with the dispute resolution procedures set forth in Article 16; or

2. if no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within 30 days after the date of such decision, and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction within 60 days after the date of such decision or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by OWNER and CONTRACTOR), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

C. If ENGINEER does not render a formal decision in writing within the time stated in paragraph 10.05.B, a decision denying the Claim in its entirety shall be deemed to have been issued 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. No Claim for an adjustment in Contract Price or Contract Times (or Milestones) will be valid if not submitted in accordance with this paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

***11.01 Cost of the Work*

~~A. *Costs Included:* The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to CONTRACTOR will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 11.01.B.~~

~~1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.~~

~~2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.~~

~~3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and~~

CON-TRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

   c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

   d. Sales, consumer, use, and other similar taxes related to the Work, and for which CON-TRACTOR is liable, imposed by Laws and Regulations.

   e. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses within the deductible amounts of property insurance established in accordance with paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee.

   f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages

   g. The cost of utilities, fuel, and sanitary facilities at the Site.

   h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

   i. When the Cost of the Work is used to determine the value of a Change Order or of a Claim, the cost of premiums for additional Bonds and insurance required because of the changes in the Work or caused by the event giving rise to the Claim.

   j. When all the Work is performed on the basis of cost plus, the costs of premiums for all Bonds and insurance CONTRACTOR is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

   1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.01.A.1 or specifically covered by paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

   2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

   3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

   4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, Disposal of materials or

equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraphs 11.01.A and 11.01.B.

C. *CONTRACTOR's Fee:* When all the Work is performed on the basis of cost-plus, CONTRACTOR's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to paragraphs 11.01.A and 11.01.B, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

*11.02 Cash Allowances*

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

1. the allowances include the cost to CON- TRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. CONTRACTOR's costs for unloading and handling on the Site, labor, installation costs, over- head, profit, and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

B. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

*11.03 Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER subject to the provisions of paragraph 9.08.

B. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

*C. OWNER or CONTRACTOR may make a Claim for an adjustment in the Contract Price in accordance with paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

## ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

*12.01 Change of Contract Price*

**A. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of para- graph 11.03 ); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under para- graph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in paragraph 11.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 12.01.C).

C. *CONTRACTOR's Fee:* The CONTRACTOR's fee for overhead and profit shall be determined as follows:

1. mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under paragraphs 11.01.A.1 and 11.01.A.2, the CONTRACTOR's fee shall be 15 percent;

b. for costs incurred under paragraph 11.01.A.3, the CONTRACTOR's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

*12.02 Change of Contract Times*

A. The Contract Times (or Milestones) may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Times (or Milestones) shall be based on written notice submitted by the party making the claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. Any adjustment of the Contract Times (or Milestones) covered by a Change Order or of any Claim for an adjustment in the Contract Times (or Milestones) will be determined in accordance with the provisions of this Article 12.

*12.03 Delays Beyond CONTRACTOR's Control*

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in paragraph 12.02.A. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

*12.04 Delays Within CONTRACTOR's Control*

A. The Contract Times (or Milestones) will not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

*12.05 Delays Beyond OWNER's and CONTRACTOR's Control*

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay.

*12.06 Delay Damages*

A. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from:

1. delays caused by or within the control of CONTRACTOR; or

2. delays beyond the control of both OWNER and CONTRACTOR including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

B. Nothing in this paragraph 12.06 bars a change in Contract Price pursuant to this Article 12 to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible.

* ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

*13.01 Notice of Defects*

A. Prompt notice of all defective Work of which OWNER or ENGINEER has actual knowledge will be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

*13.02 Access to Work*

A. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. CONTRACTOR shall provide them proper and

safe conditions for such access and advise them of CONTRACTOR's Site safety procedures and programs so that they may comply therewith as applicable.

*13.03 Tests and Inspections*

A. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.04.B shall be paid as provided in said paragraph 13.04.B; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection or approval.

D. CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to OWNER and ENGINEER.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

F. Uncovering Work as provided in paragraph 13.03.E shall be at CONTRACTOR's expense unless CON- TRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

*13.04 Uncovering Work*

A. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it is found that such Work is defective, CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

*13.05 OWNER May Stop the Work*

A. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

*13.06 Correction or Removal of Defective Work*

A. CONTRACTOR shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the Project and replace it with Work that is not defective. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

*13.07 Correction Period*

~~*A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for CONTRACTOR's use by OWNER or permitted by Laws and Regulations as contemplated in paragraph 6.11.A is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) repair such defective land or areas, or (ii) correct such defective Work or, if the defective Work has been rejected by OWNER, remove it from the Project and replace it with Work that is not defective, and (iii) satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or repaired or may have the rejected Work removed and replaced, and all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.~~

B. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

C. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

D. CONTRACTOR's obligations under this paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

*13.08 Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER's recommendation of final payment, ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by CONTRACTOR pursuant to this sentence. If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and OWNER shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

*13.09 OWNER May Correct Defective Work*

*A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06.A, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days written notice to CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER and ENGINEER's Consultants access to the Site to enable OWNER to exercise the rights and remedies under this paragraph.

C. All Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by OWNER in exercising the rights and remedies under this paragraph 13.09 will be charged against CON- TRACTOR, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to

agree as to the amount of the adjustment, OWNER may make a Claim therefor as provided in paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies under this paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

*14.01 Schedule of Values*

A. The schedule of values established as provided in paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

*14.02* Progress Payments

A. Applications for Payments

1. At least 20 days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect OWNER's interest therein, all of which must be satisfactory to OWNER.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied on account to discharge CONTRACTOR's legitimate obligations associated with prior Applications for Payment.

~~*3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.~~

B. Review of Applications

~~**1. ENGINEER will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.~~

2. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWN- ER, based on ENGINEER's observations on the Site of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.08, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

3. By recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents; or (ii) that there may not be other matters or issues between the parties that might entitle CON- TRACTOR to be paid

additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

4. Neither ENGINEER's review of CONTRACTOR's Work for the purposes of recommending payments nor ENGINEER's recommendation of any payment, including final payment, will impose responsibility on ENGINEER to supervise, direct, or control the Work or for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for CONTRACTOR's failure to comply with Laws and Regulations applicable to CONTRACTOR's performance of the Work. Additionally, said review or recommendation will not impose responsibility on ENGINEER to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price, or to determine that title to any of the Work, materials, or equipment has passed to OWNER free and clear of any Liens.

5. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.02.B.2. ENGINEER may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

   a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

   b. the Contract Price has been reduced b Written Amendment or Change Orders;

   c. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.09; or

   d. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.A.

C. Payment Becomes Due

*1. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due, and when due will be paid by OWNER to CONTRACTOR.

**D. Reduction *in Payment*

1. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

   a. claims have been made against OWN- ER on account of CONTRACTOR's performance or furnishing of the Work;

   b. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

   c. there are other items entitling OWNER to a set-off against the amount recommended; or

   d. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.B.5.a through 14.02.B.5.c or paragraph 15.02.A.

2. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

3. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.02.C.1.

*14.03 CONTRACTOR's Warranty of Title*

* ~~A. CONTRACTOR warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.~~

*14.04 Substantial Completion*

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Promptly thereafter, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list

If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within 14 days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said 14 days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

B. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

*14.05 Partial Utilization*

A. Use by OWNER at OWNER's option of any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which OWNER, ENGINEER, and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following conditions.

1. OWNER at any time may request CON- TRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons there- for. If ENGINEER considers that part of the Work to be substantially complete, the provisions of para- graph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

2. No occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

*14.06 Final Inspection*

A. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will promptly make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

*14.07 Final Payment*

A. Application for Payment

1. After CONTRACTOR has, in the opinion of ENGINEER, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in paragraph 6.12), and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.04.B.7; (ii) consent of the

surety, if any, to final payment; and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in paragraph 14.07.A.2 and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

B. Review of Application and Acceptance

**~~1. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application for Payment to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.09. Otherwise, ENGINEER will return the Application for Payment to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application for Payment.~~

C. Payment Becomes Due

1. Thirty days after the presentation to OWN- ER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER will become due and, when due, will be paid by OWNER to CONTRACTOR.

*14.08 Final Completion Delayed*

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

*14.09 Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing which are still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

*15.01 OWNER May Suspend Work*

**~~A. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to CON- TRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes a Claim therefor as provided in paragraph 10.05.~~

*15.02 OWNER May Terminate for* Cause

A. The occurrence of any one or more of the following events will justify termination for cause:

1. CONTRACTOR's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.07 as adjusted from time to time pursuant to paragraph 6.04);

2. CONTRACTOR's disregard of Laws or Regulations of any public body having jurisdiction;

3. CONTRACTOR's disregard of the authority of ENGINEER; or

4. CONTRACTOR's violation in any substantial way of any provisions of the Contract Documents.

*B. If one or more of the events identified in paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by OWNER arising out of or relating to completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and, when so approved by ENGINEER, incorporated in a Change Order. When exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

C. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

*15.03 OWNER May Terminate For Convenience*

A. Upon seven days written notice to CON- TRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Contract. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. for all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. for reasonable expenses directly attributable to termination.

B. CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

*15.04 CONTRACTOR May Stop Work or Terminate*

A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within 30 days after it is submitted, or OWNER fails for 30 days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Contract and recover from OWNER payment on the same terms as provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within 30 days after it is submitted, or OWNER has failed for 30 days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may, seven days after written notice to OWNER and ENGINEER, stop the Work until payment is made of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.04 are not intended to preclude CON- TRACTOR from making a Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Times or other- wise for expenses or damage directly attributable to CONTRACTOR's stopping the Work as permitted by this paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

*16.01 Methods and Procedures*

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of paragraphs 9.09 and 10.05, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 - MISCELLANEOUS

*17.01 Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

*17.02 Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any

such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

*17.03 Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

*17.04 Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Agreement.

*17.05 Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

**END OF SECTION**

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**SECTION 00800**

**SUPPLEMENTARY CONDITIONS**

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. 1910-8, 1996 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

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**ARTICLE 1. DEFINITIONS AND TERMINOLOGY**

Add the following language at the beginning of definition 1.01 A.12 entitled "Contract Documents" in the General Conditions: "The Advertisement for Bids, Instructions to Bidders, State Regulations,..."

Delete the words "The individual or entity named as such in the Agreement" in 1.01.A.19, “Engineer”, and insert the following in their place: "The individual or entity duly appointed by the Owner to undertake the duties and powers herein assigned to the Engineer, acting either directly or through duly appointed representatives."

Delete the words "and who is identified as such in the Supplementary Conditions" at the end of definition 1.01 A.20, entitled "ENGINEER'S Consultant."

Delete definition 1.01 A.41 entitled "Specifications" in the General Conditions in its entirety and insert the following in its place: "Sections included under Division 1 through Division 16 of the Contract Documents."

**ARTICLE 2. PRELIMINARY MATTERS SC-2.02**

Delete paragraph 2.02A of the General Conditions in its entirety.

SC-2.03

Add paragraph 2.03B:

Notwithstanding the time limitations provided in paragraph 2.03A, the OWNER may desire to commence the Contract Times later than the sixtieth day after the bid opening. The OWNER and CONTRACTOR, upon mutual agreement, may extend the commencement of the Contract Times to any date that they elect. OWNER must obtain CONTRACTOR's approval for extending the time beyond the dates/times stated in the Contract Documents.

SC-2.05

Delete paragraph 2.05C of the General Conditions in its entirety and insert the following in its place:

"C. Evidence of Insurance: CONTRACTOR shall deliver to OWNER, with a copy to the ENGINEER, Certificates of Insurance within 10 days after receipt of the notice of the acceptance of bid (and other evidence requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with the requirements of Article 5."

**ARTICLE 3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE SC-3.01**

Add the following sentence at the end of Paragraph 3.01A of the General Conditions:

"...by all. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion."

**ARTICLE 4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS**

SC-4.02

Delete the term "Supplementary Conditions" of paragraph 4.02 A of the General Conditions and replace it with "Contract Documents".

SC-4.04

Change "of" to "or" on line 6 of paragraph 4.04 B.2 of the General Conditions.

Delete the following words from lines 8 and 9 of paragraph 4.04 B.2 of the General Conditions: "...or not shown or indicated with reasonable accuracy..."

SC-4.05

Add a new paragraph immediately after paragraph 4.05A of the General Conditions which is to read as follows:

"B. ENGINEER may check the lines, elevations and reference marks set by CONTRACTOR, and CONTRACTOR shall correct any errors disclosed by such check. Such a check shall not be considered as approval of CONTRACTOR's work and shall not relieve CONTRACTOR of the responsibility for construction of the entire Work in accordance with the Contract Documents. CONTRACTOR shall furnish personnel to assist ENGINEER in checking lines and grades."

**ARTICLE 5. BONDS AND INSURANCE NOTICE TO CONTRACTOR:**

1. Proof of Insurance coverage shall be furnished to the OWNER in accordance with the schedule for submittal of Bonds and Agreements.

2. Additionally refer to Article 2. PRELIMINARY MATTERS, Paragraph SC-2.05.C

SC-5.01

Insert these sentences following SC-5.01.A:

"The Surety Company providing the bonds shall have a rating of A or better within the Best Key Rating Guide and be licensed by the Massachusetts Division of Insurance. The CONTRACTOR shall pay the premiums for such Bonds."

SC-5.03

Delete the second sentence in paragraph 5.03A of the General Conditions, which begins "OWNER shall deliver to...."

SC-5.04

The limits of liability for the insurance required by paragraph 5.04A of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law:

5.04 A.1 and 5.04 A.2 Workers' Compensation.

(1) Worker's Compensation per Statutory Requirements

(2) Coverage B - Employer's Liability $100,000/$500,000/$100,000

5.04 A.3, 5.04 A.4 and 5.04 A.5 Commercial General Liability Limits shall include coverage for Independent Contractors (also known as Owners and Contractors Protective Liability), explosion, collapse and underground hazard coverage (XCU), broad form property damage, blanket contractual liability and products/completed operations. The general aggregate limits shall be endorsed so that they respond on a per project and per location basis.

Limits: $1,000,000 each occurrence

$2,000,000 general aggregate

$2,000,000 products/completed operations aggregate

5.04 A.6 Automobile Liability for owned, hired and non-owned vehicles:

| | | | |
|---|---|---|---|
| (1) | Bodily injury: | $1,000,000 | Combined single limit |
| (2) | Property damage | $1,000,000 | Combined single limit |

Revise the beginning of paragraph 5.04.B.1 to read as follows: "with respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.5 inclusive and paragraph 5.04.C, include as additional insureds…"

Delete paragraph 5.04.B.5 in its entirety and insert the following in its place:

"5. Contains a provision that notice of cancellation of insurance be delivered in accordance with policy provisions. In addition, the CONTRACTOR and/or its insurance broker/agent shall immediately notify the OWNER and ENGINEER should any insurance coverage be cancelled. The CONTRACTOR shall immediately stop work on the Project and shall not resume work until the CONTRACTOR provides evidence, to the OWNER and ENGINEER, in the form of an acceptable insurance certificate, of new insurance coverage that replaces all cancelled coverage that is required for the Project."

Add two new paragraphs immediately after paragraph 5.04B of the General Conditions which are to read as follows:

"C. The CONTRACTOR shall also provide:

1. CONTRACTOR shall, as a minimum, purchase and maintain excess liability insurance in the umbrella form with a combined single limit of not less than $5,000,000 per occurrence and in the aggregate. Evidence of such excess liability shall be delivered to OWNER in accordance with paragraph 2.05C in the form of a certificate indicating the policy numbers and limits of liability of all underlying insurance.

2. General Liability, Workers' Compensation, Automobile Liability and Umbrella Liability Policies will contain waivers of subrogation in favor of the Engineer and Owner.

3. If the aggregate limits of liability indicated in CONTRACTOR' insurance provided in accordance with paragraphs 5.03 and 5.04 are not sufficient to cover all claims for damages arising from his operations under this Contract and from any other work performed by him or if the commercial general liability insurance policy of insurance does not provide that the general aggregate limits apply on a per project and per location basis, CONTRACTOR shall have the policy amended so that the aggregate limits of liability required by this Contract will be available to cover all claims for damages due to operations under this Contract."

The General Contractor shall carry the coverage by naming the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured at the limits specified herein. SECTION 05020, INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS are separate from the Owners and Contractors Protective Liability and shall name the Town of Orleans, Tighe & Bond and AECOM Technical Services, Inc. as additionally insured.

SC-5.05

Delete paragraph 5.05 of the General Conditions in its entirety.

SC-5.06

Delete Paragraph 5.06A of the General Conditions in its entirety.

Delete paragraph 5.06B of the General Conditions in its entirety.

Delete Paragraph 5.06C of the General Conditions in its entirety.

Delete paragraph 5.06D of the General Conditions in its entirety.

Delete paragraph 5.06E of the General Conditions in its entirety.

SC-5.07

Amend the last sentence of paragraph 5.07A of the General Conditions by striking out the words "held by OWNER as trustee or." As so amended, paragraph 5.07A remains in effect.

SC-5.08

Delete paragraph 5.08A of the General Conditions in its entirety.

Delete paragraph 5.08B of the General Conditions in its entirety.

SC-5.09

Delete paragraph 5.09A of the General Conditions in its entirety and insert the following in its place:

"A. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with this Article 5 on the basis of its not complying with the Contract Documents, OWNER will notify CONTRACTOR in writing thereof within thirty days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.05C. CONTRACTOR will provide such additional information in respect of insurance provided by him as OWNER may reasonably request."

**ARTICLE 6. CONTRACTOR'S RESPONSIBILITIES SC-6.01**

Delete paragraph 6.01B of the General Conditions in its entirety and replace with the following:

"B. At the site of the Work the CONTRACTOR shall employ a full-time construction superintendent or foreman who shall have full authority to act for the CONTRACTOR. It is understood that such representative shall be acceptable to the ENGINEER and shall be one who will be continued in the capacity for the particular job involved unless the representative ceases to be on the CONTRACTOR's payroll. If at any time during the Work the representative is deemed by the ENGINEER to be no longer acceptable, the representative shall be promptly replaced by the CONTRACTOR. All communications to the superintendent or foreman shall be as binding as if given to the CONTRACTOR."

SC-6.04

Add the following paragraph after paragraph 6.04A.2 of the General Conditions:

"B. The CONTRACTOR's resident superintendent shall attend monthly progress meetings at the site of the work with the ENGINEER and others as appropriate to review schedule status and such other pertinent subjects as may be listed on the agenda by the ENGINEER."

SC-6.05

Revise the second sentence of Paragraph A to read as follows:

"Unless the specification indicates that a proprietary item is called for, other items of material or equipment or material or equipment of other suppliers may be submitted to ENGINEER for review under the circumstances described below, and in accordance with MGL c.30, s.39M."

SC-6.17

In paragraph 6.17 E.1 of the General Conditions, delete the word "timely" from the first line.

SC-6.20

Delete paragraph 6.20A of the General Conditions in its entirety and replace with the following:

"A. To the fullest extent permitted by law, the CONTRACTOR shall indemnify and hold harmless the OWNER, the ENGINEER, ENGINEER's consultants, and any of their officers, directors, employees, agents, affiliates, subsidiaries and partners from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in part by acts or omissions of the CONTRACTOR, a subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall apply to any such claims, damages, losses and expenses which arise and/or are incurred by any person or entity either during the performance of the Work and/or after completion of construction. Nothing in this paragraph shall be construed to negate, abridge, or reduce other rights or obligations of indemnity or contribution which would otherwise exist as to a party or person indemnified hereunder. CONTRACTOR hereby assumes the responsibility and liability for injury to or death of any and all persons, including the CONTRACTOR's employees, and for any and all damage to property caused by, resulting from, or arising out of any act, omission or neglect on the part of the CONTRACTOR, or of any Subcontractor or of anyone directly or indirectly employed by any of them or of anyone for whose acts, any of them may be liable. The Contractor hereby acknowledges its obligation under the foregoing paragraph to indemnify the Engineer and Owner against judgments suffered because of the contractor's work and to assume the cost of defending the Engineer and Owner against claims as described in the foregoing paragraph."

Delete paragraph 6.20C of the General Conditions in its entirety.

**ARTICLE 8. OWNER'S RESPONSIBILITIES**

SC-8.02

Delete the phrase "to whom the CONTRACTOR makes no reasonable objection."

SC-8.06

Delete paragraph 8.06A of the General Conditions in its entirety.

SC-8.09

Insert the following after the first sentence:

"However, the OWNER shall have the right to direct the CONTRACTOR to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto."

**ARTICLE 9. ENGINEER'S STATUS DURING CONSTRUCTION SC-9.01**

Add a new paragraph 9.01B after paragraph 9.01A of the General Conditions, which is to read as follows:

"B. Nothing contained in the Contract Documents shall be construed to create a contractual relationship of any kind (1) between the ENGINEER and CONTRACTOR, (2) between the OWNER and a Subcontractor or Subcontractors,

or (3) between any person or entities other than the OWNER and CONTRACTOR. The ENGINEER shall, however, be entitled to performance and enforcement of obligations under the CONTRACT DOCUMENTS intended to facilitate performance of the ENGINEER'S duties."

SC-9.10

Insert the following after the first sentence on paragraph 9.10B:

"However, the ENGINEER shall have the right to direct the CONTRACTOR to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto."

**ARTICLE 11. COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK**

Delete Article 11 of the General Conditions in its entirety and replace with the following:

"A. The unit price of an item of Unit Price work shall be subject to reevaluation and adjustment under the following conditions:

(1) If the total extended bid price [Estimated Quantity times the Bid Unit Price] of a particular item of Unit Price Work amounts to 5 percent or more of the Original Contract Price and the variation in the quantity of the particular item of Unit Price Work performed by CONTRACTOR differs by more than 15 percent from the estimated quantity of such item indicated in the Agreement; and

(2) If there is no corresponding adjustment with respect to any other item of work; and

(3) If CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof, CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed. If OWNER believes that the quantity variation entitles OWNER to an adjustment in the unit price, OWNER shall be entitled to an adjustment in the unit price in an amount determined by the ENGINEER. ENGINEER shall not be liable in connection with any determination relating to adjustments which is rendered in good faith."

**ARTICLE 12. CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES**

SC-12.01

Delete paragraph 12.01 in its entirety.

SC-12.06

Add the following new paragraphs after paragraph 12.06 of the General Conditions: "12.07 Liquidated Damages:

"A. If the CONTRACTOR shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as a part consideration for the awarding of this Contract, to pay to the OWNER the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contract shall be in default after the time stipulated in the Contract for completing the work. Such damages may be retained from time to time by the OWNER from progress payments or any amounts owing to the CONTRACTOR, or otherwise collected.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain and said amount shall be retained from time to time by the OWNER from current periodical estimates.

C. It is further agreed that time is of the essence of each and every portion of this Contract and of the specifications wherein as definite and certain length of times if fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract. Provided that the CONTRACTOR shall not be charged with liquidated damages of any excess cost when the OWNER determines that the CONTRACTOR is without fault and the CONTRACTOR's reasons for the time extension are acceptable to the OWNER; Provided, further, that the CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due:

1) to any preference, priority or allocation order duly issued by the Government;

2) to unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR, including, but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and severe weather; and

3) to any delays of subcontractors or suppliers occasioned by any of the causes specified in subsections C (1) and C (2) above;

D. Provided, further, that the CONTRACTOR shall, within thirty (30) days from the beginning of such delay, unless the OWNER shall grant a further period of time prior to the date of final settlement of the Contract, notify the OWNER, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the CONTRACTOR within a reasonable time of its decision in the matter."

**ARTICLE 13. TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

SC-13.07

Delete paragraph 13.07A of the General Conditions and insert the following in its place:

"A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such defective work, or, if it has been rejected by OWNER, remove it from the site and replace it with work that is not defective, and (ii) satisfactorily correct or remove and replace any damage to other work or the work of others therefrom. If CONTRACTOR does not begin the repairs within ten (10) days of receipt of written notification and promptly comply with the terms of OWNER's written instructions, or in an emergency where delay would cause serious risk, loss or damage, OWNER may have the defective work corrected or the rejected work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR."

SC-13.09

Revise paragraph 13.09A of the General Conditions

"A. Delete the word "seven" and replace it with the word "ten" so that it reads "after ten days written notice to CONTRACTOR."

**ARTICLE 14. PAYMENTS TO CONTRACTOR AND COMPLETION**

SC-14.02

Delete paragraph 14.02A.3 and insert the following in its place:

"3. Retainage with respect to progress payments will be five percent or, if stipulated, the maximum allowed by law."

Add Paragraph 4. to read as follows:

"4. The CONTRACTOR shall submit Weekly Payroll Records Report and Statement of Compliance verifying compliance with the Minimum Prevailing Wage Law, MGL ch. 149, Sections 26-27H. These Statements of Compliance shall be submitted as a condition of payment for work performed during the period the reports apply."

SC-14.03

Delete paragraph 14.03A in its entirety and insert the following in its place:

"A. CONTRACTOR warrants and guarantees that title to all work, material and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than at the time of Application for Payment free and clear of all liens. CONTRACTOR shall provide written transfer of title and a certified paid invoice provided by the supplier."

**ARTICLE 15. SUSPENSION OF WORK AND TERMINATION**

SC-15.02

Add a new paragraph immediately after paragraph 15.02 A.4 of the General Conditions which is to read as follows:

"5. If the Work to be done under this Contract shall be abandoned, or if this Contract or any part thereof shall be sublet, without the previous written consent of OWNER, or if the contract or any claim thereunder shall be assigned by CONTRACTOR otherwise than as herein specified;"

**ARTICLE 17. MISCELLANEOUS**

SC-17.06, 17.07, 17.08, 17.09

Add the following new paragraphs after paragraph 17.05 of the General Conditions:

"17.06 Assignment:

The CONTRACTOR shall not assign the whole or any part of this Contract or any moneys due or to become due hereunder until thirty (30) days prior notice in writing has been given to the OWNER of the intention to assign, which notice shall state the identity and address of the prospective assignee. No assignment shall be made without the OWNER's prior written consent. Such consent shall not be unreasonably withheld. In case the CONTRACTOR assigns all or any part of the moneys due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any moneys due or to become due to the CONTRACTOR shall be subject to prior claims of all persons, firms and corporations of services rendered or materials supplied for the performance of the work called for in this Contract.

17.07 Liability

It is understood and agreed that members of the OWNER or the ENGINEER or any agent or employees of the OWNER signing this Agreement shall not be personally liable hereunder for any action incurred in connection with this Agreement.

17.08 State Statutes and Regulations

See Section 00830 for further modifications of the General Conditions due to state statutes and regulations.

17.09 Severability

If any provision of this Agreement shall be invalid or unenforceable to any extent or in any application, then the remainder of this Agreement and of such terms and conditions, except to such extent or in such application, shall not be affected thereby, and each and every term and condition of this Agreement shall be valid and enforced to the fullest extent and in the broadest application permitted by law."

**END OF SECTION**

**SECTION 00830**

**STATE STATUTES AND REGULATIONS**

**COMMONWEALTH OF MASSACHUSETTS**

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## A. REVISIONS TO GENERAL CONDITIONS

### 1. Definitions

The term "AWARDING AUTHORITY," as used herein, shall be considered to be synonymous with the term "OWNER," described in definition 1.01 A.30.

Delete definition 1.01 A.43 entitled "Substantial Completion" in the General Conditions in its entirety and insert the following in its place:

"Substantial Completion shall be interpreted in accordance with Massachusetts General Law

Chapter 30, Section 39G or 39K as appropriate."

**2. Subsurface Conditions Found Different**

Add the following sentence to the end of paragraph 4.03A of the General Conditions:

"...to do so. Adjustments resulting from subsurface or latent physical conditions will be in accordance with Massachusetts General Law Chapter 30, Section 39N."

**3. Subcontracting**

Add the following language at the end of paragraph 6.06F of the General Conditions:

"Except as required otherwise by Massachusetts General Law Chapter 149, Section 44F, for

Work governed by Chapter 149, sections 44A through 44H.

**4. Permits**

Delete paragraph 6.08A of the General Conditions in its entirety and insert the following in its place:

"A. Unless otherwise provided for in Section 00890 PERMITS, the AWARDING AUTHORITY shall be responsible for identifying and obtaining all federal, state, and local permits required by the nature and location of construction, including but not limited to railroad permits, building construction permits, and permits for street and highway cuts and openings. CONTRACTOR shall be responsible for obtaining all permits required of its equipment, work force, or particular operations in the performance of the Work and not otherwise specified to be obtained by the AWARDING AUTHORITY. These permit fees shall be paid by CONTRACTOR. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of bids, or, if there are no Bids, on the Effective Date of the Agreement." Town of Orleans building permit fees are waived.

**5. Contractor Records**

Add a new paragraph immediately after paragraph 6.09C of the General Conditions, which is to read as follows:

"D. The CONTRACTOR shall comply with all applicable provisions Chapter 30, Section 39R of the Massachusetts General Laws regarding, CONTRACTOR's records."

**6. Massachusetts Sales and Use Tax**

Add the following paragraph after paragraph 6.10A of the General Conditions:

"B. The materials and supplies to be used by the CONTRACTOR in the Work of this Contract are exempt from the Sales and Use Tax of the Commonwealth of Massachusetts. The AWARDING AUTHORITY tax exemption certificate number will be furnished to the CONTRACTOR."

**7. Clarifications and Interpretations**

Add the following language at the end of paragraph 9.04A of the General Conditions:

"The ENGINEER'S interpretation will be made in accordance with the requirements of Massachusetts General Law Chapter 30, Section 39P."

**8. Change of Contract Price**

Delete paragraphs 11.01, 11.02 and 12.01 of the General Conditions, having to do with Change of Contract Price. Changes in contract price will be governed by the section called "Change Orders," in Attachment D, Section 00830 and Article 11 in the Supplementary Conditions.

9.Payments

Delete paragraph 14.02B.1 of the General Conditions in its entirety and insert the following in its place:

“1. Progress Payments will be made in accordance with Massachusetts General Law Chapter 30, Section 39G, or 39K, as applicable.”

Add the following new paragraph following paragraph 14.02C.1 of the General Conditions:

“2. The CONTRACTOR shall make payments to Subcontractors in accordance with the requirements of Massachusetts General Law Chapter 30, Section 39F.”

Delete paragraph 14.07B of the General Conditions in its entirety and insert the following in its place:

"1. If, on the basis of the ENGINEER's observation of the Work during construction and final inspection and, upon the ENGINEER's review of the final Application for Payment and accompanying documentation, the ENGINEER is satisfied that the Work has been completed and that the CONTRACTOR's other obligations under the Contract Documents have been fulfilled, the ENGINEER will indicate in writing its recommendation of payment and present the Application to the AWARDING AUTHORITY for payment. Thereupon the ENGINEER will give written notice to the AWARDING AUTHORITY and the CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, the ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment. In such case the CONTRACTOR shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, the AWARDING AUTHORITY shall in accordance with the applicable provisions of the Massachusetts General Laws, make payment to the CONTRACTOR."

**10. Suspension of Work and Termination**

Delete paragraph 15.01A of the General Conditions in its entirety and insert the following in its place:

"A. The AWARDING AUTHORITY may order, at any time and without cause, the CONTRACTOR to suspend or delay the Work in accordance with Massachusetts General Law Chapter 30, Section 39O."

**11. Labor Classifications and Minimum Wage Rates**

Add the following paragraphs under the heading "Wage Rates" after paragraph 17.09 of the

Supplementary Conditions: "17.11 Wage Rates

A. Minimum Wage Rates as determined by the Commissioner of the Division of Occupational Safety of the Executive Office of Labor and Workforce Development under the provisions of Massachusetts General Laws Chapter 149, Sections 26-27D apply to this project. A copy of the wage schedule is included in Attachment A of Section 00830. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the Commissioner. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. The CONTRACTOR shall notify the AWARDING AUTHORITY of its intention to employ persons in trades or occupations not classified in the wage determinations as soon as possible in order to allow sufficient time for the AWARDING AUTHORITY to obtain approved rates for such trades or occupations.

B. The schedule of wages referred to above are minimum rates only, and the AWARDING AUTHORITY will not consider any claims for additional compensation made by CONTRACTOR because of payment by the CONTRACTOR of any wage rate in excess of the applicable rate contained in the Contract.

C. The said schedule of wages shall continue to be the minimum rates to be paid during the life of this Agreement, except in the case of the duration of this Agreement exceeding one year, when the Contractor will be responsible for requesting and obtaining updated minimum wage rates from the Owner before the one-year anniversary of the project's start date, and a legible copy of said schedule shall be kept posted in a conspicuous place at the site of the Work.

D. CONTRACTOR and subcontractors shall submit a copy of weekly payroll records to the AWARDING AUTHORITY and the AWARDING AUTHORITY shall retain the records for a minimum of three years."

**B. OTHER REGULATORY REQUIREMENTS:**

**1. Working Hours**

No laborer, workman, mechanic, foreman, or inspector, working within the Commonwealth, in the employ of the CONTRACTOR, subcontractor, or other person doing or contracting to do the whole or a part of the work contemplated by this contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency or required for this Project.

**2. Commonwealth of Massachusetts Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program.**

The Contractor shall abide by the Commonwealth of Massachusetts Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program, which is attached in its entirety on pages 00830-C.

**3. MassDEP Community Sound Level Criteria**

The Community Sound Level Criteria as established by the Commonwealth of Massachusetts' Department of Environmental Protection (MassDEP) must be conformed to prior to the AWARDING AUTHORITY's acceptance of the structure. The following sound level criteria must be met at the construction site:

A. The increase in the broadband noise level shall not be in excess of ten (10) dB(A) above ambient at the station boundary. The ambient level is defined as the A-weighted noise level that is exceeded ninety (90) percent of the time measured during the period in question.

B. The primary noise source(s) shall not produce a puretone condition. Puretone is any given octave band center frequency that exceeds the two adjacent center frequencies by three (3) or more decibels.

**4. OSHA 10 Hour Certification Requirements**

All employees of the Contractor who work at the jobsite must have received OSHA 10 Hour safety training, and have proof, at the jobsite, of being certified by OSHA as having received the training. The Contractor must provide written proof (copy of OSHA card each employee is required to carry is preferred) of this certification for every employee with submission of the first certified payroll report for each employee.

**END OF SECTION**

**SECTION 00830**

**ATTACHMENT A**

**MINIMUM WAGE RATES**

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CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

# THE COMMONWEALTH OF MASSACHUSETTS
# EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
# DEPARTMENT OF LABOR STANDARDS

## Prevailing Wage Rates

**As determined by the Director under the provisions of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H**

ROSALIN ACOSTA
Secretary

WILLIAM D MCKINNEY
Director

**Awarding Authority:** Town of Orleans

**Contract Number:** 2091-01 **City/Town:** ORLEANS

**Description of Work:** Construction of a 0.35 mgd Sequence Batch Reactor WWTF located at 20 Overland Way and (b) effluent disposal via 5 Wicks located at 34 Lots Hollow Road.

**Job Location:** 20 Overland Way

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule from the Department of Labor Standards ("DLS") if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or any sub-contractor.
- All apprentices working on the project are required to be registered with the Massachusetts Department of Labor Standards, Division of Apprentice Standards (DLS/DAS). Apprentice must keep his/her apprentice identification card on his/her person during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DLS/DAS regardless of whether or not they are registered with any other federal, state, local, or private agency must be paid the journeyworker's rate for the trade.**
- The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule. Awarding authorities are required to request these updates no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor. For multi-year CM AT RISK projects, awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. Contractors are required to obtain the wage schedules from awarding authorities, and to pay no less than these rates to covered workers. The annual update requirement is not applicable to 27F "rental of equipment" contracts.
- Every contractor or subcontractor which performs construction work on the project is required to submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. A sample of a payroll reporting form may be obtained at http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may report the violation to the Fair Labor Division of the office of the Attorney General at (617) 727-3465.
- Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| **Construction** | | | | | | |
| (2 AXLE) DRIVER - EQUIPMENT<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.25 | $12.41 | $13.72 | $0.00 | $60.38 |
| | 06/01/2020 | $35.15 | $12.41 | $13.72 | $0.00 | $61.28 |
| | 08/01/2020 | $35.15 | $12.91 | $13.72 | $0.00 | $61.78 |
| | 12/01/2020 | $35.15 | $12.91 | $14.82 | $0.00 | $62.88 |
| | 06/01/2021 | $35.95 | $12.91 | $14.82 | $0.00 | $63.68 |
| | 08/01/2021 | $35.95 | $13.41 | $14.82 | $0.00 | $64.18 |
| | 12/01/2021 | $35.95 | $13.41 | $16.01 | $0.00 | $65.37 |
| (3 AXLE) DRIVER - EQUIPMENT<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.32 | $12.41 | $13.72 | $0.00 | $60.45 |
| | 06/01/2020 | $35.22 | $12.41 | $13.72 | $0.00 | $61.35 |
| | 08/01/2020 | $35.22 | $12.91 | $13.72 | $0.00 | $61.85 |
| | 12/01/2020 | $35.22 | $12.91 | $14.82 | $0.00 | $62.95 |
| | 06/01/2021 | $36.02 | $12.91 | $14.82 | $0.00 | $63.75 |
| | 08/01/2021 | $36.02 | $13.41 | $14.82 | $0.00 | $64.25 |
| | 12/01/2021 | $36.02 | $13.41 | $16.01 | $0.00 | $65.44 |
| (4 & 5 AXLE) DRIVER - EQUIPMENT<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.44 | $12.41 | $13.72 | $0.00 | $60.57 |
| | 06/01/2020 | $35.34 | $12.41 | $13.72 | $0.00 | $61.47 |
| | 08/01/2020 | $35.34 | $12.91 | $13.72 | $0.00 | $61.97 |
| | 12/01/2020 | $35.34 | $12.91 | $14.82 | $0.00 | $63.07 |
| | 06/01/2021 | $36.14 | $12.91 | $14.82 | $0.00 | $63.87 |
| | 08/01/2021 | $36.14 | $13.41 | $14.82 | $0.00 | $64.37 |
| | 12/01/2021 | $36.14 | $13.41 | $16.01 | $0.00 | $65.56 |
| ADS/SUBMERSIBLE PILOT<br>*PILE DRIVER LOCAL 56 (ZONE 2)* | 08/01/2019 | $102.78 | $9.90 | $21.15 | $0.00 | $133.83 |
| For apprentice rates see "Apprentice- PILE DRIVER" | | | | | | |
| AIR TRACK OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.81 | $8.10 | $15.38 | $0.00 | $58.29 |
| | 06/01/2020 | $35.70 | $8.10 | $15.38 | $0.00 | $59.18 |
| | 12/01/2020 | $36.59 | $8.10 | $15.38 | $0.00 | $60.07 |
| | 06/01/2021 | $37.51 | $8.10 | $15.38 | $0.00 | $60.99 |
| | 12/01/2021 | $38.42 | $8.10 | $15.38 | $0.00 | $61.90 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| ASBESTOS REMOVER - PIPE / MECH. EQUIPT.<br>*HEAT & FROST INSULATORS LOCAL 6 (BOSTON)* | 12/01/2019 | $37.00 | $12.50 | $8.85 | $0.00 | $58.35 |
| | 06/01/2020 | $38.00 | $12.50 | $8.85 | $0.00 | $59.35 |
| | 12/01/2020 | $39.00 | $12.50 | $8.85 | $0.00 | $60.35 |
| ASPHALT RAKER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| BACKHOE/FRONT-END LOADER<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| BARCO-TYPE JUMPING TAMPER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| BLOCK PAVER, RAMMER / CURB SETTER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.81 | $8.10 | $15.38 | $0.00 | $58.29 |
| | 06/01/2020 | $35.70 | $8.10 | $15.38 | $0.00 | $59.18 |
| | 12/01/2020 | $36.59 | $8.10 | $15.38 | $0.00 | $60.07 |
| | 06/01/2021 | $37.51 | $8.10 | $15.38 | $0.00 | $60.99 |
| | 12/01/2021 | $38.42 | $8.10 | $15.38 | $0.00 | $61.90 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| BOILER MAKER<br>*BOILERMAKERS LOCAL 29* | 01/01/2020 | $46.10 | $7.07 | $17.98 | $0.00 | $71.15 |

**Apprentice -** *BOILERMAKER - Local 29*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 65 | $29.97 | $7.07 | $11.69 | $0.00 | $48.73 |
| 2 | 65 | $29.97 | $7.07 | $11.69 | $0.00 | $48.73 |
| 3 | 70 | $32.27 | $7.07 | $12.59 | $0.00 | $51.93 |
| 4 | 75 | $34.58 | $7.07 | $13.49 | $0.00 | $55.14 |
| 5 | 80 | $36.88 | $7.07 | $14.38 | $0.00 | $58.33 |
| 6 | 85 | $39.19 | $7.07 | $15.29 | $0.00 | $61.55 |
| 7 | 90 | $41.49 | $7.07 | $16.18 | $0.00 | $64.74 |
| 8 | 95 | $43.80 | $7.07 | $17.09 | $0.00 | $67.96 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:4**

| | | | | | | |
|---|---|---|---|---|---|---|
| BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)<br>*BRICKLAYERS LOCAL 3 (NEW BEDFORD)* | 08/01/2019 | $54.40 | $10.75 | $21.30 | $0.00 | $86.45 |
| | 02/01/2020 | $54.40 | $10.75 | $21.94 | $0.00 | $87.09 |
| | 08/01/2020 | $55.75 | $10.75 | $22.09 | $0.00 | $88.59 |
| | 02/01/2021 | $56.39 | $10.75 | $22.09 | $0.00 | $89.23 |
| | 08/01/2021 | $57.79 | $10.75 | $22.25 | $0.00 | $90.79 |
| | 02/01/2022 | $58.38 | $10.75 | $22.25 | $0.00 | $91.38 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *BRICK/PLASTER/CEMENT MASON - Local 3 New Bedford*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $27.20 | $10.75 | $21.30 | $0.00 | $59.25 |
| 2 | 60 | $32.64 | $10.75 | $21.30 | $0.00 | $64.69 |
| 3 | 70 | $38.08 | $10.75 | $21.30 | $0.00 | $70.13 |
| 4 | 80 | $43.52 | $10.75 | $21.30 | $0.00 | $75.57 |
| 5 | 90 | $48.96 | $10.75 | $21.30 | $0.00 | $81.01 |

**Effective Date -** 02/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $27.20 | $10.75 | $21.94 | $0.00 | $59.89 |
| 2 | 60 | $32.64 | $10.75 | $21.94 | $0.00 | $65.33 |
| 3 | 70 | $38.08 | $10.75 | $21.94 | $0.00 | $70.77 |
| 4 | 80 | $43.52 | $10.75 | $21.94 | $0.00 | $76.21 |
| 5 | 90 | $48.96 | $10.75 | $21.94 | $0.00 | $81.65 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| BULLDOZER/GRADER/SCRAPER<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| CAISSON & UNDERPINNING BOTTOM MAN<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $40.25 | $8.10 | $16.80 | $0.00 | $65.15 |
| | 06/01/2020 | $41.24 | $8.10 | $16.80 | $0.00 | $66.14 |
| | 12/01/2020 | $42.22 | $8.10 | $16.80 | $0.00 | $67.12 |
| | 06/01/2021 | $43.24 | $8.10 | $16.80 | $0.00 | $68.14 |
| | 12/01/2021 | $44.25 | $8.10 | $16.80 | $0.00 | $69.15 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| CAISSON & UNDERPINNING LABORER<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $39.10 | $8.10 | $16.80 | $0.00 | $64.00 |
| | 06/01/2020 | $40.09 | $8.10 | $16.80 | $0.00 | $64.99 |
| | 12/01/2020 | $41.07 | $8.10 | $16.80 | $0.00 | $65.97 |
| | 06/01/2021 | $42.09 | $8.10 | $16.80 | $0.00 | $66.99 |
| | 12/01/2021 | $43.10 | $8.10 | $16.80 | $0.00 | $68.00 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| CAISSON & UNDERPINNING TOP MAN<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $39.10 | $8.10 | $16.80 | $0.00 | $64.00 |
| | 06/01/2020 | $40.09 | $8.10 | $16.80 | $0.00 | $64.99 |
| | 12/01/2020 | $41.07 | $8.10 | $16.80 | $0.00 | $65.97 |
| | 06/01/2021 | $42.09 | $8.10 | $16.80 | $0.00 | $66.99 |
| | 12/01/2021 | $43.10 | $8.10 | $16.80 | $0.00 | $68.00 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| CARBIDE CORE DRILL OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| CARPENTER<br>*CARPENTERS -ZONE 2 (Eastern Massachusetts)* | 09/01/2019 | $41.90 | $9.40 | $18.95 | $0.00 | $70.25 |
| | 03/01/2020 | $42.50 | $9.40 | $18.95 | $0.00 | $70.85 |
| | 09/01/2020 | $43.15 | $9.40 | $18.95 | $0.00 | $71.50 |
| | 03/01/2021 | $43.75 | $9.40 | $18.95 | $0.00 | $72.10 |
| | 09/01/2021 | $44.40 | $9.40 | $18.95 | $0.00 | $72.75 |
| | 03/01/2022 | $45.00 | $9.40 | $18.95 | $0.00 | $73.35 |
| | 09/01/2022 | $45.65 | $9.40 | $18.95 | $0.00 | $74.00 |
| | 03/01/2023 | $46.25 | $9.40 | $18.95 | $0.00 | $74.60 |

**Apprentice -** *CARPENTER - Zone 2 Eastern MA*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.95 | $9.40 | $1.73 | $0.00 | $32.08 |
| 2 | 60 | $25.14 | $9.40 | $1.73 | $0.00 | $36.27 |
| 3 | 70 | $29.33 | $9.40 | $13.76 | $0.00 | $52.49 |
| 4 | 75 | $31.43 | $9.40 | $13.76 | $0.00 | $54.59 |
| 5 | 80 | $33.52 | $9.40 | $15.49 | $0.00 | $58.41 |
| 6 | 80 | $33.52 | $9.40 | $15.49 | $0.00 | $58.41 |
| 7 | 90 | $37.71 | $9.40 | $17.22 | $0.00 | $64.33 |
| 8 | 90 | $37.71 | $9.40 | $17.22 | $0.00 | $64.33 |

**Effective Date -** 03/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $21.25 | $9.40 | $1.73 | $0.00 | $32.38 |
| 2 | 60 | $25.50 | $9.40 | $1.73 | $0.00 | $36.63 |
| 3 | 70 | $29.75 | $9.40 | $13.76 | $0.00 | $52.91 |
| 4 | 75 | $31.88 | $9.40 | $13.76 | $0.00 | $55.04 |
| 5 | 80 | $34.00 | $9.40 | $15.49 | $0.00 | $58.89 |
| 6 | 80 | $34.00 | $9.40 | $15.49 | $0.00 | $58.89 |
| 7 | 90 | $38.25 | $9.40 | $17.22 | $0.00 | $64.87 |
| 8 | 90 | $38.25 | $9.40 | $17.22 | $0.00 | $64.87 |

**Notes:**

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $29.99/ 3&4 $35.85/ 5&6 $54.22/ 7&8 $60.14

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| CARPENTER WOOD FRAME<br>*CARPENTERS -ZONE 2 (Wood Frame)* | 10/01/2019 | $27.95 | $7.07 | $7.86 | $0.00 | $42.88 |
| All Aspects of New Wood Frame Work | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *CARPENTER (Wood Frame) - Zone 2*

**Effective Date -** 10/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 60 | $16.77 | $7.07 | $0.00 | $0.00 | $23.84 |
| 2 | 60 | $16.77 | $7.07 | $0.00 | $0.00 | $23.84 |
| 3 | 65 | $18.17 | $7.07 | $7.86 | $0.00 | $33.10 |
| 4 | 70 | $19.57 | $7.07 | $7.86 | $0.00 | $34.50 |
| 5 | 75 | $20.96 | $7.07 | $7.86 | $0.00 | $35.89 |
| 6 | 80 | $22.36 | $7.07 | $7.86 | $0.00 | $37.29 |
| 7 | 85 | $23.76 | $7.07 | $7.86 | $0.00 | $38.69 |
| 8 | 90 | $25.16 | $7.07 | $7.86 | $0.00 | $40.09 |

**Notes:**

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $19.65/ 3&4 $27.19/ 5&6 $34.50/ 7&8 $37.29

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| CEMENT MASONRY/PLASTERING<br>*BRICKLAYERS LOCAL 3 (NEW BEDFORD)* | 01/01/2020 | $49.07 | $12.75 | $22.41 | $0.62 | $84.85 |

**Apprentice -** *CEMENT MASONRY/PLASTERING - Eastern Mass (New Bedford)*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $24.54 | $12.75 | $15.41 | $0.00 | $52.70 |
| 2 | 60 | $29.44 | $12.75 | $17.41 | $0.62 | $60.22 |
| 3 | 65 | $31.90 | $12.75 | $18.41 | $0.62 | $63.68 |
| 4 | 70 | $34.35 | $12.75 | $19.41 | $0.62 | $67.13 |
| 5 | 75 | $36.80 | $12.75 | $20.41 | $0.62 | $70.58 |
| 6 | 80 | $39.26 | $12.75 | $21.41 | $0.62 | $74.04 |
| 7 | 90 | $44.16 | $12.75 | $22.41 | $0.62 | $79.94 |

**Notes:**

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| CHAIN SAW OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $49.73 | $12.50 | $15.70 | $0.00 | $77.93 |
| | 06/01/2020 | $50.83 | $12.50 | $15.70 | $0.00 | $79.03 |
| | 12/01/2020 | $51.98 | $12.50 | $15.70 | $0.00 | $80.18 |
| | 06/01/2021 | $53.08 | $12.50 | $15.70 | $0.00 | $81.28 |
| | 12/01/2021 | $54.23 | $12.50 | $15.70 | $0.00 | $82.43 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| COMPRESSOR OPERATOR<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $32.47 | $12.50 | $15.70 | $0.00 | $60.67 |
| | 06/01/2020 | $33.22 | $12.50 | $15.70 | $0.00 | $61.42 |
| | 12/01/2020 | $34.00 | $12.50 | $15.70 | $0.00 | $62.20 |
| | 06/01/2021 | $34.75 | $12.50 | $15.70 | $0.00 | $62.95 |
| | 12/01/2021 | $35.54 | $12.50 | $15.70 | $0.00 | $63.74 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| DELEADER (BRIDGE)<br>*PAINTERS LOCAL 35 - ZONE 2* | 01/01/2020 | $50.96 | $8.20 | $22.10 | $0.00 | $81.26 |
| | 07/01/2020 | $52.06 | $8.20 | $22.10 | $0.00 | $82.36 |
| | 01/01/2021 | $53.16 | $8.20 | $22.10 | $0.00 | $83.46 |

**Apprentice -** *PAINTER Local 35 - BRIDGES/TANKS*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $25.48 | $8.20 | $0.00 | $0.00 | $33.68 |
| 2 | 55 | $28.03 | $8.20 | $5.94 | $0.00 | $42.17 |
| 3 | 60 | $30.58 | $8.20 | $6.48 | $0.00 | $45.26 |
| 4 | 65 | $33.12 | $8.20 | $7.02 | $0.00 | $48.34 |
| 5 | 70 | $35.67 | $8.20 | $18.86 | $0.00 | $62.73 |
| 6 | 75 | $38.22 | $8.20 | $19.40 | $0.00 | $65.82 |
| 7 | 80 | $40.77 | $8.20 | $19.94 | $0.00 | $68.91 |
| 8 | 90 | $45.86 | $8.20 | $21.02 | $0.00 | $75.08 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $26.03 | $8.20 | $0.00 | $0.00 | $34.23 |
| 2 | 55 | $28.63 | $8.20 | $5.94 | $0.00 | $42.77 |
| 3 | 60 | $31.24 | $8.20 | $6.48 | $0.00 | $45.92 |
| 4 | 65 | $33.84 | $8.20 | $7.02 | $0.00 | $49.06 |
| 5 | 70 | $36.44 | $8.20 | $18.86 | $0.00 | $63.50 |
| 6 | 75 | $39.05 | $8.20 | $19.40 | $0.00 | $66.65 |
| 7 | 80 | $41.65 | $8.20 | $19.94 | $0.00 | $69.79 |
| 8 | 90 | $46.85 | $8.20 | $21.02 | $0.00 | $76.07 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| DEMO: ADZEMAN<br>*LABORERS - ZONE 2* | 12/01/2019 | $39.30 | $8.10 | $16.60 | $0.00 | $64.00 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| DEMO: BACKHOE/LOADER/HAMMER OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $40.30 | $8.10 | $16.60 | $0.00 | $65.00 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| DEMO: BURNERS<br>*LABORERS - ZONE 2* | 12/01/2019 | $40.05 | $8.10 | $16.60 | $0.00 | $64.75 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| DEMO: CONCRETE CUTTER/SAWYER<br>*LABORERS - ZONE 2*<br>For apprentice rates see "Apprentice- LABORER" | 12/01/2019 | $40.30 | $8.10 | $16.60 | $0.00 | $65.00 |
| DEMO: JACKHAMMER OPERATOR<br>*LABORERS - ZONE 2*<br>For apprentice rates see "Apprentice- LABORER" | 12/01/2019 | $40.05 | $8.10 | $16.60 | $0.00 | $64.75 |
| DEMO: WRECKING LABORER<br>*LABORERS - ZONE 2*<br>For apprentice rates see "Apprentice- LABORER" | 12/01/2019 | $39.30 | $8.10 | $16.60 | $0.00 | $64.00 |
| DIRECTIONAL DRILL MACHINE OPERATOR<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| DIVER<br>*PILE DRIVER LOCAL 56 (ZONE 2)*<br>For apprentice rates see "Apprentice- PILE DRIVER" | 08/01/2019 | $68.52 | $9.90 | $21.15 | $0.00 | $99.57 |
| DIVER TENDER<br>*PILE DRIVER LOCAL 56 (ZONE 2)*<br>For apprentice rates see "Apprentice- PILE DRIVER" | 08/01/2019 | $48.94 | $9.90 | $21.15 | $0.00 | $79.99 |
| DIVER TENDER (EFFLUENT)<br>*PILE DRIVER LOCAL 56 (ZONE 2)*<br>For apprentice rates see "Apprentice- PILE DRIVER" | 08/01/2019 | $73.41 | $9.90 | $21.15 | $0.00 | $104.46 |
| DIVER/SLURRY (EFFLUENT)<br>*PILE DRIVER LOCAL 56 (ZONE 2)*<br>For apprentice rates see "Apprentice- PILE DRIVER" | 08/01/2019 | $102.78 | $9.90 | $21.15 | $0.00 | $133.83 |
| ELECTRICIAN<br>*ELECTRICIANS LOCAL 223* | 09/01/2019 | $42.26 | $10.15 | $13.54 | $0.00 | $65.95 |
| | 03/01/2020 | $42.87 | $10.40 | $13.94 | $0.00 | $67.21 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *ELECTRICIAN - Local 223*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 40 | $16.90 | $10.15 | $0.51 | $0.00 | $27.56 |
| 2 | 42 | $17.75 | $10.15 | $0.53 | $0.00 | $28.43 |
| 3 | 45 | $19.02 | $10.15 | $0.57 | $0.00 | $29.74 |
| 4 | 48 | $20.28 | $10.15 | $4.93 | $0.00 | $35.36 |
| 5 | 50 | $21.13 | $10.15 | $4.97 | $0.00 | $36.25 |
| 6 | 55 | $23.24 | $10.15 | $5.33 | $0.00 | $38.72 |
| 7 | 60 | $25.36 | $10.15 | $5.64 | $0.00 | $41.15 |
| 8 | 65 | $27.47 | $10.15 | $5.94 | $0.00 | $43.56 |
| 9 | 70 | $29.58 | $10.15 | $6.25 | $0.00 | $45.98 |
| 10 | 75 | $31.70 | $10.15 | $6.50 | $0.00 | $48.35 |

**Effective Date -** 03/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 40 | $17.15 | $10.40 | $0.51 | $0.00 | $28.06 |
| 2 | 42 | $18.01 | $10.40 | $0.54 | $0.00 | $28.95 |
| 3 | 45 | $19.29 | $10.40 | $0.58 | $0.00 | $30.27 |
| 4 | 48 | $20.58 | $10.40 | $5.22 | $0.00 | $36.20 |
| 5 | 50 | $21.44 | $10.40 | $5.26 | $0.00 | $37.10 |
| 6 | 55 | $23.58 | $10.40 | $5.63 | $0.00 | $39.61 |
| 7 | 60 | $25.72 | $10.40 | $5.93 | $0.00 | $42.05 |
| 8 | 65 | $27.87 | $10.40 | $6.25 | $0.00 | $44.52 |
| 9 | 70 | $30.01 | $10.40 | $6.54 | $0.00 | $46.95 |
| 10 | 75 | $32.15 | $10.40 | $6.79 | $0.00 | $49.34 |

**Notes:**

Steps are 750 hours

**Apprentice to Journeyworker Ratio:2:3*****

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ELEVATOR CONSTRUCTOR<br>*ELEVATOR CONSTRUCTORS LOCAL 4* | 01/01/2020 | $61.42 | $15.73 | $18.41 | $0.00 | $95.56 |
| | 01/01/2021 | $63.47 | $15.88 | $19.31 | $0.00 | $98.66 |
| | 01/01/2022 | $65.62 | $16.03 | $20.21 | $0.00 | $101.86 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *ELEVATOR CONSTRUCTOR - Local 4*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $30.71 | $15.73 | $0.00 | $0.00 | $46.44 |
| 2 | 55 | $33.78 | $15.73 | $18.41 | $0.00 | $67.92 |
| 3 | 65 | $39.92 | $15.73 | $18.41 | $0.00 | $74.06 |
| 4 | 70 | $42.99 | $15.73 | $18.41 | $0.00 | $77.13 |
| 5 | 80 | $49.14 | $15.73 | $18.41 | $0.00 | $83.28 |

**Effective Date -** 01/01/2021

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $31.74 | $15.88 | $0.00 | $0.00 | $47.62 |
| 2 | 55 | $34.91 | $15.88 | $19.31 | $0.00 | $70.10 |
| 3 | 65 | $41.26 | $15.88 | $19.31 | $0.00 | $76.45 |
| 4 | 70 | $44.43 | $15.88 | $19.31 | $0.00 | $79.62 |
| 5 | 80 | $50.78 | $15.88 | $19.31 | $0.00 | $85.97 |

**Notes:**
Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| ELEVATOR CONSTRUCTOR HELPER<br>*ELEVATOR CONSTRUCTORS LOCAL 4* | 01/01/2020 | $42.99 | $15.73 | $18.41 | $0.00 | $77.13 |
| | 01/01/2021 | $44.43 | $15.88 | $19.31 | $0.00 | $79.62 |
| | 01/01/2022 | $45.93 | $16.03 | $20.21 | $0.00 | $82.17 |
| For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR" | | | | | | |
| FENCE & GUARD RAIL ERECTOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY<br>*OPERATING ENGINEERS LOCAL 4* | 11/01/2019 | $44.18 | $12.00 | $15.60 | $0.00 | $71.78 |
| | 05/01/2020 | $45.33 | $12.00 | $15.60 | $0.00 | $72.93 |
| | 11/01/2020 | $46.33 | $12.00 | $15.60 | $0.00 | $73.93 |
| | 05/01/2021 | $47.48 | $12.00 | $15.60 | $0.00 | $75.08 |
| | 11/01/2021 | $48.48 | $12.00 | $15.60 | $0.00 | $76.08 |
| | 05/01/2022 | $49.63 | $12.00 | $15.60 | $0.00 | $77.23 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY<br>*OPERATING ENGINEERS LOCAL 4* | 11/01/2019 | $45.68 | $12.00 | $15.60 | $0.00 | $73.28 |
| | 05/01/2020 | $46.83 | $12.00 | $15.60 | $0.00 | $74.43 |
| | 11/01/2020 | $47.84 | $12.00 | $15.60 | $0.00 | $75.44 |
| | 05/01/2021 | $49.00 | $12.00 | $15.60 | $0.00 | $76.60 |
| | 11/01/2021 | $50.01 | $12.00 | $15.60 | $0.00 | $77.61 |
| | 05/01/2022 | $51.17 | $12.00 | $15.60 | $0.00 | $78.77 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY<br>*OPERATING ENGINEERS LOCAL 4* | 11/01/2019 | $22.57 | $12.00 | $15.60 | $0.00 | $50.17 |
| | 05/01/2020 | $23.24 | $12.00 | $15.60 | $0.00 | $50.84 |
| | 11/01/2020 | $23.83 | $12.00 | $15.60 | $0.00 | $51.43 |
| | 05/01/2021 | $24.51 | $12.00 | $15.60 | $0.00 | $52.11 |
| | 11/01/2021 | $25.11 | $12.00 | $15.60 | $0.00 | $52.71 |
| | 05/01/2022 | $25.78 | $12.00 | $15.60 | $0.00 | $53.38 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| FIRE ALARM INSTALLER<br>*ELECTRICIANS LOCAL 223* | 09/01/2019 | $42.26 | $10.15 | $13.54 | $0.00 | $65.95 |
| | 03/01/2020 | $42.87 | $10.40 | $13.94 | $0.00 | $67.21 |
| For apprentice rates see "Apprentice- ELECTRICIAN" | | | | | | |
| FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING*ELECTRICIANS LOCAL 223* | 09/01/2019 | $35.78 | $10.15 | $11.45 | $0.00 | $57.38 |
| | 03/01/2020 | $36.27 | $10.40 | $11.78 | $0.00 | $58.45 |
| For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN" | | | | | | |
| FIREMAN (ASST. ENGINEER)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $39.89 | $12.50 | $15.70 | $0.00 | $68.09 |
| | 06/01/2020 | $40.80 | $12.50 | $15.70 | $0.00 | $69.00 |
| | 12/01/2020 | $41.75 | $12.50 | $15.70 | $0.00 | $69.95 |
| | 06/01/2021 | $42.66 | $12.50 | $15.70 | $0.00 | $70.86 |
| | 12/01/2021 | $43.61 | $12.50 | $15.70 | $0.00 | $71.81 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| FLAGGER & SIGNALER<br>*LABORERS - ZONE 2* | 12/01/2019 | $23.50 | $8.10 | $15.38 | $0.00 | $46.98 |
| | 06/01/2020 | $23.50 | $8.10 | $15.38 | $0.00 | $46.98 |
| | 12/01/2020 | $24.50 | $8.10 | $15.38 | $0.00 | $47.98 |
| | 06/01/2021 | $24.50 | $8.10 | $15.38 | $0.00 | $47.98 |
| | 12/01/2021 | $24.50 | $8.10 | $15.38 | $0.00 | $47.98 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| FLOORCOVERER<br>*FLOORCOVERERS LOCAL 2168 ZONE II* | 09/01/2019 | $43.94 | $9.40 | $19.25 | $0.00 | $72.59 |
| | 03/01/2020 | $44.74 | $9.40 | $19.25 | $0.00 | $73.39 |
| | 09/01/2020 | $45.54 | $9.40 | $19.25 | $0.00 | $74.19 |
| | 03/01/2021 | $46.34 | $9.40 | $19.25 | $0.00 | $74.99 |
| | 09/01/2021 | $47.14 | $9.40 | $19.25 | $0.00 | $75.79 |
| | 03/01/2022 | $47.94 | $9.40 | $19.25 | $0.00 | $76.59 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *FLOORCOVERER - Local 2168 Zone II*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $21.97 | $9.40 | $1.79 | $0.00 | $33.16 |
| 2 | 55 | $24.17 | $9.40 | $1.79 | $0.00 | $35.36 |
| 3 | 60 | $26.36 | $9.40 | $13.88 | $0.00 | $49.64 |
| 4 | 65 | $28.56 | $9.40 | $13.88 | $0.00 | $51.84 |
| 5 | 70 | $30.76 | $9.40 | $15.67 | $0.00 | $55.83 |
| 6 | 75 | $32.96 | $9.40 | $15.67 | $0.00 | $58.03 |
| 7 | 80 | $35.15 | $9.40 | $17.46 | $0.00 | $62.01 |
| 8 | 85 | $37.35 | $9.40 | $17.46 | $0.00 | $64.21 |

**Effective Date -** 03/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $22.37 | $9.40 | $1.79 | $0.00 | $33.56 |
| 2 | 55 | $24.61 | $9.40 | $1.79 | $0.00 | $35.80 |
| 3 | 60 | $26.84 | $9.40 | $13.88 | $0.00 | $50.12 |
| 4 | 65 | $29.08 | $9.40 | $13.88 | $0.00 | $52.36 |
| 5 | 70 | $31.32 | $9.40 | $15.67 | $0.00 | $56.39 |
| 6 | 75 | $33.56 | $9.40 | $15.67 | $0.00 | $58.63 |
| 7 | 80 | $35.79 | $9.40 | $17.46 | $0.00 | $62.65 |
| 8 | 85 | $38.03 | $9.40 | $17.46 | $0.00 | $64.89 |

**Notes:** Steps are 750 hrs.
% After 09/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
Step 1&2 $30.96/ 3&4 $37.09/ 5&6 $55.83/ 7&8 $62.01

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| FORK LIFT/CHERRY PICKER<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| GENERATOR/LIGHTING PLANT/HEATERS<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $32.47 | $12.50 | $15.70 | $0.00 | $60.67 |
| | 06/01/2020 | $33.22 | $12.50 | $15.70 | $0.00 | $61.42 |
| | 12/01/2020 | $34.00 | $12.50 | $15.70 | $0.00 | $62.20 |
| | 06/01/2021 | $34.75 | $12.50 | $15.70 | $0.00 | $62.95 |
| | 12/01/2021 | $35.54 | $12.50 | $15.70 | $0.00 | $63.74 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS)<br>*GLAZIERS LOCAL 1333* | 06/01/2019 | $38.18 | $10.60 | $9.90 | $0.00 | $58.68 |
| | 06/01/2020 | $39.18 | $10.80 | $10.45 | $0.00 | $60.43 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *GLAZIER - Local 1333*

**Effective Date -** 06/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $19.09 | $10.60 | $1.80 | $0.00 | $31.49 |
| 2 | 56 | $21.48 | $10.60 | $1.80 | $0.00 | $33.88 |
| 3 | 63 | $23.86 | $10.60 | $2.40 | $0.00 | $36.86 |
| 4 | 69 | $26.25 | $10.60 | $2.40 | $0.00 | $39.25 |
| 5 | 75 | $28.64 | $10.60 | $2.90 | $0.00 | $42.14 |
| 6 | 81 | $31.02 | $10.60 | $2.90 | $0.00 | $44.52 |
| 7 | 88 | $33.41 | $10.60 | $9.90 | $0.00 | $53.91 |
| 8 | 94 | $35.79 | $10.60 | $9.90 | $0.00 | $56.29 |

**Effective Date -** 06/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $19.59 | $10.80 | $1.80 | $0.00 | $32.19 |
| 2 | 56 | $22.04 | $10.80 | $1.80 | $0.00 | $34.64 |
| 3 | 63 | $24.49 | $10.80 | $2.45 | $0.00 | $37.74 |
| 4 | 69 | $26.94 | $10.80 | $2.45 | $0.00 | $40.19 |
| 5 | 75 | $29.39 | $10.80 | $3.15 | $0.00 | $43.34 |
| 6 | 81 | $31.83 | $10.80 | $3.15 | $0.00 | $45.78 |
| 7 | 88 | $34.28 | $10.80 | $10.45 | $0.00 | $55.53 |
| 8 | 94 | $36.73 | $10.80 | $10.45 | $0.00 | $57.98 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| HOISTING ENGINEER/CRANES/GRADALLS<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *OPERATING ENGINEERS - Local 4*

**Effective Date -** 12/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 55 | $26.80 | $12.50 | $0.00 | $0.00 | $39.30 |
| 2 | 60 | $29.24 | $12.50 | $15.70 | $0.00 | $57.44 |
| 3 | 65 | $31.67 | $12.50 | $15.70 | $0.00 | $59.87 |
| 4 | 70 | $34.11 | $12.50 | $15.70 | $0.00 | $62.31 |
| 5 | 75 | $36.55 | $12.50 | $15.70 | $0.00 | $64.75 |
| 6 | 80 | $38.98 | $12.50 | $15.70 | $0.00 | $67.18 |
| 7 | 85 | $41.42 | $12.50 | $15.70 | $0.00 | $69.62 |
| 8 | 90 | $43.86 | $12.50 | $15.70 | $0.00 | $72.06 |

**Effective Date -** 06/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 55 | $27.41 | $12.50 | $0.00 | $0.00 | $39.91 |
| 2 | 60 | $29.90 | $12.50 | $15.70 | $0.00 | $58.10 |
| 3 | 65 | $32.39 | $12.50 | $15.70 | $0.00 | $60.59 |
| 4 | 70 | $34.88 | $12.50 | $15.70 | $0.00 | $63.08 |
| 5 | 75 | $37.37 | $12.50 | $15.70 | $0.00 | $65.57 |
| 6 | 80 | $39.86 | $12.50 | $15.70 | $0.00 | $68.06 |
| 7 | 85 | $42.36 | $12.50 | $15.70 | $0.00 | $70.56 |
| 8 | 90 | $44.85 | $12.50 | $15.70 | $0.00 | $73.05 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:6**

| | | | | | | |
|---|---|---|---|---|---|---|
| HVAC (DUCTWORK)<br>*SHEETMETAL WORKERS LOCAL 17 - B* | 04/01/2019 | $34.71 | $13.20 | $16.55 | $1.93 | $66.39 |
| For apprentice rates see "Apprentice- SHEET METAL WORKER" | | | | | | |
| HVAC (ELECTRICAL CONTROLS)<br>*ELECTRICIANS LOCAL 223* | 09/01/2019 | $42.26 | $10.15 | $13.54 | $0.00 | $65.95 |
| | 03/01/2020 | $42.87 | $10.40 | $13.94 | $0.00 | $67.21 |
| For apprentice rates see "Apprentice- ELECTRICIAN" | | | | | | |
| HVAC (TESTING AND BALANCING - AIR)<br>*SHEETMETAL WORKERS LOCAL 17 - B* | 04/01/2019 | $34.71 | $13.20 | $16.55 | $1.93 | $66.39 |
| For apprentice rates see "Apprentice- SHEET METAL WORKER" | | | | | | |
| HVAC (TESTING AND BALANCING -WATER)<br>*PLUMBERS & PIPEFITTERS LOCAL 51* | 09/01/2018 | $42.04 | $10.00 | $18.20 | $0.00 | $70.24 |
| For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER" | | | | | | |
| HVAC MECHANIC<br>*PLUMBERS & PIPEFITTERS LOCAL 51* | 09/01/2018 | $42.04 | $10.00 | $18.20 | $0.00 | $70.24 |
| For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| HYDRAULIC DRILLS<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.81 | $8.10 | $15.38 | $0.00 | $58.29 |
| | 06/01/2020 | $35.70 | $8.10 | $15.38 | $0.00 | $59.18 |
| | 12/01/2020 | $36.59 | $8.10 | $15.38 | $0.00 | $60.07 |
| | 06/01/2021 | $37.51 | $8.10 | $15.38 | $0.00 | $60.99 |
| | 12/01/2021 | $38.42 | $8.10 | $15.38 | $0.00 | $61.90 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| INSULATOR (PIPES & TANKS)<br>*HEAT & FROST INSULATORS LOCAL 6 (BOSTON)* | 09/01/2019 | $48.44 | $12.80 | $16.40 | $0.00 | $77.64 |

**Apprentice -** *ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $24.22 | $12.80 | $11.90 | $0.00 | $48.92 |
| 2 | 60 | $29.06 | $12.80 | $12.80 | $0.00 | $54.66 |
| 3 | 70 | $33.91 | $12.80 | $13.70 | $0.00 | $60.41 |
| 4 | 80 | $38.75 | $12.80 | $14.60 | $0.00 | $66.15 |

**Notes:**
Steps are 1 year

**Apprentice to Journeyworker Ratio:1:4**

| | | | | | | |
|---|---|---|---|---|---|---|
| IRONWORKER/WELDER<br>*IRONWORKERS LOCAL 37* | 09/16/2019 | $39.71 | $7.70 | $17.10 | $0.00 | $64.51 |
| | 03/16/2020 | $40.61 | $7.70 | $17.10 | $0.00 | $65.41 |
| | 09/16/2020 | $41.51 | $7.70 | $17.10 | $0.00 | $66.31 |
| | 03/16/2021 | $42.46 | $7.70 | $17.10 | $0.00 | $67.26 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *IRONWORKER - Local 37*

**Effective Date -** 09/16/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 70 | $27.80 | $7.70 | $17.10 | $0.00 | $52.60 |
| 2 | 75 | $29.78 | $7.70 | $17.10 | $0.00 | $54.58 |
| 3 | 80 | $31.77 | $7.70 | $17.10 | $0.00 | $56.57 |
| 4 | 85 | $33.75 | $7.70 | $17.10 | $0.00 | $58.55 |
| 5 | 90 | $35.74 | $7.70 | $17.10 | $0.00 | $60.54 |
| 6 | 95 | $37.72 | $7.70 | $17.10 | $0.00 | $62.52 |

**Effective Date -** 03/16/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 70 | $28.43 | $7.70 | $17.10 | $0.00 | $53.23 |
| 2 | 75 | $30.46 | $7.70 | $17.10 | $0.00 | $55.26 |
| 3 | 80 | $32.49 | $7.70 | $17.10 | $0.00 | $57.29 |
| 4 | 85 | $34.52 | $7.70 | $17.10 | $0.00 | $59.32 |
| 5 | 90 | $36.55 | $7.70 | $17.10 | $0.00 | $61.35 |
| 6 | 95 | $38.58 | $7.70 | $17.10 | $0.00 | $63.38 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:4**

| | | | | | | |
|---|---|---|---|---|---|---|
| JACKHAMMER & PAVING BREAKER OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LABORER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *LABORER - Zone 2*

**Effective Date -** 12/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 60 | $20.44 | $8.10 | $15.38 | $0.00 | $43.92 |
| 2 | 70 | $23.84 | $8.10 | $15.38 | $0.00 | $47.32 |
| 3 | 80 | $27.25 | $8.10 | $15.38 | $0.00 | $50.73 |
| 4 | 90 | $30.65 | $8.10 | $15.38 | $0.00 | $54.13 |

**Effective Date -** 06/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 60 | $20.97 | $8.10 | $15.38 | $0.00 | $44.45 |
| 2 | 70 | $24.47 | $8.10 | $15.38 | $0.00 | $47.95 |
| 3 | 80 | $27.96 | $8.10 | $15.38 | $0.00 | $51.44 |
| 4 | 90 | $31.46 | $8.10 | $15.38 | $0.00 | $54.94 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| LABORER: CARPENTER TENDER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LABORER: CEMENT FINISHER TENDER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.15 | $8.10 | $15.44 | $0.00 | $57.69 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LABORER: MASON TENDER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LABORER: MULTI-TRADE TENDER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| LABORER: TREE REMOVER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |
| This classification applies to all tree work associated with the removal of standing trees, and trimming and removal of branches and limbs when the work is not done for a utility company for the purpose of operation, maintenance or repair of utility company equipment. For apprentice rates see "Apprentice- LABORER" | | | | | | |
| LASER BEAM OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| MARBLE & TILE FINISHERS<br>*BRICKLAYERS LOCAL 3 - MARBLE & TILE* | 08/01/2019 | $41.49 | $10.75 | $19.61 | $0.00 | $71.85 |
| | 02/01/2020 | $41.49 | $10.75 | $20.12 | $0.00 | $72.36 |
| | 08/01/2020 | $42.57 | $10.75 | $20.27 | $0.00 | $73.59 |
| | 02/01/2021 | $43.08 | $10.75 | $20.27 | $0.00 | $74.10 |
| | 08/01/2021 | $44.20 | $10.75 | $20.43 | $0.00 | $75.38 |
| | 02/01/2022 | $44.67 | $10.75 | $20.43 | $0.00 | $75.85 |

**Apprentice -** *MARBLE & TILE FINISHER - Local 3 Marble & Tile*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.75 | $10.75 | $19.61 | $0.00 | $51.11 |
| 2 | 60 | $24.89 | $10.75 | $19.61 | $0.00 | $55.25 |
| 3 | 70 | $29.04 | $10.75 | $19.61 | $0.00 | $59.40 |
| 4 | 80 | $33.19 | $10.75 | $19.61 | $0.00 | $63.55 |
| 5 | 90 | $37.34 | $10.75 | $19.61 | $0.00 | $67.70 |

**Effective Date -** 02/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.75 | $10.75 | $20.12 | $0.00 | $51.62 |
| 2 | 60 | $24.89 | $10.75 | $20.12 | $0.00 | $55.76 |
| 3 | 70 | $29.04 | $10.75 | $20.12 | $0.00 | $59.91 |
| 4 | 80 | $33.19 | $10.75 | $20.12 | $0.00 | $64.06 |
| 5 | 90 | $37.34 | $10.75 | $20.12 | $0.00 | $68.21 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| MARBLE MASONS,TILELAYERS & TERRAZZO MECH<br>*BRICKLAYERS LOCAL 3 - MARBLE & TILE* | 08/01/2019 | $54.42 | $10.75 | $21.30 | $0.00 | $86.47 |
| | 02/01/2020 | $54.42 | $10.75 | $21.93 | $0.00 | $87.10 |
| | 08/01/2020 | $55.77 | $10.75 | $22.08 | $0.00 | $88.60 |
| | 02/01/2021 | $56.41 | $10.75 | $22.08 | $0.00 | $89.24 |
| | 08/01/2021 | $57.81 | $10.75 | $22.24 | $0.00 | $90.80 |
| | 02/01/2022 | $58.38 | $10.75 | $22.24 | $0.00 | $91.37 |

**Apprentice -** *MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $27.21 | $10.75 | $21.30 | $0.00 | $59.26 |
| 2 | 60 | $32.65 | $10.75 | $21.30 | $0.00 | $64.70 |
| 3 | 70 | $38.09 | $10.75 | $21.30 | $0.00 | $70.14 |
| 4 | 80 | $43.54 | $10.75 | $21.30 | $0.00 | $75.59 |
| 5 | 90 | $48.98 | $10.75 | $21.30 | $0.00 | $81.03 |

**Effective Date -** 02/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $27.21 | $10.75 | $21.93 | $0.00 | $59.89 |
| 2 | 60 | $32.65 | $10.75 | $21.93 | $0.00 | $65.33 |
| 3 | 70 | $38.09 | $10.75 | $21.93 | $0.00 | $70.77 |
| 4 | 80 | $43.54 | $10.75 | $21.93 | $0.00 | $76.22 |
| 5 | 90 | $48.98 | $10.75 | $21.93 | $0.00 | $81.66 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| MECH. SWEEPER OPERATOR (ON CONST. SITES)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| MECHANICS MAINTENANCE<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| MILLWRIGHT (Zone 2)<br>*MILLWRIGHTS LOCAL 1121 - Zone 2* | 04/01/2019 | $38.87 | $9.90 | $18.50 | $0.00 | $67.27 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *MILLWRIGHT - Local 1121 Zone 2*

**Effective Date -** 04/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 55 | $21.38 | $9.90 | $5.31 | $0.00 | $36.59 |
| 2 | 65 | $25.27 | $9.90 | $15.13 | $0.00 | $50.30 |
| 3 | 75 | $29.15 | $9.90 | $16.10 | $0.00 | $55.15 |
| 4 | 85 | $33.04 | $9.90 | $17.06 | $0.00 | $60.00 |

**Notes:**

Steps are 2,000 hours

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| MORTAR MIXER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| OILER (OTHER THAN TRUCK CRANES,GRADALLS)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $23.08 | $12.50 | $15.70 | $0.00 | $51.28 |
| | 06/01/2020 | $23.63 | $12.50 | $15.70 | $0.00 | $51.83 |
| | 12/01/2020 | $24.20 | $12.50 | $15.70 | $0.00 | $52.40 |
| | 06/01/2021 | $24.75 | $12.50 | $15.70 | $0.00 | $52.95 |
| | 12/01/2021 | $25.33 | $12.50 | $15.70 | $0.00 | $53.53 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| OILER (TRUCK CRANES, GRADALLS)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $27.64 | $12.50 | $15.70 | $0.00 | $55.84 |
| | 06/01/2020 | $28.29 | $12.50 | $15.70 | $0.00 | $56.49 |
| | 12/01/2020 | $28.97 | $12.50 | $15.70 | $0.00 | $57.17 |
| | 06/01/2021 | $29.61 | $12.50 | $15.70 | $0.00 | $57.81 |
| | 12/01/2021 | $30.29 | $12.50 | $15.70 | $0.00 | $58.49 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| OTHER POWER DRIVEN EQUIPMENT - CLASS II<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| PAINTER (BRIDGES/TANKS)<br>*PAINTERS LOCAL 35 - ZONE 2* | 01/01/2020 | $50.96 | $8.20 | $22.10 | $0.00 | $81.26 |
| | 07/01/2020 | $52.06 | $8.20 | $22.10 | $0.00 | $82.36 |
| | 01/01/2021 | $53.16 | $8.20 | $22.10 | $0.00 | $83.46 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER Local 35 - BRIDGES/TANKS*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $25.48 | $8.20 | $0.00 | $0.00 | $33.68 |
| 2 | 55 | $28.03 | $8.20 | $5.94 | $0.00 | $42.17 |
| 3 | 60 | $30.58 | $8.20 | $6.48 | $0.00 | $45.26 |
| 4 | 65 | $33.12 | $8.20 | $7.02 | $0.00 | $48.34 |
| 5 | 70 | $35.67 | $8.20 | $18.86 | $0.00 | $62.73 |
| 6 | 75 | $38.22 | $8.20 | $19.40 | $0.00 | $65.82 |
| 7 | 80 | $40.77 | $8.20 | $19.94 | $0.00 | $68.91 |
| 8 | 90 | $45.86 | $8.20 | $21.02 | $0.00 | $75.08 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $26.03 | $8.20 | $0.00 | $0.00 | $34.23 |
| 2 | 55 | $28.63 | $8.20 | $5.94 | $0.00 | $42.77 |
| 3 | 60 | $31.24 | $8.20 | $6.48 | $0.00 | $45.92 |
| 4 | 65 | $33.84 | $8.20 | $7.02 | $0.00 | $49.06 |
| 5 | 70 | $36.44 | $8.20 | $18.86 | $0.00 | $63.50 |
| 6 | 75 | $39.05 | $8.20 | $19.40 | $0.00 | $66.65 |
| 7 | 80 | $41.65 | $8.20 | $19.94 | $0.00 | $69.79 |
| 8 | 90 | $46.85 | $8.20 | $21.02 | $0.00 | $76.07 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PAINTER (SIGN, PICTORIAL & DISPLAY)<br>*PAINTERS LOCAL 35 - ZONE 2* | 06/01/2013 | $25.81 | $7.07 | $7.05 | $0.00 | $39.93 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER SIGN - Local 35 Zone 2*

**Effective Date -** 06/01/2013

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $12.91 | $7.07 | $0.00 | $0.00 | $19.98 |
| 2 | 55 | $14.20 | $7.07 | $2.45 | $0.00 | $23.72 |
| 3 | 60 | $15.49 | $7.07 | $2.45 | $0.00 | $25.01 |
| 4 | 65 | $16.78 | $7.07 | $2.45 | $0.00 | $26.30 |
| 5 | 70 | $18.07 | $7.07 | $7.05 | $0.00 | $32.19 |
| 6 | 75 | $19.36 | $7.07 | $7.05 | $0.00 | $33.48 |
| 7 | 80 | $20.65 | $7.07 | $7.05 | $0.00 | $34.77 |
| 8 | 85 | $21.94 | $7.07 | $7.05 | $0.00 | $36.06 |
| 9 | 90 | $23.23 | $7.07 | $7.05 | $0.00 | $37.35 |

**Notes:**
Steps are 4 mos.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PAINTER (SPRAY OR SANDBLAST, NEW) * | 01/01/2020 | $41.86 | $8.20 | $22.10 | $0.00 | $72.16 |
| * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2* | 07/01/2020 | $42.96 | $8.20 | $22.10 | $0.00 | $73.26 |
| | 01/01/2021 | $44.06 | $8.20 | $22.10 | $0.00 | $74.36 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER Local 35 Zone 2 - Spray/Sandblast - New*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.93 | $8.20 | $0.00 | $0.00 | $29.13 |
| 2 | 55 | $23.02 | $8.20 | $5.94 | $0.00 | $37.16 |
| 3 | 60 | $25.12 | $8.20 | $6.48 | $0.00 | $39.80 |
| 4 | 65 | $27.21 | $8.20 | $7.02 | $0.00 | $42.43 |
| 5 | 70 | $29.30 | $8.20 | $18.86 | $0.00 | $56.36 |
| 6 | 75 | $31.40 | $8.20 | $19.40 | $0.00 | $59.00 |
| 7 | 80 | $33.49 | $8.20 | $19.94 | $0.00 | $61.63 |
| 8 | 90 | $37.67 | $8.20 | $21.02 | $0.00 | $66.89 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $21.48 | $8.20 | $0.00 | $0.00 | $29.68 |
| 2 | 55 | $23.63 | $8.20 | $5.94 | $0.00 | $37.77 |
| 3 | 60 | $25.78 | $8.20 | $6.48 | $0.00 | $40.46 |
| 4 | 65 | $27.92 | $8.20 | $7.02 | $0.00 | $43.14 |
| 5 | 70 | $30.07 | $8.20 | $18.86 | $0.00 | $57.13 |
| 6 | 75 | $32.22 | $8.20 | $19.40 | $0.00 | $59.82 |
| 7 | 80 | $34.37 | $8.20 | $19.94 | $0.00 | $62.51 |
| 8 | 90 | $38.66 | $8.20 | $21.02 | $0.00 | $67.88 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PAINTER (SPRAY OR SANDBLAST, REPAINT)<br>*PAINTERS LOCAL 35 - ZONE 2* | 01/01/2020 | $39.92 | $8.20 | $22.10 | $0.00 | $70.22 |
| | 07/01/2020 | $41.02 | $8.20 | $22.10 | $0.00 | $71.32 |
| | 01/01/2021 | $42.12 | $8.20 | $22.10 | $0.00 | $72.42 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $19.96 | $8.20 | $0.00 | $0.00 | $28.16 |
| 2 | 55 | $21.96 | $8.20 | $5.94 | $0.00 | $36.10 |
| 3 | 60 | $23.95 | $8.20 | $6.48 | $0.00 | $38.63 |
| 4 | 65 | $25.95 | $8.20 | $7.02 | $0.00 | $41.17 |
| 5 | 70 | $27.94 | $8.20 | $18.86 | $0.00 | $55.00 |
| 6 | 75 | $29.94 | $8.20 | $19.40 | $0.00 | $57.54 |
| 7 | 80 | $31.94 | $8.20 | $19.94 | $0.00 | $60.08 |
| 8 | 90 | $35.93 | $8.20 | $21.02 | $0.00 | $65.15 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.51 | $8.20 | $0.00 | $0.00 | $28.71 |
| 2 | 55 | $22.56 | $8.20 | $5.94 | $0.00 | $36.70 |
| 3 | 60 | $24.61 | $8.20 | $6.48 | $0.00 | $39.29 |
| 4 | 65 | $26.66 | $8.20 | $7.02 | $0.00 | $41.88 |
| 5 | 70 | $28.71 | $8.20 | $18.86 | $0.00 | $55.77 |
| 6 | 75 | $30.77 | $8.20 | $19.40 | $0.00 | $58.37 |
| 7 | 80 | $32.82 | $8.20 | $19.94 | $0.00 | $60.96 |
| 8 | 90 | $36.92 | $8.20 | $21.02 | $0.00 | $66.14 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PAINTER (TRAFFIC MARKINGS)<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.06 | $8.10 | $15.38 | $0.00 | $57.54 |
| | 06/01/2020 | $34.95 | $8.10 | $15.38 | $0.00 | $58.43 |
| | 12/01/2020 | $35.84 | $8.10 | $15.38 | $0.00 | $59.32 |
| | 06/01/2021 | $36.76 | $8.10 | $15.38 | $0.00 | $60.24 |
| | 12/01/2021 | $37.67 | $8.10 | $15.38 | $0.00 | $61.15 |
| For Apprentice rates see "Apprentice- LABORER" | | | | | | |
| PAINTER / TAPER (BRUSH, NEW) *<br>* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2* | 01/01/2020 | $40.46 | $8.20 | $22.10 | $0.00 | $70.76 |
| | 07/01/2020 | $41.56 | $8.20 | $22.10 | $0.00 | $71.86 |
| | 01/01/2021 | $42.66 | $8.20 | $22.10 | $0.00 | $72.96 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER - Local 35 Zone 2 - BRUSH NEW*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.23 | $8.20 | $0.00 | $0.00 | $28.43 |
| 2 | 55 | $22.25 | $8.20 | $5.94 | $0.00 | $36.39 |
| 3 | 60 | $24.28 | $8.20 | $6.48 | $0.00 | $38.96 |
| 4 | 65 | $26.30 | $8.20 | $7.02 | $0.00 | $41.52 |
| 5 | 70 | $28.32 | $8.20 | $18.86 | $0.00 | $55.38 |
| 6 | 75 | $30.35 | $8.20 | $19.40 | $0.00 | $57.95 |
| 7 | 80 | $32.37 | $8.20 | $19.94 | $0.00 | $60.51 |
| 8 | 90 | $36.41 | $8.20 | $21.02 | $0.00 | $65.63 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $20.78 | $8.20 | $0.00 | $0.00 | $28.98 |
| 2 | 55 | $22.86 | $8.20 | $5.94 | $0.00 | $37.00 |
| 3 | 60 | $24.94 | $8.20 | $6.48 | $0.00 | $39.62 |
| 4 | 65 | $27.01 | $8.20 | $7.02 | $0.00 | $42.23 |
| 5 | 70 | $29.09 | $8.20 | $18.86 | $0.00 | $56.15 |
| 6 | 75 | $31.17 | $8.20 | $19.40 | $0.00 | $58.77 |
| 7 | 80 | $33.25 | $8.20 | $19.94 | $0.00 | $61.39 |
| 8 | 90 | $37.40 | $8.20 | $21.02 | $0.00 | $66.62 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PAINTER / TAPER (BRUSH, REPAINT)<br>*PAINTERS LOCAL 35 - ZONE 2* | 01/01/2020 | $38.52 | $8.20 | $22.10 | $0.00 | $68.82 |
| | 07/01/2020 | $39.62 | $8.20 | $22.10 | $0.00 | $69.92 |
| | 01/01/2021 | $40.72 | $8.20 | $22.10 | $0.00 | $71.02 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PAINTER Local 35 Zone 2 - BRUSH REPAINT*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $19.26 | $8.20 | $0.00 | $0.00 | $27.46 |
| 2 | 55 | $21.19 | $8.20 | $5.94 | $0.00 | $35.33 |
| 3 | 60 | $23.11 | $8.20 | $6.48 | $0.00 | $37.79 |
| 4 | 65 | $25.04 | $8.20 | $7.02 | $0.00 | $40.26 |
| 5 | 70 | $26.96 | $8.20 | $18.86 | $0.00 | $54.02 |
| 6 | 75 | $28.89 | $8.20 | $19.40 | $0.00 | $56.49 |
| 7 | 80 | $30.82 | $8.20 | $19.94 | $0.00 | $58.96 |
| 8 | 90 | $34.67 | $8.20 | $21.02 | $0.00 | $63.89 |

**Effective Date -** 07/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $19.81 | $8.20 | $0.00 | $0.00 | $28.01 |
| 2 | 55 | $21.79 | $8.20 | $5.94 | $0.00 | $35.93 |
| 3 | 60 | $23.77 | $8.20 | $6.48 | $0.00 | $38.45 |
| 4 | 65 | $25.75 | $8.20 | $7.02 | $0.00 | $40.97 |
| 5 | 70 | $27.73 | $8.20 | $18.86 | $0.00 | $54.79 |
| 6 | 75 | $29.72 | $8.20 | $19.40 | $0.00 | $57.32 |
| 7 | 80 | $31.70 | $8.20 | $19.94 | $0.00 | $59.84 |
| 8 | 90 | $35.66 | $8.20 | $21.02 | $0.00 | $64.88 |

**Notes:**
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

| | | | | | | |
|---|---|---|---|---|---|---|
| PANEL & PICKUP TRUCKS DRIVER<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.08 | $12.41 | $13.72 | $0.00 | $60.21 |
| | 06/01/2020 | $34.98 | $12.41 | $13.72 | $0.00 | $61.11 |
| | 08/01/2020 | $34.98 | $12.91 | $13.72 | $0.00 | $61.61 |
| | 12/01/2020 | $34.98 | $12.91 | $14.82 | $0.00 | $62.71 |
| | 06/01/2021 | $35.78 | $12.91 | $14.82 | $0.00 | $63.51 |
| | 08/01/2021 | $35.78 | $13.41 | $14.82 | $0.00 | $64.01 |
| | 12/01/2021 | $35.78 | $13.41 | $16.01 | $0.00 | $65.20 |
| PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK)<br>*PILE DRIVER LOCAL 56 (ZONE 2)*<br>For apprentice rates see "Apprentice- PILE DRIVER" | 08/01/2019 | $44.61 | $9.90 | $21.15 | $0.00 | $75.66 |
| PILE DRIVER<br>*PILE DRIVER LOCAL 56 (ZONE 2)* | 08/01/2019 | $44.61 | $9.90 | $21.15 | $0.00 | $75.66 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *PILE DRIVER - Local 56 Zone 2*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 0 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |

**Notes:** Apprentice wages shall be no less than the following Steps;
(Same as set in Zone 1)
1$54.34/2$58.99/3$63.65/4$65.98/5$68.31/6$68.31/7$72.96/8$72.96

**Apprentice to Journeyworker Ratio:1:5**

| | | | | | | |
|---|---|---|---|---|---|---|
| PIPELAYER<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| PLUMBER & PIPEFITTER<br>*PLUMBERS & PIPEFITTERS LOCAL 51* | 09/01/2018 | $42.04 | $10.00 | $18.20 | $0.00 | $70.24 |

**Apprentice -** *PLUMBER/PIPEFITTER - Local 51*

**Effective Date -** 09/01/2018

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 40 | $16.82 | $10.00 | $2.50 | $0.00 | $29.32 |
| 2 | 50 | $21.02 | $10.00 | $2.50 | $0.00 | $33.52 |
| 3 | 60 | $25.22 | $10.00 | $7.85 | $0.00 | $43.07 |
| 4 | 70 | $29.43 | $10.00 | $12.56 | $0.00 | $51.99 |
| 5 | 80 | $33.63 | $10.00 | $15.70 | $0.00 | $59.33 |

**Notes:**
Steps 2000hrs. Prior 9/1/05; 40/40/45/50/55/60/65/75/80/85

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| PNEUMATIC CONTROLS (TEMP.)<br>*PLUMBERS & PIPEFITTERS LOCAL 51* | 09/01/2018 | $42.04 | $10.00 | $18.20 | $0.00 | $70.24 |
| For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER" | | | | | | |
| PNEUMATIC DRILL/TOOL OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| POWDERMAN & BLASTER<br>*LABORERS - ZONE 2* | 12/01/2019 | $35.06 | $8.10 | $15.38 | $0.00 | $58.54 |
| | 06/01/2020 | $35.95 | $8.10 | $15.38 | $0.00 | $59.43 |
| | 12/01/2020 | $36.84 | $8.10 | $15.38 | $0.00 | $60.32 |
| | 06/01/2021 | $37.76 | $8.10 | $15.38 | $0.00 | $61.24 |
| | 12/01/2021 | $38.67 | $8.10 | $15.38 | $0.00 | $62.15 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| POWER SHOVEL/DERRICK/TRENCHING MACHINE<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| PUMP OPERATOR (CONCRETE)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| PUMP OPERATOR (DEWATERING, OTHER)<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $32.47 | $12.50 | $15.70 | $0.00 | $60.67 |
| | 06/01/2020 | $33.22 | $12.50 | $15.70 | $0.00 | $61.42 |
| | 12/01/2020 | $34.00 | $12.50 | $15.70 | $0.00 | $62.20 |
| | 06/01/2021 | $34.75 | $12.50 | $15.70 | $0.00 | $62.95 |
| | 12/01/2021 | $35.54 | $12.50 | $15.70 | $0.00 | $63.74 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| READY-MIX CONCRETE DRIVER<br>*TEAMSTERS 653 - Southeastern Concrete (Weymouth)* | 08/01/2019 | $23.00 | $11.91 | $6.90 | $0.00 | $41.81 |
| | 05/01/2020 | $23.50 | $11.91 | $6.90 | $0.00 | $42.31 |
| | 08/01/2020 | $23.50 | $12.41 | $6.90 | $0.00 | $42.81 |
| | 05/01/2021 | $24.00 | $12.41 | $6.90 | $0.00 | $43.31 |
| | 08/01/2021 | $24.00 | $12.91 | $6.90 | $0.00 | $43.81 |
| | 05/01/2022 | $24.50 | $12.91 | $6.90 | $0.00 | $44.31 |
| | 08/01/2022 | $24.50 | $13.41 | $6.90 | $0.00 | $44.81 |
| | 05/01/2023 | $25.00 | $13.41 | $6.90 | $0.00 | $45.31 |
| | 08/01/2023 | $25.00 | $13.91 | $6.90 | $0.00 | $45.81 |
| RECLAIMERS<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| RIDE-ON MOTORIZED BUGGY OPERATOR<br>*LABORERS - ZONE 2* | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| ROLLER/SPREADER/MULCHING MACHINE<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg)<br>*ROOFERS LOCAL 33* | 08/01/2019 | $44.64 | $11.50 | $15.90 | $0.00 | $72.04 |
| | 02/01/2020 | $45.92 | $11.50 | $15.90 | $0.00 | $73.32 |
| | 08/01/2020 | $47.35 | $11.50 | $15.90 | $0.00 | $74.75 |
| | 02/01/2021 | $48.78 | $11.50 | $15.90 | $0.00 | $76.18 |
| | 08/01/2021 | $50.21 | $11.50 | $15.90 | $0.00 | $77.61 |
| | 02/01/2022 | $51.64 | $11.50 | $15.90 | $0.00 | $79.04 |

**Apprentice -** *ROOFER - Local 33*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $22.32 | $11.50 | $3.69 | $0.00 | $37.51 |
| 2 | 60 | $26.78 | $11.50 | $15.90 | $0.00 | $54.18 |
| 3 | 65 | $29.02 | $11.50 | $15.90 | $0.00 | $56.42 |
| 4 | 75 | $33.48 | $11.50 | $15.90 | $0.00 | $60.88 |
| 5 | 85 | $37.94 | $11.50 | $15.90 | $0.00 | $65.34 |

**Effective Date -** 02/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $22.96 | $11.50 | $3.69 | $0.00 | $38.15 |
| 2 | 60 | $27.55 | $11.50 | $15.90 | $0.00 | $54.95 |
| 3 | 65 | $29.85 | $11.50 | $15.90 | $0.00 | $57.25 |
| 4 | 75 | $34.44 | $11.50 | $15.90 | $0.00 | $61.84 |
| 5 | 85 | $39.03 | $11.50 | $15.90 | $0.00 | $66.43 |

**Notes:** ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
(Hot Pitch Mechanics' receive $1.00 hr. above ROOFER)

**Apprentice to Journeyworker Ratio:****

| | | | | | | |
|---|---|---|---|---|---|---|
| ROOFER SLATE / TILE / PRECAST CONCRETE<br>*ROOFERS LOCAL 33* | 08/01/2019 | $44.89 | $11.50 | $15.90 | $0.00 | $72.29 |
| | 02/01/2020 | $46.17 | $11.50 | $15.90 | $0.00 | $73.57 |
| | 08/01/2020 | $47.60 | $11.50 | $15.90 | $0.00 | $75.00 |
| | 02/01/2021 | $49.03 | $11.50 | $15.90 | $0.00 | $76.43 |
| | 08/01/2021 | $50.46 | $11.50 | $15.90 | $0.00 | $77.86 |
| | 02/01/2022 | $51.89 | $11.50 | $15.90 | $0.00 | $79.29 |
| For apprentice rates see "Apprentice- ROOFER" | | | | | | |
| SHEETMETAL WORKER<br>*SHEETMETAL WORKERS LOCAL 17 - B* | 04/01/2019 | $34.71 | $13.20 | $16.55 | $1.93 | $66.39 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *SHEET METAL WORKER - Local 17-B*

**Effective Date -** 04/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 40 | $13.88 | $13.20 | $4.02 | $0.95 | $32.05 |
| 2 | 45 | $15.62 | $13.20 | $4.52 | $1.02 | $34.36 |
| 3 | 50 | $17.36 | $13.20 | $10.48 | $1.26 | $42.30 |
| 4 | 55 | $19.09 | $13.20 | $10.48 | $1.31 | $44.08 |
| 5 | 60 | $20.83 | $13.20 | $13.52 | $1.43 | $48.98 |
| 6 | 65 | $22.56 | $13.20 | $13.78 | $1.49 | $51.03 |
| 7 | 70 | $24.30 | $13.20 | $14.03 | $1.55 | $53.08 |
| 8 | 75 | $26.03 | $13.20 | $14.28 | $1.61 | $55.12 |
| 9 | 80 | $27.77 | $13.20 | $14.54 | $1.67 | $57.18 |
| 10 | 85 | $29.50 | $13.20 | $14.79 | $1.72 | $59.21 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| SPECIALIZED EARTH MOVING EQUIP < 35 TONS<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.54 | $12.41 | $13.72 | $0.00 | $60.67 |
| | 06/01/2020 | $35.44 | $12.41 | $13.72 | $0.00 | $61.57 |
| | 08/01/2020 | $35.44 | $12.91 | $13.72 | $0.00 | $62.07 |
| | 12/01/2020 | $35.44 | $12.91 | $14.82 | $0.00 | $63.17 |
| | 06/01/2021 | $36.24 | $12.91 | $14.82 | $0.00 | $63.97 |
| | 08/01/2021 | $36.24 | $13.41 | $14.82 | $0.00 | $64.47 |
| | 12/01/2021 | $36.24 | $13.41 | $16.01 | $0.00 | $65.66 |
| SPECIALIZED EARTH MOVING EQUIP > 35 TONS<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.83 | $12.41 | $13.72 | $0.00 | $60.96 |
| | 06/01/2020 | $35.73 | $12.41 | $13.72 | $0.00 | $61.86 |
| | 08/01/2020 | $35.73 | $12.91 | $13.72 | $0.00 | $62.36 |
| | 12/01/2020 | $35.73 | $12.91 | $14.82 | $0.00 | $63.46 |
| | 06/01/2021 | $36.53 | $12.91 | $14.82 | $0.00 | $64.26 |
| | 08/01/2021 | $36.53 | $13.41 | $14.82 | $0.00 | $64.76 |
| | 12/01/2021 | $36.53 | $13.41 | $16.01 | $0.00 | $65.95 |
| SPRINKLER FITTER<br>*SPRINKLER FITTERS LOCAL 550 - (Section B) Zone 2* | 01/01/2020 | $54.06 | $9.68 | $19.80 | $0.00 | $83.54 |
| | 03/01/2020 | $55.78 | $9.47 | $19.60 | $0.00 | $84.85 |
| | 10/01/2020 | $57.13 | $9.47 | $19.60 | $0.00 | $86.20 |
| | 03/01/2021 | $58.48 | $9.47 | $19.60 | $0.00 | $87.55 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *SPRINKLER FITTER - Local 550 (Section B) Zone 2*

**Effective Date -** 01/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 35 | $18.92 | $9.68 | $11.35 | $0.00 | $39.95 |
| 2 | 40 | $21.62 | $9.68 | $12.00 | $0.00 | $43.30 |
| 3 | 45 | $24.33 | $9.68 | $12.65 | $0.00 | $46.66 |
| 4 | 50 | $27.03 | $9.68 | $13.30 | $0.00 | $50.01 |
| 5 | 55 | $29.73 | $9.68 | $13.95 | $0.00 | $53.36 |
| 6 | 60 | $32.44 | $9.68 | $14.60 | $0.00 | $56.72 |
| 7 | 65 | $35.14 | $9.68 | $15.25 | $0.00 | $60.07 |
| 8 | 70 | $37.84 | $9.68 | $15.90 | $0.00 | $63.42 |
| 9 | 75 | $40.55 | $9.68 | $16.55 | $0.00 | $66.78 |
| 10 | 80 | $43.25 | $9.68 | $17.20 | $0.00 | $70.13 |

**Notes:** Apprentice entered prior 9/30/10:
40/45/50/55/60/65/70/75/80/85
Steps are 850 hours

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| STEAM BOILER OPERATOR<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| TELECOMMUNICATION TECHNICIAN<br>*ELECTRICIANS LOCAL 223* | 09/01/2019 | $35.78 | $10.15 | $11.45 | $0.00 | $57.38 |
| | 03/01/2020 | $36.27 | $10.40 | $11.78 | $0.00 | $58.45 |

**Apprentice -** *TELECOMMUNICATION TECHNICIAN - Local 223*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 0 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |

**Notes:** See Electrician Apprentice Wages
Steps are 750hrs
Telecom Apprentice Wages shall be the same as the Electrician Apprentice Wages

**Apprentice to Journeyworker Ratio:2:3*****

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| TERRAZZO FINISHERS<br>*BRICKLAYERS LOCAL 3 - MARBLE & TILE* | 08/01/2019 | $53.34 | $10.75 | $21.30 | $0.00 | $85.39 |
| | 02/01/2020 | $53.34 | $10.75 | $21.94 | $0.00 | $86.03 |
| | 08/01/2020 | $54.69 | $10.75 | $22.09 | $0.00 | $87.53 |
| | 02/01/2021 | $55.33 | $10.75 | $22.09 | $0.00 | $88.17 |
| | 08/01/2021 | $56.73 | $10.75 | $22.25 | $0.00 | $89.73 |
| | 02/01/2022 | $57.32 | $10.75 | $22.25 | $0.00 | $90.32 |

**Apprentice -** *TERRAZZO FINISHER - Local 3 Marble & Tile*

**Effective Date -** 08/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $26.67 | $10.75 | $21.30 | $0.00 | $58.72 |
| 2 | 60 | $32.00 | $10.75 | $21.30 | $0.00 | $64.05 |
| 3 | 70 | $37.34 | $10.75 | $21.30 | $0.00 | $69.39 |
| 4 | 80 | $42.67 | $10.75 | $21.30 | $0.00 | $74.72 |
| 5 | 90 | $48.01 | $10.75 | $21.30 | $0.00 | $80.06 |

**Effective Date -** 02/01/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 50 | $26.67 | $10.75 | $21.94 | $0.00 | $59.36 |
| 2 | 60 | $32.00 | $10.75 | $21.94 | $0.00 | $64.69 |
| 3 | 70 | $37.34 | $10.75 | $21.94 | $0.00 | $70.03 |
| 4 | 80 | $42.67 | $10.75 | $21.94 | $0.00 | $75.36 |
| 5 | 90 | $48.01 | $10.75 | $21.94 | $0.00 | $80.70 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

| | | | | | | |
|---|---|---|---|---|---|---|
| TEST BORING DRILLER<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $40.50 | $8.10 | $16.80 | $0.00 | $65.40 |
| | 06/01/2020 | $41.49 | $8.10 | $16.80 | $0.00 | $66.39 |
| | 12/01/2020 | $42.47 | $8.10 | $16.80 | $0.00 | $67.37 |
| | 06/01/2021 | $43.49 | $8.10 | $16.80 | $0.00 | $68.39 |
| | 12/01/2021 | $44.50 | $8.10 | $16.80 | $0.00 | $69.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| TEST BORING DRILLER HELPER<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $39.22 | $8.10 | $16.80 | $0.00 | $64.12 |
| | 06/01/2020 | $40.21 | $8.10 | $16.80 | $0.00 | $65.11 |
| | 12/01/2020 | $41.19 | $8.10 | $16.80 | $0.00 | $66.09 |
| | 06/01/2021 | $42.21 | $8.10 | $16.80 | $0.00 | $67.11 |
| | 12/01/2021 | $43.22 | $8.10 | $16.80 | $0.00 | $68.12 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| TEST BORING LABORER<br>*LABORERS - FOUNDATION AND MARINE* | 12/01/2019 | $39.10 | $8.10 | $16.80 | $0.00 | $64.00 |
| | 06/01/2020 | $40.09 | $8.10 | $16.80 | $0.00 | $64.99 |
| | 12/01/2020 | $41.07 | $8.10 | $16.80 | $0.00 | $65.97 |
| | 06/01/2021 | $42.09 | $8.10 | $16.80 | $0.00 | $66.99 |
| | 12/01/2021 | $43.10 | $8.10 | $16.80 | $0.00 | $68.00 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| TRACTORS/PORTABLE STEAM GENERATORS<br>*OPERATING ENGINEERS LOCAL 4* | 12/01/2019 | $48.23 | $12.50 | $15.70 | $0.00 | $76.43 |
| | 06/01/2020 | $49.31 | $12.50 | $15.70 | $0.00 | $77.51 |
| | 12/01/2020 | $50.45 | $12.50 | $15.70 | $0.00 | $78.65 |
| | 06/01/2021 | $51.54 | $12.50 | $15.70 | $0.00 | $79.74 |
| | 12/01/2021 | $52.68 | $12.50 | $15.70 | $0.00 | $80.88 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| TRAILERS FOR EARTH MOVING EQUIPMENT<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $35.12 | $12.41 | $13.72 | $0.00 | $61.25 |
| | 06/01/2020 | $36.02 | $12.41 | $13.72 | $0.00 | $62.15 |
| | 08/01/2020 | $36.02 | $12.91 | $13.72 | $0.00 | $62.65 |
| | 12/01/2020 | $36.02 | $12.91 | $14.82 | $0.00 | $63.75 |
| | 06/01/2021 | $36.82 | $12.91 | $14.82 | $0.00 | $64.55 |
| | 08/01/2021 | $36.82 | $13.41 | $14.82 | $0.00 | $65.05 |
| | 12/01/2021 | $36.82 | $13.41 | $16.01 | $0.00 | $66.24 |
| TUNNEL WORK - COMPRESSED AIR<br>*LABORERS (COMPRESSED AIR)* | 12/01/2019 | $51.38 | $8.10 | $17.20 | $0.00 | $76.68 |
| | 06/01/2020 | $52.37 | $8.10 | $17.20 | $0.00 | $77.67 |
| | 12/01/2020 | $53.35 | $8.10 | $17.20 | $0.00 | $78.65 |
| | 06/01/2021 | $54.37 | $8.10 | $17.20 | $0.00 | $79.67 |
| | 12/01/2021 | $55.38 | $8.10 | $17.20 | $0.00 | $80.68 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE)<br>*LABORERS (COMPRESSED AIR)* | 12/01/2019 | $53.38 | $8.10 | $17.20 | $0.00 | $78.68 |
| | 06/01/2020 | $54.37 | $8.10 | $17.20 | $0.00 | $79.67 |
| | 12/01/2020 | $55.35 | $8.10 | $17.20 | $0.00 | $80.65 |
| | 06/01/2021 | $56.37 | $8.10 | $17.20 | $0.00 | $81.67 |
| | 12/01/2021 | $57.38 | $8.10 | $17.20 | $0.00 | $82.68 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| TUNNEL WORK - FREE AIR<br>*LABORERS (FREE AIR TUNNEL)* | 12/01/2019 | $43.45 | $8.10 | $17.20 | $0.00 | $68.75 |
| | 06/01/2020 | $44.44 | $8.10 | $17.20 | $0.00 | $69.74 |
| | 12/01/2020 | $45.42 | $8.10 | $17.20 | $0.00 | $70.72 |
| | 06/01/2021 | $46.44 | $8.10 | $17.20 | $0.00 | $71.74 |
| | 12/01/2021 | $47.45 | $8.10 | $17.20 | $0.00 | $72.75 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| TUNNEL WORK - FREE AIR (HAZ. WASTE)<br>*LABORERS (FREE AIR TUNNEL)* | 12/01/2019 | $45.45 | $8.10 | $17.20 | $0.00 | $70.75 |
| | 06/01/2020 | $46.44 | $8.10 | $17.20 | $0.00 | $71.74 |
| | 12/01/2020 | $47.42 | $8.10 | $17.20 | $0.00 | $72.72 |
| | 06/01/2021 | $48.44 | $8.10 | $17.20 | $0.00 | $73.74 |
| | 12/01/2021 | $49.45 | $8.10 | $17.20 | $0.00 | $74.75 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| VAC-HAUL<br>*TEAMSTERS JOINT COUNCIL NO. 10 ZONE B* | 12/01/2019 | $34.54 | $12.41 | $13.72 | $0.00 | $60.67 |
| | 06/01/2020 | $35.44 | $12.41 | $13.72 | $0.00 | $61.57 |
| | 08/01/2020 | $35.44 | $12.91 | $13.72 | $0.00 | $62.07 |
| | 12/01/2020 | $35.44 | $12.91 | $14.82 | $0.00 | $63.17 |
| | 06/01/2021 | $36.24 | $12.91 | $14.82 | $0.00 | $63.97 |
| | 08/01/2021 | $36.24 | $13.41 | $14.82 | $0.00 | $64.47 |
| | 12/01/2021 | $36.24 | $13.41 | $16.01 | $0.00 | $65.66 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| WAGON DRILL OPERATOR | 12/01/2019 | $34.31 | $8.10 | $15.38 | $0.00 | $57.79 |
| *LABORERS - ZONE 2* | 06/01/2020 | $35.20 | $8.10 | $15.38 | $0.00 | $58.68 |
| | 12/01/2020 | $36.09 | $8.10 | $15.38 | $0.00 | $59.57 |
| | 06/01/2021 | $37.01 | $8.10 | $15.38 | $0.00 | $60.49 |
| | 12/01/2021 | $37.92 | $8.10 | $15.38 | $0.00 | $61.40 |
| For apprentice rates see "Apprentice- LABORER" | | | | | | |
| WASTE WATER PUMP OPERATOR | 12/01/2019 | $48.73 | $12.50 | $15.70 | $0.00 | $76.93 |
| *OPERATING ENGINEERS LOCAL 4* | 06/01/2020 | $49.83 | $12.50 | $15.70 | $0.00 | $78.03 |
| | 12/01/2020 | $50.98 | $12.50 | $15.70 | $0.00 | $79.18 |
| | 06/01/2021 | $52.08 | $12.50 | $15.70 | $0.00 | $80.28 |
| | 12/01/2021 | $53.23 | $12.50 | $15.70 | $0.00 | $81.43 |
| For apprentice rates see "Apprentice- OPERATING ENGINEERS" | | | | | | |
| WATER METER INSTALLER | 09/01/2018 | $42.04 | $10.00 | $18.20 | $0.00 | $70.24 |
| *PLUMBERS & PIPEFITTERS LOCAL 51* | | | | | | |
| For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER" | | | | | | |
| **Outside Electrical - East** | | | | | | |
| CABLE TECHNICIAN (Power Zone) | 09/01/2019 | $28.83 | $8.75 | $1.86 | $0.00 | $39.44 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $29.67 | $9.25 | $1.89 | $0.00 | $40.81 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| CABLEMAN (Underground Ducts & Cables) | 09/01/2019 | $40.84 | $8.75 | $10.02 | $0.00 | $59.61 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $42.03 | $9.25 | $10.27 | $0.00 | $61.55 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| DRIVER / GROUNDMAN CDL | 09/01/2019 | $33.64 | $8.75 | $9.86 | $0.00 | $52.25 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $34.62 | $9.25 | $10.07 | $0.00 | $53.94 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| DRIVER / GROUNDMAN -Inexperienced (<2000 Hrs) | 09/01/2019 | $26.43 | $8.75 | $1.79 | $0.00 | $36.97 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $27.20 | $9.25 | $1.82 | $0.00 | $38.27 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| EQUIPMENT OPERATOR (Class A CDL) | 09/01/2019 | $40.84 | $8.75 | $14.10 | $0.00 | $63.69 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $42.03 | $9.25 | $14.35 | $0.00 | $65.63 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| EQUIPMENT OPERATOR (Class B CDL) | 09/01/2019 | $36.04 | $8.75 | $10.65 | $0.00 | $55.44 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $37.09 | $9.25 | $10.87 | $0.00 | $57.21 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| GROUNDMAN | 09/01/2019 | $21.62 | $8.75 | $1.65 | $0.00 | $32.02 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $22.25 | $9.25 | $1.67 | $0.00 | $33.17 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| GROUNDMAN -Inexperienced (<2000 Hrs.) | 09/01/2019 | $26.43 | $8.75 | $1.79 | $0.00 | $36.97 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $27.20 | $9.25 | $1.82 | $0.00 | $38.27 |
| For apprentice rates see "Apprentice- LINEMAN" | | | | | | |
| JOURNEYMAN LINEMAN | 09/01/2019 | $48.05 | $8.75 | $17.19 | $0.00 | $73.99 |
| *OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 08/30/2020 | $49.45 | $9.25 | $17.48 | $0.00 | $76.18 |

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

**Apprentice -** *LINEMAN (Outside Electrical) - East Local 104*

**Effective Date -** 09/01/2019

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 60 | $28.83 | $8.75 | $3.36 | $0.00 | $40.94 |
| 2 | 65 | $31.23 | $8.75 | $3.44 | $0.00 | $43.42 |
| 3 | 70 | $33.64 | $8.75 | $3.51 | $0.00 | $45.90 |
| 4 | 75 | $36.04 | $8.75 | $5.08 | $0.00 | $49.87 |
| 5 | 80 | $38.44 | $8.75 | $5.15 | $0.00 | $52.34 |
| 6 | 85 | $40.84 | $8.75 | $5.23 | $0.00 | $54.82 |
| 7 | 90 | $43.25 | $8.75 | $7.30 | $0.00 | $59.30 |

**Effective Date -** 08/30/2020

| Step | percent | Apprentice Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|
| 1 | 60 | $29.67 | $9.25 | $3.39 | $0.00 | $42.31 |
| 2 | 65 | $32.14 | $9.25 | $3.46 | $0.00 | $44.85 |
| 3 | 70 | $34.62 | $9.25 | $3.54 | $0.00 | $47.41 |
| 4 | 75 | $37.09 | $9.25 | $5.11 | $0.00 | $51.45 |
| 5 | 80 | $39.56 | $9.25 | $5.19 | $0.00 | $54.00 |
| 6 | 85 | $42.03 | $9.25 | $5.26 | $0.00 | $56.54 |
| 7 | 90 | $44.51 | $9.25 | $7.34 | $0.00 | $61.10 |

**Notes:**

**Apprentice to Journeyworker Ratio:1:2**

| | | | | | | |
|---|---|---|---|---|---|---|
| TELEDATA CABLE SPLICER<br>*OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 02/04/2019 | $30.73 | $4.70 | $3.17 | $0.00 | $38.60 |
| TELEDATA LINEMAN/EQUIPMENT OPERATOR<br>*OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 02/04/2019 | $28.93 | $4.70 | $3.14 | $0.00 | $36.77 |
| TELEDATA WIREMAN/INSTALLER/TECHNICIAN<br>*OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 02/04/2019 | $28.93 | $4.70 | $3.14 | $0.00 | $36.77 |
| TREE TRIMMER<br>*OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 01/31/2016 | $18.51 | $3.55 | $0.00 | $0.00 | $22.06 |

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is not on the ground. This classification does not apply to wholesale tree removal.

| | | | | | | |
|---|---|---|---|---|---|---|
| TREE TRIMMER GROUNDMAN<br>*OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104* | 01/31/2016 | $16.32 | $3.55 | $0.00 | $0.00 | $19.87 |

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is on the ground. This classification does not apply to wholesale tree removal.

| Classification | Effective Date | Base Wage | Health | Pension | Supplemental Unemployment | Total Rate |
|---|---|---|---|---|---|---|

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)
Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

** Multiple ratios are listed in the comment field.
*** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.
**** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.

**ATTACHMENT B**

**Excerpts from Chapters 30, Section 39F of the Massachusetts General Laws**

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***NOTICE** - These are **NOT** the official versions of the Massachusetts General Laws (MGL). While reasonable efforts have been made to assure the accuracy of the excerpts provided, do not rely on this information without first checking an official edition of the MGL. If you are in need of legal advice or counsel, consult a lawyer.*

Certain excerpts from the Massachusetts General Laws are applicable to Construction contracts. Attention is directed to the following Sections of Chapter 30 as amended.

**Chapter 30: Section 39F. Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts**

Section 39F. (1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the

subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub- bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty- nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

**Chapter 30: Section 39K. Public building construction contracts; payments**

Section 39K. Every contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, shall contain the following paragraph:— Within fifteen days (30 days in the case of the commonwealth, including local housing authorities) after receipt from the contractor, at the place designated by the awarding authority if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the awarding authority will make a periodic payment to the contractor for the workperformed during the preceding month and for the materials not incorporated in the work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the contractor has title or to which a subcontractor has title and has authorized the contractor to transfer title to the awarding authority, upon certification by the contractor that he is the lawful owner and that the materials are free from all encumbrances, but less (1) a retention based on its estimate of the fair value of its claims against the contractor and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, and less (3) a retention not exceeding five per cent of the approved amount of the periodic payment. After the receipt of a periodic estimate requesting final payment and within sixty-five days after (a) the contractor fully completes the work or substantially completes the work so that the value of the work remaining to be done is, in the estimate of the awarding authority, less than one per cent of the original contract price, or (b) the contractor substantially completes the work and the awarding authority takes possession

for occupancy, whichever occurs first, the awarding authority shall pay the contractor the entire balance due on the contract less (1) a retention based on its estimate of the fair value of its claims against the contractor and of the cost of completing the incomplete and unsatisfactory items of work and less (2) a retention for direct payments to subcontractors based on demands

for same in accordance with the provisions of section thirty-nine F, or based on the record of payments by the contractor to the subcontractors under this contract if such record of payment indicates that the contractor has not paid subcontractors as provided in section thirty-nine F. If the awarding authority fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate than charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor; provided, that no interest shall be due, in any event, on the amount due on a periodic estimate for final payment until fifteen days (twenty-four days in the case of the commonwealth) after receipt of such a periodic estimate from the contractor, at the place designated by the awarding authority if such a place is so designated. The contractor agrees to pay to each subcontractor a portion of any such interest paid in accordance with the amount due each subcontractor.

The awarding authority may make changes in any periodic estimate submitted by the contractor and the payment due on said periodic estimate shall be computed in accordance with the changes so made, but such changes or any requirement for a corrected periodic estimate shall not affect the due date for the periodic payment or the date for the commencement of interest charges on the amount of the periodic payment computed in accordance with the changes made, as provided herein; provided, that the awarding authority may, within seven days after receipt, return to the contractor for correction, any periodic estimate which is not in the required form or which contains computations not arithmetically correct and, in that event, the date of receipt of such periodic estimate shall be the date of receipt of the corrected periodic estimate in proper form and with arithmetically correct computations. The date of receipt of a periodic estimate received on a Saturday shall be the first working day thereafter. The provisions of section thirty-nine G shall not apply to any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building to which this section applies.

All periodic estimates shall be submitted to the awarding authority, or to its designee as set forth in writing to the contractor, and the date of receipt by the awarding authority or its designee shall be marked on the estimate. All periodic estimates shall contain a separate item for each filed subtrade and each sub-subtrade listed in sub-bid form as required by specifications and a column listing the amount paid to each subcontractor and sub-subcontractor as of the date the periodic estimate is filed. The person making payment for the awarding authority shall add the daily interest provided for herein to each payment for each day beyond the due date based on the date of receipt marked on the estimate.

A certificate of the architect to the effect that the contractor has fully or substantially completed the work shall, subject to the provisions of section thirty-nine J, be conclusive for the purposes of this section.

Notwithstanding the provisions of this section, at any time after the value of the work remaining to be done is, in the estimation of the awarding authority, less than 1 per cent of the adjusted contract price, or the awarding authority has determined that the contractor has substantially completed the work and the awarding authority has taken possession for occupancy, the awarding authority may send to the general contractor by certified mail, return receipt requested, a complete and final list of all incomplete and unsatisfactory work items, including, for each item on the list, a good faith estimate of the fair and reasonable cost of completing such item. The general contractor shall then complete all such work items within 30 days of receipt of such list or before the contract completion date, whichever is later. If the general contractor fails to complete all incomplete and unsatisfactory work items within 45 days after receipt of such items furnished by the awarding authority or before the contract completion date, whichever is later, subsequent to an additional 14 days' written notice to the general contractor by certified mail, return receipt requested, the awarding authority may terminate the contract and complete the incomplete and unsatisfactory work items and charge the cost of same to the general contractor and such termination shall be without prejudice to any other rights or remedies the awarding authority may have under the contract. The awarding authority shall note any such termination in the evaluation form to be filed by the awarding authority pursuant to the provisions of section 44D of chapter 149.

**Chapter 30: Section 39N. Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions**

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation

of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

**Chapter 30: Section 39O. Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim**

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance

to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and (b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act

**END OF SECTION**

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**ATTACHMENT C**

**CHANGE ORDERS**

Policy:

This section supplements Article 12, Change of Contract Price, in the General Conditions and Supplementary Conditions.

All executed change orders submitted to the Engineer for review and processing must be prepared in accordance with the attached change order format (Appendix A) with the appropriate number of copies, calculation sheet(s) (Appendix B) and all other supporting documentation necessary for evaluation. Failure to comply with these instructions will result in delays in processing the change order.

In order to avoid possible delays with approval of change orders, at the beginning of the project and as circumstances warrant, the Contractor shall submit a list of construction equipment, identifying major pieces of equipment to be utilized on the project. The list shall include the Contractor's designation, if any, the manufacturer, model, year of manufacture, serial number, size and horsepower of equipment. The Contractor shall also provide for approval a proposed bluebook equipment rental rate development that separately lists for each piece of equipment the monthly rental rate, area adjustment factor, depreciation factor, estimated operating cost per hour and total hourly rate. In the event the Contractor fails or is unable to provide appropriate rate information the Engineer may develop equipment rental rates for use on change orders.

Payment of Change Orders:

Payment of all change orders shall be in accordance with the relevant provisions of Massachusetts General Laws, Chapter 30, Section 39G for non-building construction and Section 39K for building construction as amended from time to time.

Payment of change orders shall be made in accordance with one of the following three methods:

A. Existing unit prices as set forth in the contract; or

B. Agreed upon lump sum or unit prices; or

C. Time and materials

A. Payment for work for which there is a unit price in the contract:

Where the contract contains a unit price for work and the Engineer orders a change for work of the same kind as other work contained in the contract and is performed under similar physical conditions, the Contractor shall accept full and final payment at the contract unit price(s) for the acceptable quantities. Under certain circumstances, the unit prices may be subject to revaluation and adjustment. See Article 11 in the Supplementary Conditions.

B. Payment for work or materials for which no price is contained in the contract:

If the Engineer directs, the Contractor shall submit promptly in writing to the Engineer an offer to do the required work on a lump sum or unit price basis, as specified by the Engineer. The stated price, either lump sum or unit price, shall be divided so as to show that it is the sum of:

1. The estimated cost of Labor, plus
2. Direct Labor Cost, plus
3. Material and Freight Costs, plus
4. Equipment Costs, plus
5. An amount not to exceed 20% of the sum of items 1 through 4 for overhead and profit, plus (if applicable),
6. In the case of work done by a subcontractor an amount not to exceed 7 ½%, for the general contractor of the sum of the cost (not including subcontractor's overhead and profit) of items 1 through 4 for his overhead and profit (less, if applicable),
7. Credits for work deleted from the contract, including actual costs of the deleted work plus the percentage of overhead, profit, bonds and insurance attributable to such credit amount.

C. Payment for work on a time and materials basis:

Unless an agreed lump sum and/or unit price is obtained as noted above and is so stated in the change price, the Contractor shall accept as full payment for which no agreement is contained in contract, an amount equal to:

1. The estimated cost of Labor, plus
2. The Direct Labor Costs, plus
3. Equipment Costs, plus
4. Material and Freight Costs, plus
5. An amount not to exceed 20% of the sum of items 1 through 4 for overhead and profit, plus, if applicable,
6. In the case of work done by a subcontractor an amount not to exceed 7 ½%, for the general contractor of the sum of the cost (not including subcontractor's overhead and profit) of items 1 through 4 for his overhead and profit (less, if applicable),
7. Credit for work deleted from the Contract, including actual costs of the deleted work plus the percentage of overhead, profit, bonds and insurance attributable to such credit amount.

Explanation of items 1 through 7 as outlined in "B" and "C" above:

1. Labor - Only those workers employed on the project who are doing the extra work, including the foreman in charge, are allowable. General foremen, superintendents, or other supervisory personnel are considered to be included in the overhead markup as provided in items 5 and/or 6. Hourly labor rates in excess of those as listed in the contract wage rates require documentation. As a minimum, an explanation and the appropriate copy of the certified payroll are required.
2. Direct Labor Costs - These costs are limited to those which are required in the contract document. Coverage in excess of the contract provisions, secured by the contractor/subcontractor(s) at his option, are ineligible. The following list of typical direct labor charges is provided for your assistance and is in no way intended to be complete or all encompassing:

   Workman's Compensation

   Federal/State: Social Security Tax and Unemployment Tax;

   Health, Welfare and Pension Benefits; (this cost is included in the wage rates appearing in the Attachment A Massachusetts Wage Rates.

   | | |
   |---|---|
   | Liability insurance: | Bodily injury; excess umbrella; property damage; public liability |
   | Blasters insurance: | If applied to any required direct labor costs |
   | Builders risk insurance: | If applied to any required direct labor costs |
   | Experience modification insurance: | If applied to any required direct labor costs |
   | Surcharges: | If applied to any required direct labor costs |

   Following award and prior to execution of a construction contract, the Contractor and filed subbidders (where applicable) shall submit for review by the Owner, documentation to establish the markup percentage(s).

   The documented direct labor markup for this contract may be adjusted on an annual basis as measured from the date the contract is executed. The contract agreement will provide for the establishment of the Direct Labor Cost percentage.
3. Material and Freight - Only those materials required as a result of the change order and reasonable freight charges for delivery of same are allowable.
4. Equipment - Only the equipment required as a result of the change order is allowable.

   Equipment rental rates shall be governed by the current Equipment Watch, division of Intertec Publishing [Formerly Nielson/Dataquest] Rental Rate Bluebook for Construction Equipment (the "Bluebook"). In determining the rental rate the following shall apply:

a. For equipment already on the project - the monthly prorated rental rate by the hourly use shall be applicable;

b. For equipment not on the project the daily rate, the weekly rate, or monthly rate will prevail, whichever will prove to be most cost effective. Small tools and manual equipment are examples of costs not allowable under this item. These costs are considered to be included in the overhead markup as provided in items 5 and/or 6.

(1 Month (Normal Use) = 176 hours)

5. Overhead and Profit - All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

6. Overhead and Profit - All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

7. Credits - Work deleted, material and equipment removed from the contract, stored and/or returned shall be credited to the cost of the change order, less documented costs.

This change order will be prepared in such manner as to clearly separate Eligible and Ineligible Costs (as applicable to state-funded projects).

The Contractor shall furnish itemized statements of the cost of the work ordered and shall give the Engineer access to all accounts, bills and vouchers relating thereto; and unless the Contractor shall furnish such itemized statements, and access to all accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is sought by the Engineer.

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**APPENDIX A**

**CHANGE ORDER**

| | |
|---|---|
| Date | |
| Project Name | Downtown Area WWTF and Effluent Disposal<br>Contract No. 2019-01 and SRF No. 4486 |
| Change Order No. | |
| Owner's Name: | Town of Orleans, MA |
| Owner's Address: | 19 School Road, Orleans, Massachusetts, 02653 |
| Contractor's Name: | |
| Contractor's Address: | |

**Change Order Summary**

| Item Number | Description | Amount |
|---|---|---|
| 1 | | |
| 2 | | |
| | Total | |

**Item 1**

Description of Change:

Reason for Change:

Backup Information:

Cost:

**Item 2**

Description of Change:

Reason for Change:

Backup Information:

Cost:

| | |
|---|---|
| Contract Amount (As Bid) | |
| Amount of Previous Change Orders | |
| Net Change in Contract Price (this Change Order) | |
| Total Adjusted Contract Price (including this Change Order | |
| This Change Order extends the time to complete the work by | |
| The extended completion date for Phase I is | |
| The extended completion date for Phase II is | |

This Change Order checked by:

| | | |
|---|---|---|
| AECOM Technical Services, Inc. | | |
| Consultant Engineer | Martin (Reggie) Donoghue, P.E.<br>Resident Representative | Date |

This Change Order is requested by: Town of Orleans, MA

This Change Order is recommended by:

| | | |
|---|---|---|
| AECOM Technical Services, Inc. | | |
| Consultant Engineer | Thomas E. Parece, P.E.<br>Associate Vice President | Date |

The undersigned agree to the terms of the Change Order.

| | | |
|---|---|---|
| | | |
| Contractor | | Date |
| Town of Orleans, MA | | |
| Owner | John F. Kelly<br>Orleans Town Administrator | Date |

Certification of Appropriation under M.G.L. c.44, s.31C: Adequate funding in an amount sufficient to cover the total cost of this change order is available.

By: _____ _____
Cathy Doane, Orleans Finance Director — Date

Do not write below this space: this space reserved for STATE AGENCY APPROVAL

**APPENDIX B**

**EXAMPLE CALCULATION SHEET**

1.Labor

| | | | |
|---|---|---|---|
| Foreman | 10 hours @ | $10.00/hour | $100.00 |
| Engineer | 10 hours @ | $8.80/hour | $85.00 |
| Operator | 10 hours @ | $9.50/hour | $95.00 |
| Laborers | 24 hours @ | $7.00/hour | $168.00 |
| | | | $448.00 |

2.Direct Labor Cost (use the agreed upon Direct Labor Cost)

*(30)% of $448.

*(used for example purposes only) $134.00

3.Materials & Freight

| | |
|---|---|
| 150 1.f. of 12" pipe @ $2.00/1.f. | $300.00 |
| 15 v.f. precast SMH | $1,700.00 |
| Freight (slip 652-1 enclosed) | $25.00 |
| | $2,025.00 |

EXAMPLE

4.Equipment

| | |
|---|---|
| 1 Backhoe - 10 hours @ $80.00/hour | $800.00 |
| 1 Truck-crane - 10 hours @ $100.00/hour | $1,000.00 |
| | $1,800.00 |
| **TOTAL (items 1 through 4):** | **$4,407.00** |

5.(20%) markup for Overhead, Profit

(20%) of $4,407 $881.00

6.(7½ %) markup on subcontractor's cost for general contractor(if subcontractor is involved)

(7½ %) of $4,407 $331.00

7.Credits (deductibles)-$323.00

**TOTAL COST: $5,296.00**

**Reminder:** Provide support documentation as necessary i.e. vouchers, correspondence, calculation, photographs, reports**.**

**END OF SECTION**

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**DOCUMENT 00852**

**SPECIAL CONDITIONS - GENERAL**

1.01 STATUTORY REQUIREMENTS IN GENERAL

A. Keep fully informed of all existing and future state and federal laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the Work, or the materials used or employed in the Work, or in any way affecting the conduct of the Work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same and of all provisions required by law to be made a part of this Contract, all of which provisions are hereby incorporated by reference and made a part thereof. If any discrepancy or inconsistency is discovered in the Contract Documents for this Work in relation to any such law, ordinance, regulation, order or decree, report the same to the Engineer in writing. At all times observe and comply with, and cause all agents and employees to observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees; and protect and indemnify the Owner and Engineer and all of its and their officers, agents, and servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by itself or its employees or subcontractors.

B. All materials furnished and Work done are to comply with all state and federal laws and regulations.

1.02 POLICE OFFICERS

A. Any police officers, reserve, special or otherwise, employed by the Contractor, shall be paid the prevailing wage rates paid to regular police officers of the municipality in which the Work is to be performed.

1.03 RELATION OF SEWER MAINS TO WATER LINES

A. Horizontal Separation

1. Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water mains.

2. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:

a. It is laid in a separate trench.

b. It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth.

c. In either case the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

B. Vertical Separation

1. Whenever sewers must cross under water mains, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstruction with slip-on or mechanical-joint cast-iron pipe, or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

2. When a sewer crosses above a water main, the following measures will be taken:

a. Both pipes will be encased in concrete for a distance of 10 feet on either side of the crossing, or

b. The sewer will be encased in concrete and the water main will be constructed of mechanical joint ductile iron pipe for a distance of 10 feet on either side of the crossing.

C. Special Conditions

1. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main shall be constructed of slip-on or mechanical-joint cast-iron pipe or prestressed concrete cylinder pipe and the sewer constructed of mechanical-joint cast-iron pipe and both services shall be pressure tested to assure water tightness.

**END OF DOCUMENT**

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DOCUMENT 00855

# SPECIAL CONDITIONS

# COMMONWEALTH OF MASSACHUSETTS

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**Article 1. Payment to Subcontractor (MGL Chapter 30, Section 39F)**

Section 39F: Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts

(1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub-bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty-nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

**Article 2. Deviations from Plans and Specifications (MGL Chapter 30, Section 39I)**

Section 39I: Deviations from plans and specifications

Every contractor having a contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public building or public works for the commonwealth, or of any political subdivision thereof, shall perform all the work required by such contract in conformity with the plans and specifications contained therein. No willful and substantial deviation from said plans and specifications shall be made unless authorized in writing by the awarding authority or by the engineer or architect in charge of the work who is duly authorized by the awarding authority to approve such deviations. In order to avoid delays in the prosecution of the work required by such contract such deviation from the plans or specifications may be authorized by a written order of the awarding authority or such engineer or architect so authorized to approve such deviation. Within thirty days thereafter, such written order shall be confirmed by a certificate of the awarding authority stating: (1) If such deviation involves any substitution or elimination of materials, fixtures or equipment, the reasons why such materials, fixtures or equipment were included in the first instance and the reasons for substitution or elimination, and, if the deviation is of any other nature, the reasons for such deviation, giving justification therefor; (2) that the specified deviation does not materially injure the project as a whole; (3) that either the work substituted for the work specified is of the same cost and quality, or that an equitable adjustment has been agreed upon between the contracting agency and the contractor and the amount in dollars of said adjustment; and (4) that the deviation is in the best interest of the contracting authority.

Such certificate shall be signed under the penalties of perjury and shall be a permanent part of the file record of the work contracted for.

Whoever violates any provision of this section willfully and with intent to defraud shall be punished by a fine of not more than five thousand dollars or by imprisonment for not more than six months, or both.

**Article 3. No Arbitrary Decisions are Final (MGL Chapter 30, Section 39J)**

Section 39J: Public construction contracts; effect of decisions of contracting body or administrative board

Notwithstanding any contrary provision of any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or public works by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount of the contract is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, a decision, by the contracting body or by any administrative board, official or agency, or by any architect or engineer, on a dispute, whether of fact or of law, arising under said contract shall not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily is unsupported by substantial evidence, or is based upon error of law.

**Article 4. Construction Work by Foreign Corporations (MGL Chapter 30, Section 39L)**

Section 39L: Public construction work by foreign corporations; restrictions and reports

Section 39L. The commonwealth and every county, city, town, district, board, commission or other public body which, as the awarding authority, requests proposals, bids or sub-bids for any work in the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or other public works (1) shall not enter into a contract for the work with, and shall not approve as a subcontractor furnishing labor and materials for a part of the work, a foreign corporation which has not filed with the awarding authority a certificate of the state secretary stating that the corporation has complied with requirements of section 15.03 of subdivision A of Part 15 of chapter 156D and the date of compliance, and further has filed all annual reports required by section 16.22 of subdivision B of Part 16 of said chapter 156D, and (2) shall report to the state secretary and to the department of corporations and taxation any foreign corporation performing work under such contract or subcontract, and any person, other than a corporation, performing work under such contract or subcontract, and residing or having a principal place of business outside the commonwealth.

**Article 5. Substitution of Equal Products (MGL Chapter 30, Section 39M (b))**

Section 39M: Contracts for construction and materials; manner of awarding

(a) Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is and estimated by the awarding authority to cost less than $10,000 dollars shall be obtained through the exercise of sound business practices as defined in section 2 of chapter 30B. The awarding authority shall make and keep a record of each procurement that, at a minimum, shall include the name and address of the person from whom the services were procured. An awarding authority that utilizes a vendor on a statewide contract procured through the operational services division, or a blanket contract procured by the awarding authority pursuant to this section, shall be deemed to have obtained the contract through sound business practices.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to cost not less than $10,000 but not more than $50,000 shall be awarded to the responsible bidder offering to perform the contract at the lowest price. The awarding authority shall make public notification of the contract and shall seek written responses from no fewer than 3 persons who customarily perform such work. For purposes of this subsection, the term "public notification" shall include, but need not be limited to, posting, at least 2 weeks before the time specified in the notification for the receipt of responses, the contract and scope-of-work statement: (1) on the website of the awarding authority, (2) on the COMMBUYS system administered by the operational services division, (3) in the central register published pursuant to section 20A of chapter 9 and (4) in a conspicuous place in or near the primary office of the awarding authority; provided, however, that if the awarding authority obtains a minimum of 2 written responses from a vendor list established through a blanket contract or a statewide contract procured through the operational services division, and the lowest of those written responses is deemed acceptable to the awarding authority, public notification is not required. The solicitation shall include a scope-of-work statement that defines the work to be performed and provides potential responders with sufficient information regarding the objectives and requirements of the awarding authority and the time period within which the work shall be completed. The awarding authority shall record the names and addresses of all persons from whom written responses were sought, the names of the persons submitting written responses and the date and amount of each written response.

An awarding authority may utilize a vendor list established through a statewide contract procured through the operational services division to identify 1 or more of the persons from whom it will seek written responses for purposes of this subsection. An awarding authority may also procure a blanket contract to establish a listing of vendors in certain defined categories of work that are under contract to provide services for multiple individual tasks of not more than $50,000 each, and from whom written responses will be sought. Any such blanket contract procured by the awarding authority shall be procured pursuant to this section or sections 44A to 44J, inclusive, of chapter 149 which are applicable to projects over $50,000.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to cost more than $50,000, and every contract for the construction, reconstruction, installation, demolition, maintenance or repair of any building by a public agency, as defined by subsection (1) of section 44A of chapter 149, estimated to cost more than $50,000 but not more than $150,000, shall be awarded to the lowest eligible responsible bidder on the basis of competitive bids publicly opened and read by the awarding authority forthwith upon expiration of the time for the filing thereof; provided, however, that such awarding authority may reject any and all bids, if it is in the public interest to do so. Every bid for such contract shall be accompanied by a bid deposit in the form of: (1) a bid bond, (2) cash, or (3) a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to the awarding authority. The amount of the bid deposit shall be 5 per cent of the value of the bid. Any person submitting a bid pursuant to this section shall, on such bid, certify as follows:

The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

_____

(Name of person signing bid)

_____

(Company)

This subsection shall not apply to the award of any contract subject to the provisions of sections 44A to 44J, inclusive, of chapter 149 and every such contract shall continue to be awarded as provided therein. In cases of extreme emergency: (1) caused by enemy attack, sabotage or other such hostile actions or (2) resulting from an imminent security threat explosion, fire, flood, earthquake, hurricane, tornado or other such catastrophe, an awarding authority may, without competitive bids and notwithstanding any general or special law, award contracts otherwise subject to this subsection to perform work and to purchase or rent materials and equipment, all as may be necessary for temporary repair and restoration to service of any and all public work in order to preserve the health and safety of persons or property; provided, that this exception shall not apply to any permanent reconstruction, alteration, remodeling or repair of any public work.

(b) Specifications for such contracts, and specifications for contracts awarded pursuant to the provisions of said sections forty-four A to forty-four L of said chapter one hundred and forty-nine, shall be written to provide for full competition for each item of material to be furnished under the contract; except, however, that said specifications may be otherwise written for sound reasons in the public interest stated in writing in the public records of the awarding authority or promptly given in writing by the awarding authority to anyone making a written request therefor, in either instance such writing to be prepared after reasonable investigation. Every such contract shall provide that an item equal to that named or described in the said specifications may be furnished; and an item shall be considered equal to the item so named or described if, in the opinion of the awarding authority: (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications. For each item of material the specifications shall provide for either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers, and for the equal of any one of said name or described materials.

(c) The term "lowest responsible and eligible bidder" shall mean the bidder: (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who shall certify, that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (3) who shall certify that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; (4) who, where the provisions of section 8B of chapter 29 apply, shall have been determined to be qualified thereunder; and (5) who obtains within 10 days of the notification of contract award the security by bond required under section 29 of chapter 149; provided that for the purposes of this section the term "security by bond" shall mean the bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority; provided further, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable.

(d) The provisions of this section shall not apply (1) to the extent that they prevent the approval of such specifications by any contributing federal agency, (2) to materials purchased under specifications of the state department of highways at prices established by the said department pursuant to advertisement and bidding in connection with work to be performed under the provisions of chapter eighty-one or chapter ninety, (3) to any transaction between the commonwealth and any of its political subdivisions or between the commonwealth and any public service corporation, and (4) to any contract of not more than $50,000 awarded by a governmental body, as defined by section two of chapter thirty B, in accordance with the provisions of section five of said chapter thirty B; and (5) to any contract solely for the purchase of material awarded by a governmental body, as defined by section 2 of chapter 30B, in accordance with section 5 of said chapter 30B, or procured through the operational services division pursuant to sections 22 and 52 of chapter 7.

(e) The word "material" as used in this section shall mean and include any article, assembly, system, or any component part thereof.

**Article 6. Differing Site Conditions (MGL Chapter 30, Section 39N)**

Section 39N: Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

**Article 7. Equitable Adjustments for Delays (MGL Chapter 30, Section 39O)**

Section 39O: Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and (b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act involved in the claim.

**Article 8. Decisions on Interpretation of Specifications (MGL Chapter 30, Section 39P)**

Section 39P: Contracts for construction and materials; awarding authority's decisions on interpretation of specifications, etc.; time limit; notice

Section 39P. Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event, no later than thirty days after the written submission for decision; but if such decision requires extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

**Article 9. Contractor’s Records (MGL Chapter 30, Section 39R)**

Section 39R: Keeping and maintaining of books, records and accounts; statement of management on internal accounting control; financial statements; enforcement

Section 39R. (a) The words defined herein shall have the meaning stated below whenever they appear in this section:

(1) "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded a contract pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A to forty-four H, inclusive, of chapter one hundred and forty-nine, which is for an amount or estimated amount greater than one hundred thousand dollars.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred and forty-nine, which is for amount or estimated amount greater than one hundred thousand dollars.

(3) "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.

(4) "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his residence or principal office and who is in fact independent. In determining whether an accountant is independent with respect to a particular person, appropriate consideration should be given to all relationships between the accountant and that person or any affiliate thereof. Determination of an accountant's independence shall not be confined to the relationships existing in connection with the filing of reports with the awarding authority.

(5) "Audit", when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a certified opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.

(6) "Accountant's Report", when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he has made and sets forth his opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefor shall be stated. An accountant's report shall include as a part thereof a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the contractor.

(7) "Management", when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the contractor.

(8) Accounting terms, unless otherwise defined herein, shall have a meaning in accordance with generally accepted accounting principles and auditing standards.

(b) Subsection (a)(2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven, or eleven C of chapter twenty-five A, and pursuant to section thirty-nine M of chapter thirty or to section forty-four A through H, inclusive, of chapter one hundred and forty-nine, shall provide that:

(1) The contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the contractor, and

(2) until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the contractor or of his subcontractors that directly pertain to, and involve transactions relating to, the contractor or his subcontractors, and

(3) if the agreement is a contract as defined herein, the contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the awarding authority, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the contractor's independent certified public accountant approving or otherwise commenting on the changes, and

(4) if the agreement is a contract as defined herein, the contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and

(5) if the agreement is a contract as defined herein, the contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

(c) Every contractor awarded a contract shall file with the awarding authority a statement of management as to whether the system of internal accounting controls of the contractor and its subsidiaries reasonably assures that:

(1) transactions are executed in accordance with management's general and specific authorization;

(2) transactions are recorded as necessary

i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and

ii. to maintain accountability for assets;

(3) access to assets is permitted only in accordance with management's general or specific authorization; and

(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Every contractor awarded a contract shall also file with the awarding authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to

(1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and

(2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

(d) Every contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the commissioner of capital asset management and maintenance during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the awarding authority upon request.

(e) The office of inspector general, the commissioner of capital asset management and maintenance and any other awarding authority shall enforce the provisions of this section. The commissioner of capital asset management and maintenance may after providing an opportunity for the inspector general and other interested parties to comment, promulgate pursuant to the provisions of chapter thirty A such rules, regulations and guidelines as are necessary to effectuate the purposes of this section. Such rules, regulations and guidelines may be applicable to all awarding authorities. A contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of chapter one hundred and forty-nine.

(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b).

**Article 10. Limitations on Hours of Work (MGL Chapter 149, Section 34)**

Section 34: Public contracts; stipulation as to hours and days of work; void contracts

Section 34. Every contract, except for the purchase of material or supplies, involving the employment of laborers, workmen, mechanics, foremen or inspectors, to which the commonwealth or any county or any town, subject to section thirty, is a party, shall contain a stipulation that no laborer, workman, mechanic, foreman or inspector working within the commonwealth, in the employ of the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency, or, in case any town subject to section thirty-one is a party to such a contract, more than eight hours in any one day, except as aforesaid; provided, that in contracts entered into by the department of highways for the construction or reconstruction of highways there may be inserted in said stipulation a provision that said department, or any contractor or sub-contractor for said department, may employ laborers, workmen, mechanics, foremen and inspectors for more than eight hours in any one day in such construction or reconstruction when, in the opinion of the commissioner, public necessity so requires. Every such contract not containing the aforesaid stipulation shall be null and void.

**Article 11. Advertising Invitations to Bid (MGL Chapter 149, Section 44J)**

Section 44J: Invitations to bid; notice; contents; violations; penalty

(1) No public agency or authority of the commonwealth or any political subdivision thereof shall award any contract for which competitive bids are required pursuant to section forty-four A of this chapter or section thirty-nine M of chapter thirty, or for which competitive proposals are required pursuant to subsection (4) of section forty-four E of this chapter or section eleven C of chapter twenty-five A, unless a notice inviting bids or proposals therefor shall have been posted no less than one week prior to the time specified in such notice for the receipt of said bids or proposals in a conspicuous place in or near the offices of the awarding authority, and shall have remained posted until the time so specified, and unless such notice shall also have been published at least once not less than two weeks prior to the time so specified in the central register published by the secretary of state pursuant to section twenty A of chapter nine and in a newspaper of general circulation in the locality of the proposed project, and on the COMMBUYS system administered by the operational services division. Said notice shall also be published at such other times and in such other newspapers or trade periodicals as the commissioner of capital asset management and maintenance may require, having regard to the locality of the work involved.

(2) Said notice shall specify the time and place where plans and specifications of the proposed work may be had; the time and place of submission of general bids; and the time and place for opening of the general bids. For contracts subject to the provisions of sections forty-four A to H, inclusive, of this chapter, said notice shall also specify the time and place for submission of filed sub-bids, where required pursuant to section forty-four F; and the time and place for opening of said filed sub-bids.

Said notice shall also provide sufficient facts concerning the nature and scope of such project, the type and elements of construction, and such other information as will assist applicants in deciding to bid on such contract.

(3) No contract or preliminary plans and specifications shall be split or divided for the purpose of evading the provisions of this section.

(4) General bids and filed sub-bids for any contract subject to this section shall be in writing and shall be opened in public at the time and place specified in the posted or published notice, and after being so opened shall be open to public inspection.

(5) The provisions of this section shall not apply to any transaction between the commonwealth and any public service corporation.

(6) The provisions of this section may be waived in cases of extreme emergency involving the health and safety of the people and their property, upon the written approval of said commissioner. The written approval shall contain a description of the circumstances and the reasons for the commissioner's determination.

(7) Whoever violates any provision of this section shall be punished by a fine of not more than ten thousand dollars or by imprisonment in the state prison for not more than three years or in a jail or house of correction for not more than two and one-half years, or by both said fine and imprisonment; and in the event of final conviction, said person shall be incapable of holding any office of honor, trust or profit under the commonwealth or under any county, district of municipal agency.

Each and every person who shall cause or conspire to cause any contract or preliminary plans and specifications to be split or divided for the purpose of evading the provisions of this section shall forfeit and pay to the commonwealth, a political subdivision thereof or other awarding authority subject to this section, the sum of not more than five thousand dollars and, in addition, such person or persons shall pay, apportioned among them, double the amount of damages which the commonwealth or political subdivision thereof or other awarding authority may have sustained by reason of the doing of such act, together with the costs of the action.

(8) If an awarding authority rejects all general bids or does not receive any general bids, and advertises for a second opening of general bids with the original filed sub-bids as set forth in subsection (1) of section forty-four E the notice for receipt of such general bids may be published in the central register and elsewhere as required not less than one week prior to the time specified for such second opening of general bids.

(9) No request for proposals or invitation for bids issued under sections 38A 1/2 to 38O, inclusive, of chapter 7, section 11C of chapter 25A, section 39M of chapter 30, this section and sections 44A to 44H, inclusive, shall be advertised if the awarding authority's cost estimate is greater than 1 year old.

**Article 12. Excavations; Notice; Penalties (MGL Chapter 82, Section 40)**

Section 40: Definitions

Section 40. The following words, as used in this section and sections 40A to 40E, inclusive, shall have the following meanings:

"Company", natural gas pipeline company, petroleum or petroleum products pipeline company, public utility company, cable television company, and municipal utility company or department that supply gas, electricity, telephone, communication or cable television services or private water companies within the city or town where such excavation is to be made.

"Description of excavation location", such description shall include the name of the city or town, street, way, or route number where appropriate, the name of the streets at the nearest intersection to the excavation, the number of the buildings closest to the excavation or any other description, including landmarks, utility pole numbers or other information which will accurately define the location of the excavation.

"Emergency", a condition in which the safety of the public is in imminent danger, such as a threat to life or health or where immediate correction is required to maintain or restore essential public utility service.

"Excavation", an operation for the purpose of movement or removal of earth, rock or the materials in the ground including, but not limited to, digging, blasting, augering, backfilling, test boring, drilling, pile driving, grading, plowing in, hammering, pulling in, jacking in, trenching, tunneling and demolition of structures, excluding excavation by tools manipulated only by human power for gardening purposes and use of blasting for quarrying purposes.

"Excavator", any entity including, but not limited to, a person, partnership, joint venture, trust, corporation, association, public utility, company or state or local government body which performs excavation operations.

"Premark", to delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on nonpaved surfaces. No premarking shall be acceptable if such marks can reasonably interfere with traffic or pedestrian control or are misleading to the general public. Premarking shall not be required of any continuous excavation that is over 500 feet in length.

"Safety zone", a zone designated on the surface by the use of standard color-coded markings which contains the width of the facilities plus not more than 18 inches on each side.

"Standard color-coded markings", red - electric power lines, cables, conduit or light cables; yellow - gas, oil, street petroleum, or other gaseous materials; orange - communications cables or conduit, alarm or signal lines; blue - water, irrigation and slurry lines; green - sewer and drain lines; white - premark of proposed excavation.

"System", the underground plant damage prevention system as defined in section 76D of chapter 164.

Section 40A: Excavations; notice

Section 40A. No excavator installing a new facility or an addition to an existing facility or the relay or repair of an existing facility shall, except in an emergency, make an excavation, in any public or private way, any company right-of-way or easement or any public or privately owned land or way, unless at least 72 hours, exclusive of Saturdays, Sundays and legal holidays but not more than 30 days before the proposed excavation is to be made, such excavator has premarked not more than 500 feet of the proposed excavation and given an initial notice to the system. Such initial notice shall set forth a description of the excavation location in the manner as herein defined. In addition, such initial notice shall indicate whether any such excavation will involve blasting and, if so, the date and the location at which such blasting is to occur.

The notice requirements shall be waived in an emergency as defined herein; provided, however, that before such excavation begins or during a life-threatening emergency, notification shall be given to the system and the initial point of boring or excavation shall be premarked. The excavator shall ensure that the underground facilities of the utilities in the area of such excavation shall not be damaged or jeopardized.

In no event shall any excavation by blasting take place unless notice thereof, either in the initial notice or a subsequent notice accurately specifying the date and location of such blasting shall have been given and received at least 72 hours in advance, except in the case of an unanticipated obstruction requiring blasting when such notice shall be not less than four hours prior to such blasting. If any such notice cannot be given as aforesaid because of an emergency requiring blasting, it shall be given as soon as may be practicable but before any explosives are discharged.

Section 40B: Designation of location of underground facilities

Section 40B. Within 72 hours, exclusive of Saturdays, Sundays and legal holidays, from the time the initial notice is received by the system or at such time as the company and the excavator agree, such company shall respond to the initial notice or subsequent notice by designating the location of the underground facilities within 15 feet in any direction of the premarking so that the existing facilities are to be found within a safety zone. Such safety zone shall be so designated by the use of standard color-coded markings. The providing of such designation by the company shall constitute prima facie evidence of an exercise of reasonable precaution by the company as required by this section; provided, however, that in the event that the excavator has given notice as aforesaid at a location at which because of the length of excavation the company cannot reasonably designate the entire location of its facilities within such 72 hour period, then such excavator shall identify for the company that portion of the excavation which is to be first made and the company shall designate the location of its facilities in such portion within 72 hours and shall designate the location of its facilities in the remaining portion of the location within a reasonable time thereafter. When an emergency notification has been given to the system, the company shall make every attempt to designate its facilities as promptly as possible.

Section 40C: Excavator's responsibility to maintain designation markings; damage caused by excavator

Section 40C. After a company has designated the location of its facilities at the location in accordance with section 40B, the excavator shall be responsible for maintaining the designation markings at such locations, unless such excavator requests remarking at the location due to the obliteration, destruction or other removal of such markings. The company shall then remark such location within 24 hours following receipt of such request.

When excavating in close proximity to the underground facilities of any company when such facilities are to be exposed, non-mechanical means shall be employed, as necessary, to avoid damage in locating such facility and any further excavation shall be performed employing reasonable precautions to avoid damage to any underground facilities including, but not limited to, any substantial weakening of structural or lateral support of such facilities, penetration or destruction of any pipe, main, wire or conduit or the protective coating thereof, or damage to any pipe, main, wire or conduit.

If any damage to such pipe, main, wire or conduit or its protective coating occurs, the company shall be notified immediately by the excavator responsible for causing such damage.

The making of an excavation without providing the notice required by section 40A with respect to any proposed excavation which results in any damage to a pipe, main, wire or conduit, or its protective coating, shall be prima facie evidence in any legal or administrative proceeding that such damage was caused by the negligence of such person.

Section 40D: Local laws requiring excavation permits; public ways

Section 40D. Nothing in this section shall affect or impair local ordinances or by-laws requiring a permit to be obtained before excavation in a public way or on private property; but notwithstanding any general or special law, ordinance or by-law to the contrary, to the extent that any permit issued under the provisions of the state building code or state fire code requires excavation by an excavator on a public way or on private property, the permit shall not be valid unless the excavator notifies the system as required pursuant to sections 40 and 40A, before the commencement of the excavation, and has complied with the permitting requirements of chapter 82A.

Section 40E: Violations of Secs. 40A to 40E; punishment

Section 40E. Any person or company found by the department of telecommunications and energy, after a hearing, to have violated any provision of sections 40A to 40E, inclusive, shall be fined $1,000 for the first offense and not less than $5,000 nor more than $10,000 for any subsequent offense within 12 consecutive months as set forth by the rules of said department; provided, however, that nothing herein shall be construed to require forfeiture of any penal sum by a state or local government body for violation of section 40A or 40C; and provided, further, that nothing herein shall be construed to require the forfeiture of any penal sum by a residential property owner for the failure to premark for an excavation on such person's residential property.

**Article 13. Public Building Construction Contracts; Payments (MGL Chapter 30, Section 39K)**

Section 39K. Every contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, shall contain the following paragraph:— Within fifteen days (30 days in the case of the commonwealth, including local housing authorities) after receipt from the contractor, at the place designated by the awarding authority if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the awarding authority will make a periodic payment to the contractor for the work performed during the preceding month and for the materials not incorporated in the work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the contractor has title or to which a subcontractor has title and has authorized the contractor to transfer title to the awarding authority, upon certification by the contractor that he is the lawful owner and that the materials are free from all encumbrances, but less (1) a retention based on its estimate of the fair value of its claims against the contractor and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, and less (3) a retention not exceeding five per cent of the approved amount of the periodic payment. After the receipt of a periodic estimate requesting final payment and within sixty-five days after (a) the contractor fully completes the work or substantially completes the work so that the value of the work remaining to be done is, in the estimate of the awarding authority, less than one per cent of the original contract price, or (b) the contractor substantially completes the work and the awarding authority takes possession for occupancy, whichever occurs first, the awarding authority shall pay the contractor the entire balance due on the contract less (1) a retention based on its estimate of the fair value of its claims against the contractor and of the cost of completing the incomplete and unsatisfactory items of work and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, or based on the record of payments by the contractor to the subcontractors under this contract if such record of payment indicates that the contractor has not paid subcontractors as provided in section thirty-nine F. If the awarding authority fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate than charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor; provided, that no interest shall be due, in any event, on the amount due on a periodic estimate for final payment until fifteen days (twenty-four days in the case of the commonwealth) after receipt of such a periodic estimate from the contractor, at the place designated by the awarding authority if such a place is so designated. The contractor agrees to pay to each subcontractor a portion of any such interest paid in accordance with the amount due each subcontractor.

The awarding authority may make changes in any periodic estimate submitted by the contractor and the payment due on said periodic estimate shall be computed in accordance with the changes so made, but such changes or any requirement for a corrected periodic estimate shall not affect the due date for the periodic payment or the date for the commencement of interest charges on the amount of the periodic payment computed in accordance with the changes made, as provided herein; provided, that the awarding authority may, within seven days after receipt, return to the contractor for correction, any periodic estimate which is not in the required form or which contains computations not arithmetically correct and, in that event, the date of receipt of such periodic estimate shall be the date of receipt of the corrected periodic estimate in proper form and with arithmetically correct computations. The date of receipt of a periodic estimate received on a Saturday shall be the first working day thereafter. The provisions of section thirty-nine G shall not apply to any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building to which this section applies.

All periodic estimates shall be submitted to the awarding authority, or to its designee as set forth in writing to the contractor, and the date of receipt by the awarding authority or its designee shall be marked on the estimate. All periodic estimates shall contain a separate item for each filed subtrade and each sub-subtrade listed in sub-bid form as required by specifications and a column listing the amount paid to each subcontractor and sub-subcontractor as of the date the periodic estimate is filed. The person making payment for the awarding authority shall add the daily interest provided for herein to each payment for each day beyond the due date based on the date of receipt marked on the estimate.

A certificate of the architect to the effect that the contractor has fully or substantially completed the work shall, subject to the provisions of section thirty-nine J, be conclusive for the purposes of this section.

Notwithstanding the provisions of this section, at any time after the value of the work remaining to be done is, in the estimation of the awarding authority, less than 1 per cent of the adjusted contract price, or the awarding authority has determined that the contractor has substantially completed the work and the awarding authority has taken possession for occupancy, the awarding authority may send to the general contractor by certified mail, return receipt requested, a complete and final list of all incomplete and unsatisfactory work items, including, for each item on the list, a good faith estimate of the fair and reasonable cost of completing such item. The general contractor shall then complete all such work items within 30 days of receipt of such list or before the contract completion date, whichever is later. If the general contractor fails to complete all incomplete and unsatisfactory work items within 45 days after receipt of such items furnished by the awarding authority or before the contract completion date, whichever is later, subsequent to an additional 14 days' written notice to the general contractor by certified mail, return receipt requested, the awarding authority may terminate the contract and complete the incomplete and unsatisfactory work items and charge the cost of same to the general contractor and such termination shall be without prejudice to any other rights or remedies the awarding authority may have under the contract. The awarding authority shall note any such termination in the evaluation form to be filed by the awarding authority pursuant to the provisions of section 44D of chapter 149.

**Article 14. Plans and Specifications; Sub-bids; Form; Contents (MGL Chapter149, Section 44F)**

Section 44F. (1)(a) Every contract subject to section forty-four A shall include specifications and, if deemed necessary or convenient by the awarding authority, plans, detailing all labor and materials to be furnished thereunder. Such specifications shall have a separate section for each of the following classes of work if in the estimate of the awarding authority such class of work will exceed $25,000: (a) roofing and flashing; (b) metal windows; (c) waterproofing, damp-proofing and caulking; (d) miscellaneous and ornamental iron; (e) lathing and plastering; (f) acoustical tile; (g) marble; (h) tile; (i) terrazzo; (j) resilient floors; (k) glass and glazing; (l) painting; (m) plumbing; (n) heating, ventilating and air-conditioning; (o) electrical work, including direct electrical radiation for heating; (p) elevators; (q) masonry work; (r) fire protection sprinkler system as defined in section 81 of chapter 146; and (s) any other class of work for which the awarding authority deems it necessary or convenient to receive sub-bids, provided that the awarding authority may, in addition, receive a combined sub-bid on the marble, tile and terrazzo work, but in that event, the marble, tile and terrazzo work shall each be a class of work for which the sub-bidder must list the information in a clearly designated place on the bid form for that purpose. Each separate section in the specifications prescribed or provided for by this paragraph shall state the time limit for filing sub-bids with the awarding authority, shall specify by number each sheet of plans showing work to be done by the subcontractor under such section, and shall require the subcontractor to install all materials to be furnished by him under such section other than materials which in the opinion of the awarding authority it is not customary under then current trade practices for such subcontractor to install and the installation of which is expressly required by another section of the specifications. Each class of work set forth in a separate section of the specifications pursuant to this section shall be a sub-trade designated in the appropriate category of the general bid form and shall be the matter of subcontract made on the basis of sub-bids in accordance with the procedure set forth in sections forty-four F(1)—(5).

Each separate section of the specifications required by the provisions of this section shall contain a paragraph describing by class of work and by reference to paragraph numbers in that section, each class of work, if any, requiring labor and materials which, in the opinion of the awarding authority based upon an investigation of the work involved, is customarily performed in that sub-trade under subcontract with a sub-bidder for that sub-trade, and which is estimated by the awarding authority to cost in excess of $25,000, and only each class of work so described shall be a class of work for which sub-bidder for that sub-trade must list the information required in the appropriate place designated on the bid form for that purpose.

Every contract subject to section forty-four A shall include specifications for the installation of weather protection and shall require that the general contractor shall install the same and that he shall furnish adequate heat in the area so protected during the months of November through March. Standards for such specifications shall be established by the commissioner of planning and operations in the executive office for administration and finance.

[There is no paragraph (b) of subsection (1).]

(2) Every sub-bid submitted in connection with a contract subject to section forty-four A for a sub-trade designated in item 2 of the general bid form pursuant to section forty-four E shall be submitted on a form furnished by the awarding authority and containing the following provisions:

FORM FOR SUB–BID

To all General Bidders Except those Excluded:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described plans, specifications and addenda, all the work specified in Section No. _____ of the specifications and in any plans specified in such section, prepared by

_____ for _____ in

(name of architect or engineer)(project)

_____, Massachusetts, for the contract

(city or town)

sum of _____ dollars ($_____).

For Alternate No. _____; Add $_____ Subtract $_____

[Repeat preceding line for each alternate]

B. This sub-bid includes addenda numbered _____

C. This sub-bid

☐ may be used by any general bidder except:

_____

_____

☐ may only be used by the following general bidders:

_____

_____

[To exclude general bidders, insert "X" in one box only and fill in blank following that box. Do not answer C if no general bidders are excluded.]

D. The undersigned agrees that, if he is selected as a sub-bidder, he will, within 5 days, Saturdays, Sundays and legal holidays excluded, after presentation of a subcontract by the general bidder selected as the general contractor, execute with such general bidder a subcontract in accordance with the terms of this sub-bid, and contingent upon the execution of the general contract, and, if requested so to do in the general bid by the general bidder, who shall pay the premiums therefor, or if prequalification is required pursuant to section 44D 3/4, furnish a performance and payment bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority, in the full sum of the subcontract price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of work for which the provisions of the section of the specifications for this sub-trade require a listing in this paragraph, including the undersigned if customarily furnished by persons on his own payroll and in the absence of a contrary provision in the specifications, the name of each such class of work or part thereto and the bid price for such class of work or part thereof are:

| Name | Class of Work | Bid Price |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

[Do not give bid price for any class or part thereof furnished by undersigned.]

F. The undersigned agrees that the above list of bids to the undersigned represents bona fide bids based on the hereinbefore described plans, specifications and addenda and that, if the undersigned is awarded the contract, they will be used for the work indicated at the amounts stated, if satisfactory to the awarding authority.

G. The undersigned further agrees to be bound to the general contractor by the terms of the hereinbefore described plans, specifications, including all general conditions stated therein, and addenda, and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the owner.

H. The undersigned offers the following information as evidence of his qualifications to perform the work as bid upon according to all the requirements of the plans and specifications:—

1. Have been in business under present business name

_____

years.

2. Ever failed to complete any work awarded?

_____

3. List one or more recent buildings with names of the general contractor and architect on which you served as a sub-contractor for work of similar character as required for the above-named building.

| | Building | Architect | General Contractor | Amount of Contract |
|---|---|---|---|---|
| (a) | | | | |
| (b) | | | | |
| (c) | | | | |

4. Bank reference _____

I. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that he will comply fully with all laws and regulations applicable to awards of subcontracts subject to section 44F.

The undersigned further certifies under penalties of perjury that this sub-bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the commonwealth under the provisions of section twenty-nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

Date _____

_____

(Name of Sub-bidder)

By _____

(Title and Name of Person Signing Bid)

_____

(Business Address)

_____

(City and State)

(3) Every sub-bid in connection with a contract subject to section forty-four A for a sub-trade designated on the general bid form pursuant to section forty-four F(2) shall be for the complete work of the sub-trade as specified, and shall be filed with the awarding authority, in a sealed envelope, before twelve o'clock noon at least four days, Saturdays, Sundays and legal holidays excluded, before the day fixed by the awarding authority for the opening of general bids, and forthwith after the time limit for the filing thereof shall be publicly opened and read by the awarding authority, which, within two days thereafter, Saturdays, Sundays and legal holidays excluded, shall reject every sub-bid which is not accompanied by a bid deposit as prescribed in sub-section (2) of section forty-four B, or which otherwise does not conform with sections forty-four A to forty-four H, inclusive, or which is on a form not completely filled in, or which is incomplete, conditional or obscure, or which contains any addition not called for; provided, however, that the failure of the awarding authority to reject such a sub-bid within such period shall not validate such a sub-bid nor preclude the awarding authority from subsequently rejecting it. Not later than the second day, Saturdays, Sundays and legal holidays excluded, before the day fixed by the awarding authority for the opening of general bids, the awarding authority shall mail to every person on record as having taken a set of plans and specifications list of sub-bidders arranged by sub-trades and listing for each sub-trade the name, address and sub-bid price of every sub-bidder submitting a sub-bid thereon not rejected by the awarding authority and the general bidders excluded from using such sub-bid. A person shall not be named by a general bidder as a sub-bidder for a sub-trade on the general bid form unless such person is included for such sub-trade in said list. If a general bidder not excluded in said list from doing so names as a sub-bidder for a sub-trade on the general bid form a person included for such sub-trade in said list at the sub-bid price stated in said list, neither the general bid of such general bidder nor the general contract executed on the basis of such general bid shall be invalid or rejected because of the invalidity of such sub-bid, or because of error in said list, nor shall such general bid be rejected nor shall such general contract be invalid because of any invalid action taken by the awarding authority in connection with any sub-bid or sub-bids; but there shall be substitution of sub-bidders and adjustment of contract price as if paragraph (c) of section forty-four F(4) were applicable. No sub-bid shall be rejected because of the failure to submit prices for or information relating to, any item or items for which no space is provided in the sub-bid form furnished by the awarding authority; but this sentence shall not be applicable to any failure to furnish prices or information required by section forty-four F to be furnished in the Form for Sub–Bid.

Every sub-bidder duly filing a sub-bid with the awarding authority as aforesaid shall be bound thereby to every general bidder not excluded therein from the use thereof; and any variance from such sub-bid communicated to a general bidder shall be of no effect.

A performance and payment bond furnished by the subcontractor, either pursuant to the requirements of the prequalification process as established in section 44D 3/4 or at the request of a general contractor set forth in the general bid form, shall be for the benefit of the general contractor; shall secure the performance of the subcontract by the subcontractor; and shall indemnify and hold harmless the general contractor and the surety or sureties under the labor and materials or payment bond furnished by the general contractor to the awarding authority against (i) any and all loss and expense arising out of any and all claims in connection with the performance of the subcontract which would be required to be paid under the labor and materials or payment bond furnished by the general contractor to the awarding authority and (ii) attorneys' fees in the event that the subcontractor, after notice, fails to assume the defense of and defend such claims.

Each sub-bidder shall list in the sub-bid form the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the section of the specifications for that sub-trade requires such listing; provided that, in the absence of a contrary provision in the specifications, any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the awarding authority that he does customarily perform such class of work or the part thereof with employees on his own payroll who are mechanics or laborers as referred to in section twenty-six, and is qualified so to do.

If a sub-trade for which the awarding authority is required to take filed sub-bids constitutes the predominant work of the contract, the awarding authority may include that sub-trade work as part of the general bidder's work. The awarding authority shall award the general contract to the lowest responsible and eligible bidder who customarily performs that sub-trade with employees on his own payroll who are mechanics or laborers as referred to in said section twenty-six, except for any part of that sub-trade customarily performed by sub-contractors.

(4)(a)(1) If no sub-bid is filed for a sub-trade designated in the general bid form or if the only sub-bids which are filed are restricted to the use of one or more general bidders, the awarding authority may state, in an addendum issued with the list of sub-bidders required by subsection (3), that the general bidder shall include in the cost of his own work an amount to cover all the work required for any such sub-trade. The general contractor shall cause the work covered by such sub-trade to be done by a qualified and responsible sub-contractor, subject to the written approval of the awarding authority. If the awarding authority determines that any sub-contractor chosen by the general contractor under this section is not qualified or responsible, the general contractor shall obtain another sub-contractor who is satisfactory to the awarding authority with no adjustment in the general contractor's price.

(2) If a rejection of all sub-bids, other than as set forth above, for such a sub-trade occurs pursuant to subsection (1) of section forty-four E or subsection (3) of this section, the awarding authority shall state, in an addendum issued with the list of sub-bidders required by said subsection (3), the amount to be included by a general bidder on the general bid form for such sub-trade; and without in any way affecting other sub-bidders who have conformed to the prescribed bidding procedure, new sub-bids for such sub-trade shall be requested forthwith by written invitation to three or more qualified sub-bidders and shall be publicly opened and read by the awarding authority at a time and place to be specified in such invitation. The general contractor shall cause the work covered by such sub-trade to be done by the lowest responsible and eligible sub-bidder against whose standing and ability the general contractor makes no objection or, if there is no such sub-bidder, by such sub-contractor against whose standing and ability the general contractor makes no objection and for such sum as the general contractor and the awarding authority may agree upon; and the contract price shall be adjusted by the difference between the sub-contract sum and the amount stated in the addendum. The general bidder shall include in the cost of his own work on the general bid form all expenses and profits on account of such adjustments.

(b) If, after the selection of the lowest responsible and eligible general bidder, it be decided to consider sub-bidders other than the ones named by such general bidder in his general bid, the awarding authority and such general bidder shall jointly consider all filed sub-bids not rejected under section forty-four F(3). Any agreement to substitute a sub-bid for the one named in the selected general bid shall result in an adjustment of the general bid price by the difference between the amount of the sub-bid originally named and the amount of the sub-bid substituted therefor. If by such substitutions the total adjusted general bid price of the general bidder first selected becomes greater than the original general bid price of the second lowest responsible and eligible general bidder, then the latter shall be selected and his sub-bidders similarly considered. If, by substitutions as hereinbefore provided, the total adjusted general bid price of the second selected general bidder becomes greater than the total adjusted general bid price of the general bidder first selected or greater than the original general bid price of the third lowest responsible and eligible general bidder, then the bidder having the lower of these two general bid prices shall be selected; provided, that if the third lowest responsible and eligible general bidder is selected, his sub-bidders shall be similarly considered. The general bidder finally selected by the aforementioned process of substitutions shall be the general bidder to whom the contract shall be awarded.

(c) If a selected sub-bidder fails, within 5 days, Saturdays, Sundays and legal holidays excluded, after presentation of a subcontract by the general bidder selected as the general contractor, to perform his agreement to execute a subcontract in the form hereinafter set forth with such general bidder, contingent upon the execution of the general contract, and, if required to do so pursuant to the prequalification process under section 44D 3/4 or if requested to do so by such general bidder in the general bid, to furnish a performance and payment bond as stated in his sub-bid such general bidder and the awarding authority shall select, from the other sub-bids duly filed with the awarding authority for such sub-trade and not rejected under section 44H the lowest responsible and eligible sub-bidder at the amount named in his sub-bid as so filed against whose standing and ability the general contractor makes no objection, and the contract price shall be adjusted by the difference between the amount of the sub-bid and the amount of the sub-bid of the delinquent sub-bidder.

The subcontract shall be in the following form:

SUBCONTRACT

THIS AGREEMENT MADE THIS ___ DAY OF ___ (insert year), by and between ___ a corporation organized and existing under the laws of ___ an individual doing business as ___ hereinafter called the "Contractor" and ___ a corporation organized and existing under the laws of ___ an individual doing business as ___ hereinafter called the "Subcontractor".

WITNESSETH that the Contractor and the Subcontractor for the considerations hereafter named, agree as follows:

1. The Subcontractor agrees to furnish all labor and materials required for the completion of all work specified in Section No. _____ of the specifications for _____
(Name of Sub-Trade) and the plans referred to therein and addenda No. _____, _____, _____, and _____ for the
_____
(complete title of the project and the project number taken from the title page of the specifications)all as prepared by
_____
(Name of Architect or Engineer) for the sum of ___ ($___) and the Contractor agrees to pay the Subcontractor said sum for said work. This price includes the following alternates (and other items set forth in the sub-bid): Alternate No(s). ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ___

(a) The Subcontractor agrees to be bound to the Contractor by the terms of the hereinbefore described plans; specifications (including all general conditions stated therein) and addenda No. ____, and ____, and ____, and to assume to the Contractor all the obligations and responsibilities that the Contractor by those documents assumes to the
_____
(Awarding Authority) hereinafter called the "Awarding Authority", except to the extent that provisions contained therein are by their terms or by law applicable only to the Contractor.

(b) The Contractor agrees to be bound to the Subcontractor by the terms of the hereinbefore described documents and to assume to the Subcontractor all the obligations and responsibilities that the Awarding Authority by the terms of the hereinbefore described documents assumes to the Contractor, except to the extent that provisions contained therein are by their terms or by law applicable only to the Awarding Authority.

2. The Contractor agrees to begin, prosecute and complete the entire work specified by the Awarding Authority in an orderly manner so that the Subcontractor will be able to begin, prosecute and complete the work described in this subcontract; and, in consideration thereof, upon notice from the Contractor, either oral or in writing, the Subcontractor agrees to begin, prosecute and complete the work described in this Subcontract in an orderly manner and with due consideration to the date or time specified by the Awarding Authority for the completion of the entire work.

3. The Subcontractor agrees to furnish to the Contractor within a reasonable time after the execution of this subcontract, evidence of workers' compensation insurance as required by law and evidence of public liability and property damage insurance of the type and in limits required to be furnished to the Awarding Authority by the Contractor.

4. The Contractor agrees that no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten (10) days of the calendar month following that in which the claim originated.

5. This agreement is contingent upon the execution of a general contract between the Contractor and the Awarding Authority for the complete work.

IN WITNESS WHEREOF, the parties hereto have executed this agreement the date and year first above-written.

SEAL
ATTEST _____
_____
(Name of Subcontractor)

By _____

SEAL
ATTEST _____ _____
(Name of Contractor)

By _____

In the event that the contract between the general contractor and the awarding authority does not contain provisions granting to the awarding authority the right to terminate the general contract when the general contractor encounters financial difficulties or fails to make satisfactory progress, the general contractor may insert the following paragraph:

If the Subcontractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Contractor, or otherwise be guilty of a substantial violation of any provision of the contract, then the Contractor may, without prejudice to any other right or remedy and after giving the Subcontractor and his surety, if any, seven days' written notice, terminate the employment of the Subcontractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he may deem expedient. In such case the Subcontractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work including compensation for additional architectural, managerial and administrative services, such excess shall be paid to the Subcontractor. If such expense shall exceed such unpaid balance, the Subcontractor shall pay the difference to the Contractor.

The contractor and subcontractor shall have the right to seek damages for breach of a subcontract without terminating the subcontract or ceasing performance thereunder.

All sub-bidders when finally selected shall be notified in writing of their selection within forty-eight hours thereafter by the general bidder.

In each case of substitution of a sub-bidder for a sub-bidder listed in the general bid of the selected general contractor, the selected general contractor may require the substituted sub-bidder to furnish a performance and payment bond, and the premiums for same shall be added to the general bidder's price for work to be performed by him except where the selected general contractor had indicated in his general bid that the original sub-bidder designated for that sub-trade, in which substitution was made, would be required to furnish such bond.

In the instances enumerated in paragraphs (1), (2) and (3) of this section, the general bidder's price for work to be performed by him shall also be adjusted by the amount of the change in the premium for the general contractor's performance bond and his labor and materials or payment bond caused by the substitution.

(5) If a general bidder customarily performs, with employees on his own payroll who are mechanics or laborers as referred to in section twenty-six, a sub-trade for which the awarding authority invites sub-bids, he may submit a sub-bid for such sub-trade which shall be considered on a par with other sub-bids, and he shall also list under the appropriate sub-bid category in his general bid his own name and sub-bid price for such sub-trade. No such sub-bid shall be considered unless the general bidder can show (a) he does so customarily perform such sub-trade, and (b) he is qualified to do the sub-trade work.

In lieu of listing his name and sub-bid price in his general bid, such general bidder may list the name and amount of the lowest responsible and eligible sub-bidder for that sub-trade if (a) such sub-bidder's price is lower than his, (b) such sub-bid is available for his use; and (c) such sub-bid is not restricted to his use alone or to his use and that of another general bidder, or bidders.

**Article 15. Allowances; Alternates; Weather Protection Devices (MGL Chapter 149, Section 44G)**

Section 44G. (A) "Allowance" as used herein means a sum of money covering one or more items of labor or labor and materials which is designated in bid documents and which general bidders are required to use in computing their bids. The use of such allowances shall be prohibited in the award of any contract subject to the provisions of section forty-four A. Whenever the designer is unable to supply specifications for any item prior to the solicitation of bids, such item shall not be included in any contract subject to the provisions of section forty-four A. The awarding authority shall solicit bids for every such item separately pursuant to the provisions of section forty-four A after specifications for that item are prepared.

(B) Every alternate contained in the form for general bids shall be listed in a numerical sequence in order of priority. When the awarding authority decides to consider alternates in determining the lowest eligible and responsible bidder, the awarding authority shall consider the alternates in descending numerical sequence, such that no single alternate shall be considered unless every alternate preceding it on the list has been added to or subtracted from the base bid price.

(C) The use of options other than alternates in bid documents or bid forms subject to section forty-four A shall be prohibited under all circumstances.

(D) Every contract subject to section forty-four A shall include specifications for the installation of weather protection and shall require that the contractor shall install the same and that he shall furnish adequate heat in the area so protected during the months of November through March. Standards for such specifications shall be established by the commissioner or his designee.

**END OF DOCUMENT**

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**DOCUMENT 00858**

**SPECIAL CONDITIONS - PERMITS AND LICENSES**

1.01 LIST OF PERMITS AND/OR LICENSES

A. The Town of Orleans has received the following Permits and Licenses:

1. Cape Cod Commission – Consistency Review
2. Massachusetts Historical Commission (MHC)
3. Massachusetts Department of Environmental Protection – CWMP Approval
4. Massachusetts Department of Environmental Protection – Site Assignment
5. Orleans, MA - Conservation Commission – Determination of Applicability
6. Old King's Highway Regional Historic District Committee – Certificate of Appropriateness
7. Massachusetts Department of Environmental Protection – Groundwater Discharge Permit

The Applications and Permits and Licenses are included as an Attachment and are made part of the Contract Documents.

The Contractor is responsible for comping with the terms, conditions and any special conditions specified in the Permits and Licensees.

B. Not Used

C. Town of Orleans, MA (To be issued after the Contract is awarded).

1. Trench and Road Opening Permit
2. Building Department

**END OF TEXT**

See Attachments

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**Cape Cod Commission**

**Consistency Review**

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3225 MAIN STREET • P.O. BOX 226
BARNSTABLE, MASSACHUSETTS 02630

(508) 362-3828 • Fax (508) 362-3136 • www.capecodcommission.org

CAPE COD
COMMISSION

April 26, 2019

Maria Pinaud
Acting Director, Division of Municipal Services
MA Department of Environmental Protection
1 Winter Street, 5th Floor
Boston, MA 02108

Ms. Pinaud,

This letter is in response to your request for a consistency determination for those projects in Barnstable County included on the Calendar Year 2019 Intended Use Plan (IUP) for the Clean Water State Revolving Fund (SRF). As you know, Cape Cod communities are subject to the Cape Cod Area Wide Water Quality Management Plan (208 Plan), which was certified and approved by the Massachusetts Department of Environmental Protection and the United States Environmental Protection Agency in 2015. Clean Water State Revolving Fund regulations (310 CMR 44.00) require projects be deemed consistent with the 208 Plan through written notice by the Regional Land Use Planning Agency for the region in which the municipal applicant is located.

The Town of Orleans proposes construction of the Downtown Area Collection System and Wastewater Treatment Facility with a project cost of $42,420,000. This project is consistent with the Orleans Comprehensive Wastewater Management Plan (CWMP), which was approved by the Cape Cod Commission as a Development of Regional Impact on October 13, 2011. For the purposes of SRF, these projects are consistent with the 208 Plan Update. The Town of Orleans underwent an extensive public process over the last several years to develop an Amended CWMP. The Commission was a partner in that effort and anticipates submission of the Orleans Amended CWMP for a full 208 consistency review in the future.

Please feel free to get in touch if you have any questions.

Sincerely,

Kristy Senatori
Executive Director

CC: Gary Moran, Deputy Commissioner, MassDEP
Millie Garcia-Serrano, Southeast Regional Director, MassDEP
David Johnston, Deputy Regional Director, Bureau of Water Resources, MassDEP
Steven McCurdy, Acting Chief Financial Officer, MassDEP

COUNTY OF BARNSTABLE • MASSACHUSETTS •

Brian Dudley, Wastewater Section Chief – Cape & Islands, MassDEP
John Kelly, Town Administrator, Town of Orleans
George Meservey, Town Planner, Town of Orleans

**Massachusetts Historical Commission (MHC)**

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APPENDIX A (continued)

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS 02125
617-727-8470, FAX: 617-727-5128

## PROJECT NOTIFICATION FORM

Project Name: *Downtown Area Orleans Sanitary Sewer Collection System Construction*

Location / Address: *Downtown Area*

City / Town: *Orleans, Massachusetts, MA*

Project Proponent

Name: *Town of Orleans*

Address: *c/o Thomas Parece, PE, AECOM, 9 Jonathan Bourne Drive*

City/Town/Zip/Telephone: *Pocasset, MA 02559*

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

| *Agency Name:* | *Type of License or funding (specify)* |
|---|---|
| *Orleans Building Department* | *Building Permit (by Construction Contractor)* |
| *Orleans Site Plan Review Committee* | *Certificate of Appropriateness* |
| *Orleans Conservation Commission* | *Wetlands Notice of Intent/Order of Conditions ** |
| *Massachusetts Historical Commission* | *Certificate of Appropriateness* |
| *Old's Kings Highway Historic District* | *Certificate of Appropriateness* |
| *MassDEP* | *Water Quality Permit ** |
| *MassDEP* | *Plan and Specification Approval* |
| *Massachusetts Natural Heritage* | *Conservation Permit** |
| *U.S. Army Corps of Engineers* | *Programmatic General Permit ** |
| *U.S. EPA* | *NPDES Permit for construction dewatering permit ** |

**Project Description (narrative):**

*Utility Construction of a Sanitary Sewer Collection System in the Downtown Area of Orleans, MA. Construction will include: 32,000 +/- l.f. of gravity and low pressure sewers; manholes; pump stations; force mains; and sewer services. The sewers will primarily be construsted within the previously disturbed roadway rights of way.*

**Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition**. *No.*

**Does the project include rehabilitation of any existing building? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.** *No*.

APPENDIX A (continued)

**Does the project include new construction? If so, describe (attach plans and elevations if necessary).**

*Yes. The project includes sewer system improvements including the construction of three pump stations*

**To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact?** *Yes*. **If so, specify.**

*There are two historic districts with 73 historic properties listed within the ODWCS, one of which is listed in the National Register of Historic Places (ORL.91 – French Cable Station at 41 South Orleans Road).*

*There are seven previously recorded pre-contact archaeological sites (19-BR-208, -529, -532, -616, -625, -810, and -938) within the boundaries of the proposed project area that have yielded evidence of Native American activity spanning ca. 5000 to 450 years before present (B.P.). Site 19-BN-810, identified near Town Landing contained a Native American burial, shell midden, and cultural material diagnostic of the Late Woodland Period (ca. 1000 to 450 B.P.).*

**What is the total acreage of the project area?**

| | | | |
|---|---|---|---|
| Woodland | *0.3* acres | Productive Resources: | |
| Wetland | _____ acres | Agriculture | _____ acres |
| Floodplain | *0.7* acres | Forestry | _____ acres |
| Open Space | _____ acres | Mining | _____ acres |
| Developed | *7.2* acres | Total Project Acreage | _____ acres |

**What is the acreage of the proposed new construction?** 7.5 acres

**What is the present land use of the project area?** *Residential and light commercial development*

**Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location**.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submiting this form _____ Date: _____

Name: The Public Archaeology Laboratory, Inc.

Address: 26 Main Street

City / Town: Pawtucket, Rhode Island 02860

Telephone: 401-728-8780

REGULATORY AUTHORITY

930CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St.1988, c.254.

# Memorandum
## Orleans Downtown Area Wastewater Collection System Project
Orleans, Massachusetts

*Cultural Resource Evaluation*

*September 22, 2017*

Submitted to:

**PAL Project #3316**

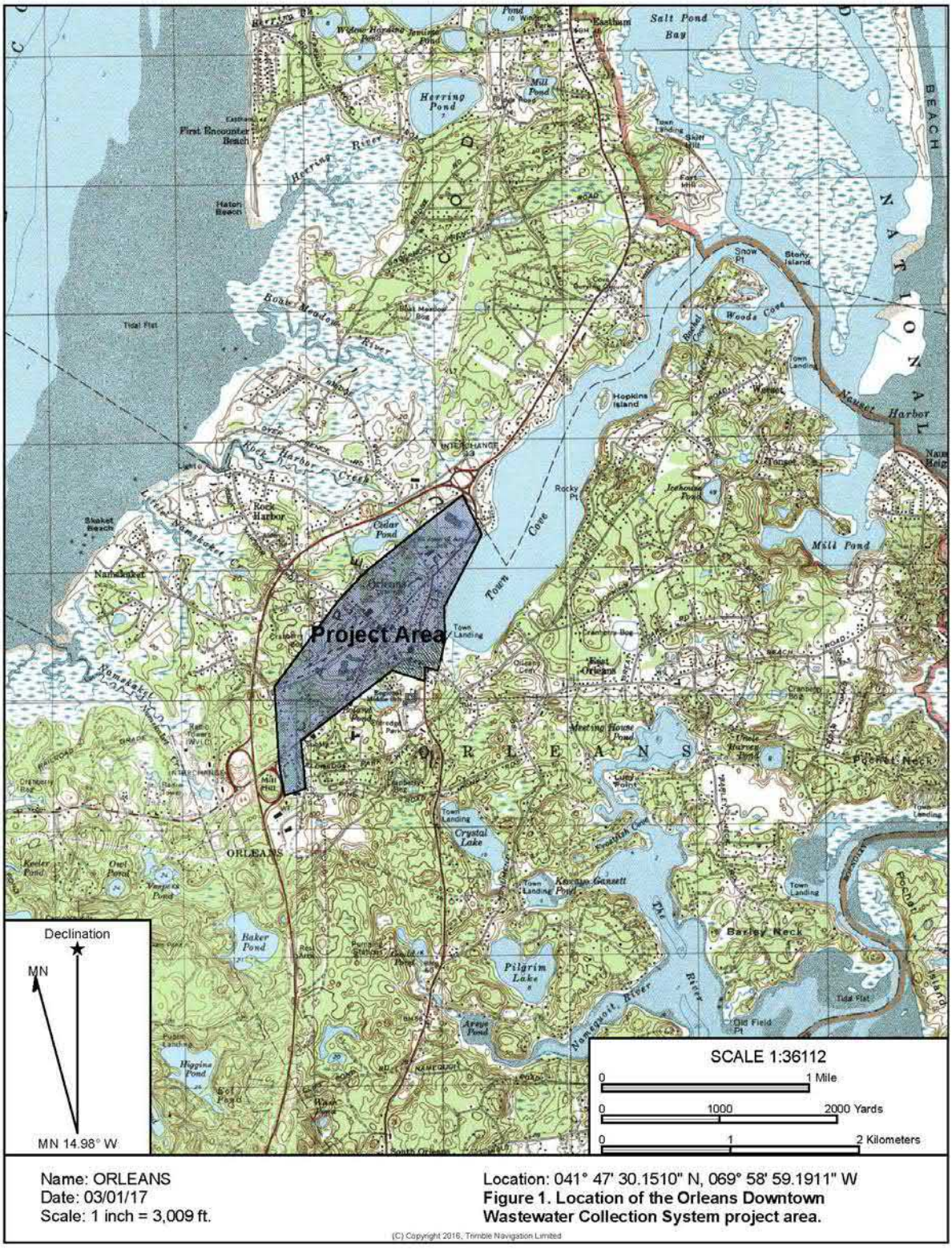
**AECOM**
9 Jonathan Bourne Drive
Pocasset, MA 02559

In response to a request from AECOM, on behalf of the Town of Orleans, PAL completed a cultural resources evaluation as part of a proposed new wastewater collection system in Orleans, Massachusetts (Figure 1). The project will include construction of sewer lines and three pump stations in the downtown area of Orleans (Figure 2).

The goal of the archaeological sensitivity assessment was to collect updated information about previously identified archaeological resources, document previous disturbance and existing conditions, and produce a detailed archaeological sensitivity assessment of the project areas. The assessment also includes recommendations on the need for and scope of additional archaeological investigations, if necessary. The survey will be designed to address MHC review and comment on the project, and to provide information necessary to facilitate project review under Section 106 of the National Historic Preservation Act of 1966 (as amended) (36 CFR 800) and M.G. L. Chapter 9, Sections 26-27c (950 CMR 70-71).

The cultural resources review included the collection of information about known cultural resources within the project's area of potential effect (APE), including historic and archaeological resources in the Commonwealth of Massachusetts Inventory, and an assessment of existing conditions with the project area. The purpose of the work was to assemble information about previously documented historical resources within and near the project area and provide recommendations about significant archaeological sites that may be affected by the project. PAL compiled information about previously documented cultural resources and assessed the sensitivity of the project area for the potential to contain previously unrecorded archaeological sites. For purposes of this proposal, PAL assumes that the project does not have the potential to affect historic structures or landscapes, and that the project tasks are limited to known and potential archaeological resources only.

This memorandum summarizes the results of the cultural resources evaluation and recommendations for archaeological monitoring during project construction work. The sensitivity assessment included background research and a walkover/drive-over field assessment of the project area.


Project Area
Declination
MN
MN 14.98° W
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Name: ORLEANS
Date: 03/01/17
Scale: 1 inch = 3,009 ft.
Location: 041° 47' 30.1510" N, 069° 58' 59.1911" W
Figure 1. Location of the Orleans Downtown Wastewater Collection System project area.
(C) Copyright 2016, Trimble Navigation Limited

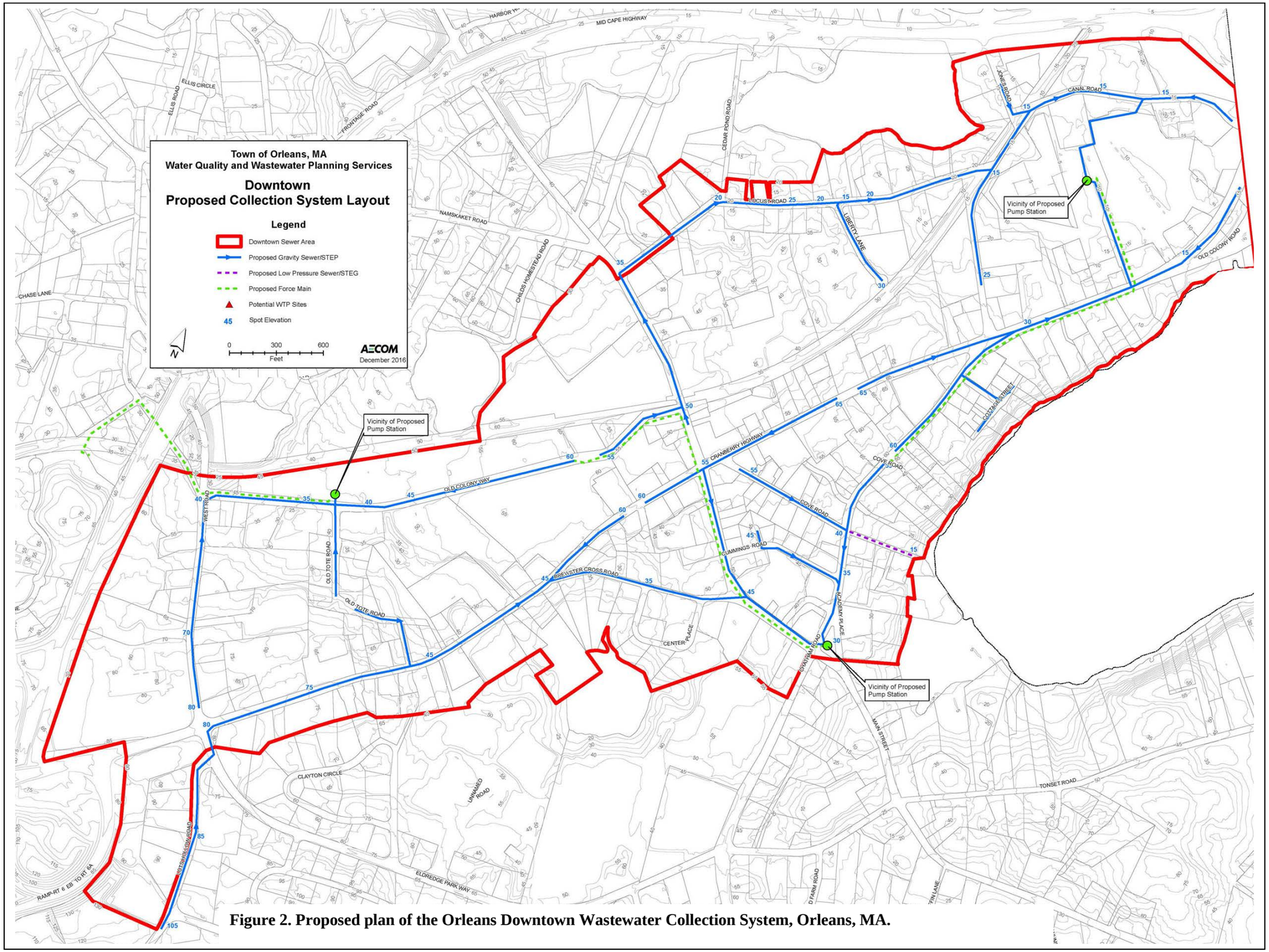


**Figure 2. Proposed plan of the Orleans Downtown Wastewater Collection System, Orleans, MA.**

**Results of the Inventory File Review**

The MHC site files list dozens of historic architectural properties and archaeological sites within the vicinity of the Orleans Downtown Area Wastewater Collection System (ODWCS) project area. The resources were identified through a search of the MHC's Inventory of the Historic and Archaeological Assets of the Commonwealth (MHC Inventory). The study areas established for the purposes of the identification effort were broadly defined to provide information about the types of resources located around the project area. For historic properties, the study area encompassed everything within the project area boundaries; and for archaeological resources, the study area encompassed everything within one-quarter mile on either side of the project's outer boundaries for a total width of one-half mile (Figure 3).

***Architectural and Historic Resources***

There are two historic districts with 73 historic properties listed within the ODWCS, one of which is listed in the National Register of Historic Places (ORL.91; Table 1; Figure 3). Most the inventoried properties fall within the Orleans Town Center historic district (ORL.C). Two other historic districts abut downtown area: Rock Harbor historic district (ORL.A) and Main Street East (ORL.D). Three war memorials (ORL.908, ORL.910, and ORL.911) fall within Academy Place Park, one of the proposed pump station locations, which may also have been the location of the Rock Harbor Academy, built in 1827 and shown on an 1857 map of Orleans (Walling 1857). In 1877, the Academy building was replaced with the Snow Library (1877 - 1952) on Main Street and Chatham Road (MHC 1984).

The following is a list of architectural resources that were identified by this cultural resource review:

**Table 1. Evaluated and Unevaluated Architectural Properties Recorded within the ODWCS Project Area.**

| MHC # | Historic/Common Name | Orleans Address | Date of Construction | Architectural Style |
|---|---|---|---|---|
| ORL.33 | Hurd, Bangs House | 11 Jones Rd | 1830 | Federal; |
| ORL.34 | Unknown | 6 Jones Rd | 1789 | Federal; |
| ORL.35 | Swain, Eunice - Winchester, S. Coleman House | 43 Canal Rd | 1790 | Federal; |
| ORL.36 | Snow, Lt. Prence - Snow, Jonathan House | 31 Canal Rd | 1723 | No style; |
| ORL.38 | Swain, Sue House | 64 Locust Rd | 1750 | Colonial; |
| ORL.39 | Baker, Cal House | 63 Locust Rd | 1890 | Victorian Eclectic; |
| ORL.40 | | 58 Locust Rd | 1850 | No style; |
| ORL.41 | Mayo, Josuah - Myrick, Capt. Josiah House/ Snow, Sarah - Greenhalge, Richard House | 52 Locust Rd | 1788 | Federal; |
| ORL.42 | Peter House | 39 Locust Rd | 1827 | No style; |

| MHC # | Historic/Common Name | Orleans Address | Date of Construction | Architectural Style |
|---|---|---|---|---|
| ORL.43 | Smith, E. House/ Cape Cable Television Associates | 15 Locust Rd | 1875 | No style; |
| ORL.68 | Knowles House/ Smith, Fannie - Young, Mehitable House | 9 Locust Rd | 1800 | Greek Revival; |
| ORL.69 | Knowles House/ Mayo, Arthur - Brooks House | 5 Locust Rd | 1875 | Victorian Eclectic; |
| ORL.76 | Gould, Nathaniel House | 36 West Rd | 1830 | Federal; Greek Revival; |
| ORL.77 | Orleans Jail/ Long, N. - Marquite, George House | 24 West Rd | 1770 | No style; |
| ORL.78 | Long, M. House | 12 West Rd | 1795 | Federal; |
| ORL.85 | Sparrow, Joel House | 4 Main St | 1850 | No style; |
| ORL.86 | Vanasse, Clarence Guest House/ Orleans Council on Aging Office | 12 Main St | 1875 | Queen Anne; |
| ORL.87 | Rogers, Prince Dry Goods Store/ Besse, Dr. Albion Drugstore | 28 Main St | 1875 | Greek Revival; |
| ORL.88 | U. S. Post Office - Orleans Branch/ The Clothes Works Store | 31 Main St | 1858 | Altered beyond recognition; Greek Revival; |
| ORL.89 | Davis and Chase Drugstore/ Cole Universalist Church Parish House | 46 Main St | 1890 | Italianate; |
| ORL.90 | Horton, E. R. - Belcher House | 45 South Orleans Rd | 1880 | Colonial Revival; |
| ORL.91* | French Cable Station | 41 South Orleans Rd | 1891 | Victorian Eclectic; |
| ORL.92 | Newcomb, Capt. Thomas Snow/ Peacock Alley Shops | 35 South Orleans Rd | 1850 | Greek Revival; |
| ORL.93 | Nickerson, Winsor House/ Pulitzer, Lily Dress Shop | 21 South Orleans Rd | 1840 | Italianate; |
| ORL.94 | Murray's Fabric Shop | 11 South Orleans Rd | 1880 | No style; |
| ORL.95 | Music Pad, The | 7 South Orleans Rd | 1890 | No style; |

| MHC # | Historic/Common Name | Orleans Address | Date of Construction | Architectural Style |
|---|---|---|---|---|
| ORL.96 | Higgins - Norgeot, Gaston House | 5 South Orleans Rd | 1874 | Greek Revival; |
| ORL.97 | Higgins, Benjamin House/ Deschamps, Ralph House | 16 South Orleans Rd | 1861 | Greek Revival; |
| ORL.98 | Swain, Capt. William House/ Arbor Restaurant - Wells Boarding House | 20 South Orleans Rd | 1900 | No style; |
| ORL.99 | Upham, Edgar H. House | 42 South Orleans Rd | 1911 | Queen Anne; |
| ORL.100 | Myrick, Richard House/ Smith, Alton House | 19 Cove Rd | 1894 | Queen Anne; |
| ORL.101 | Knowles, Clarence Two-Family House | 14 Cove Rd | 1890 | Federal; |
| ORL.102 | Unknown | 17 Cove Rd | 1900 | Queen Anne; |
| ORL.103 | Smith, Warren House/ Eagle Wing Restaurant | 3 Doane Terr | 1800 | No style; |
| ORL.104 | Orleans Methodist Chapel | 12 Cove Rd | 1840 | Greek Revival; |
| ORL.105 | Smith, T. A. - Ellis, Lloyd Market/ Orleans Fishermans Market | 8 Cove Rd | 1875 | No style; |
| ORL.106 | Knowles, Clarence Bakery/ Timbucktoo Travel Agency | 6 Cove Rd | 1890 | Greek Revival; |
| ORL.107 | Snow, Aaron House/ Aaron's Folly - Orleans Inn | 3 Old County Rd | 1881 | Second Empire; |
| ORL.108 | Fulcher, Alfred Double House | 41 Cranberry Hwy | 1820 | Federal; |
| ORL.109 | Young, David General Store/Marvel, Dr. Reuben - Eldredge, Judah Hous | 8 Judah's Way | 1858 | Greek Revival; |
| ORL.111 | Snow Double House/ Double Dragon Inn | 57 Cranberry Hwy | 1800 | No style; |
| ORL.112 | Snow, Joseph C. House/ Harbor View - Davis, Leander House | 5 North Cottage St | 1900 | No style; |
| ORL.113 | Young, David House/ Orleans Catholic Church Thrift Shop | 54 Cranberry Hwy | 1858 | Second Empire; |

| MHC # | Historic/Common Name | Orleans Address | Date of Construction | Architectural Style |
|---|---|---|---|---|
| ORL.114 | French Atlantic Cable Station Superintendent House/ Hall, George House | 71 Canal Rd | 1880 | No style; |
| ORL.115 | Young, Jonathan Jr. House/ Tree's Place Gift Shop | 60 Cranberry Hwy | 1875 | Italianate; |
| ORL.116 | Howard Johnson Restaurant/ Adam's Rib Restaurant | 63 Cranberry Hwy | 1935 | No style; |
| ORL.117 | Davis, Dr. S. T. House and Office/ Marvel, Dr. Reuben House and Office | 80 Cranberry Hwy | 1880 | Victorian Eclectic; |
| ORL.118 | Lake, Leander Houses/ Jolly Jack Antique Store | 81 Cranberry Hwy | 1900 | Victorian Eclectic; |
| ORL.120 | Nickerson, Eugene House | 94 Cranberry Hwy | 1900 | Victorian Eclectic; |
| ORL.121 | Howes, William House | 85 Cranberry Hwy | 1900 | Queen Anne; |
| ORL.122 | Shattuck, Abigail House | 111 Cranberry Hwy | 1874 | Italianate; |
| ORL.123 | Young, Jonathan Store/ Coles, George House - Barber, Ruth Barn | 117 Cranberry Hwy | 1858 | Altered beyond recognition; Greek Revival; |
| ORL.124 | Snow, Joe Jesse House | 121 Cranberry Hwy | 1900 | Queen Anne; |
| ORL.125 | Bassett, Albert House | 116 Cranberry Hwy | 1885 | Victorian Eclectic; |
| ORL.126 | Mayo, J. C. - Percival, Joseph W. House | 120 Cranberry Hwy | 1852 | Greek Revival; |
| ORL.127 | Unknown | 14 Brewster Cross Rd | 1790 | No style; |
| ORL.128 | Hohn, F. Tailor Sho/ Higgins, Joshua House p | 139 Cranberry Hwy | 1800 | Greek Revival; |
| ORL.129 | Boland, James House/ Higgins, Simeon House - Shattuck, Abel Tavern | 143 Cranberry Hwy | 1750 | Colonial; |
| ORL.130 | Higgins, Simeon Tavern Wing/ Olde Tavern Motel | 151 Cranberry Hwy | 1829 | Federal; |
| ORL.131 | Village Lobster House | 157 Cranberry Hwy | 1880 | Queen Anne; |
| ORL.132 | Kingman, Seth House/ Eldredge, Charles J. House | 164 Cranberry Hwy | 1798 | Federal; |

| MHC # | Historic/Common Name | Orleans Address | Date of Construction | Architectural Style |
|---|---|---|---|---|
| ORL.144 | French Atlantic Cable Station Worker Housing/ Geers, George House | 2 Academy Pl | 1880 | No style; |
| ORL.145 | Knowles, Richard House/ Snow, Azariah House | 8 Academy Pl | 1752 | No style; |
| ORL.396 | Higgins, Benjamin Barn/ Red Balloon Toy and Gift Shop | 16 South Orleans Rd | | No style; |
| ORL.902 | Jeremiah's Gutter Site Marker | Canal Rd | 1976 | |
| ORL.903 | Orleans Oldest House Marker | Canal Rd | 1976 | |
| ORL.904 | Doane, John House Site Marker | Main St | 1976 | |
| ORL.905 | French Atlantic Cable Station Marker | 41 South Orleans Rd | 1976 | |
| ORL.906 | Young, Jonathan Windmill | 33 Cranberry Hwy | 1793 | |
| ORL.907 | Higgins Tavern Site Marker | 154 Cranberry Hwy | 1976 | |
| ORL.908 | Orleans World War I Monument | 5 Academy Pl | | |
| ORL.910 | Orleans World War II Memorial | 5 Academy Pl | 1954 | |
| ORL.911 | Orleans Korean and Vietnam War Monument | 5 Academy Pl | 1981 | |

*Listed in the National Register of Historic Place

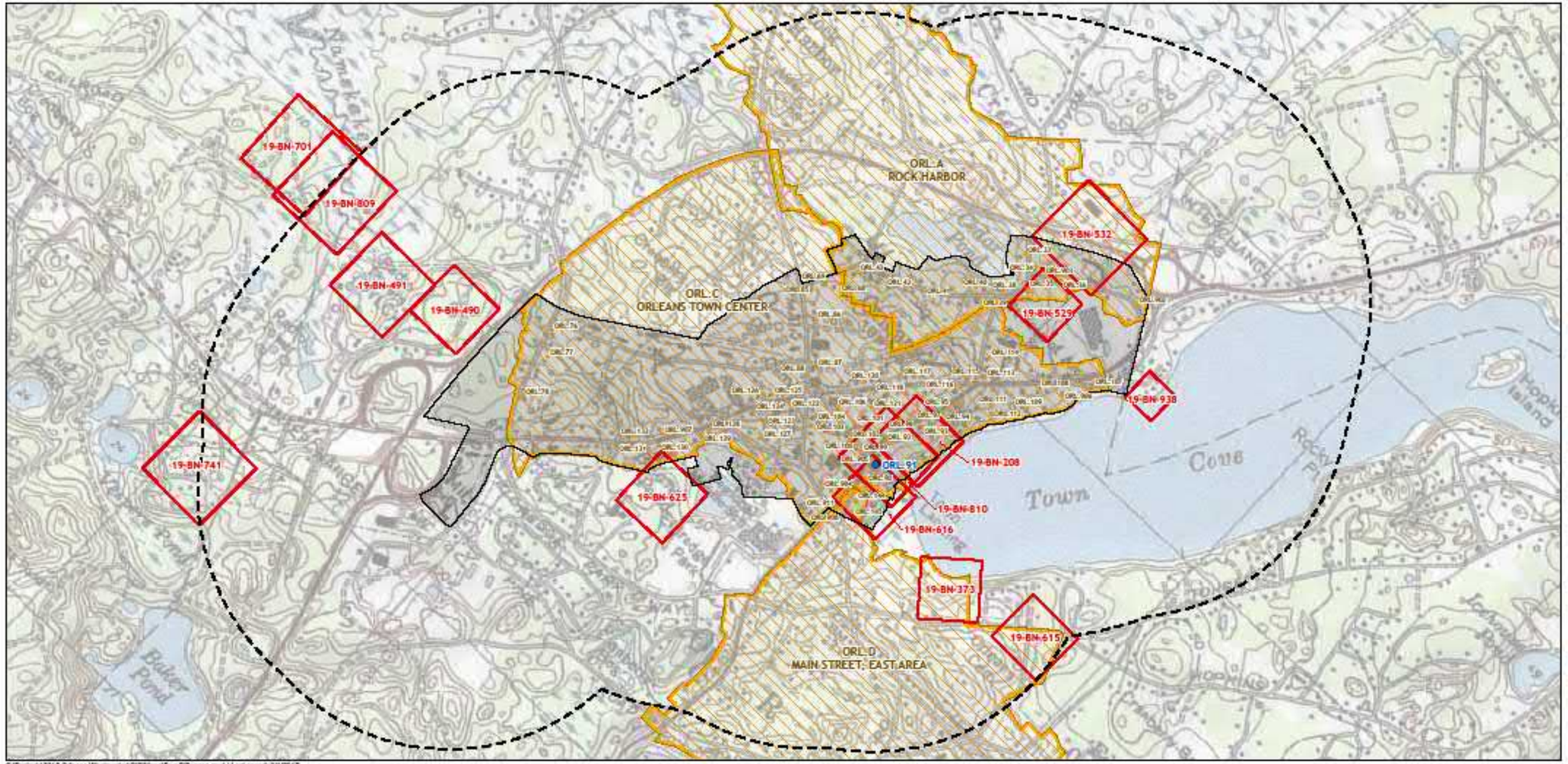


**Figure 3. Recorded archaeological sites within ½ mile and inventoried historic aboveground resources within the Orleans Downtown Area Wastewater Collection System Project Area on the Harwich OE N and Orleans, Massachusetts USGS topographic quadrangles, 7.5 minute series.**

***Archaeological Resources***

Background research was conducted to assist with the archaeological sensitivity assessment and to develop predictive statements for the types of archaeological resources that may be present within the project area. Background research for the project was accessed through the Orleans Historical Society's online archives, a review of MHC's cultural resource database, literature review, and a review of PAL's collection of resources from conducting extensive work on Cape Cod. Several sources of information in PAL's database relative to environmental and pre- and post-contact historic contexts for Orleans and Cape Cod were reviewed for information on known and expected archaeological resources (PAL 2016; Banister and Herbster 2015; Gillis and Herbster 2013; Herbster and Heitert 2011; Waller and Leveillee 2011). Cultural resource inventory files maintained at the MHC were also reviewed for updated information on known historic and archaeological resources in proximity to the project area (MHC 1984, 1987; Decima 1995; Decima et al. 1992; Edens 1995; Edens et al. 1995). Primary and secondary histories and historical maps and atlases were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks (an important variable in the location of post-contact archaeological sites). Town and regional histories, and historical maps and atlases were consulted to locate possible sites dating to the post-contact period within and close to the project area (Waller 1880, 1905, 1910; Walling 1857, 1858). Taken together, information from these various sources was used to arrive at a preliminary assessment of the archaeological sensitivity of the project area.

There are 14 Native American pre-contact archaeological sites recorded with MHC within one half mile of the proposed project area (see Figure 3; Table 3). There are no post-contact (i.e., post European contact) archaeological sites recorded within one half mile of the proposed project area. Seven of the 14 previously recorded sites (19-BR-208, -529, -532, -616, -625, -810, and -938) fall along the proposed ODWCS line. These sites have yielded evidence of Native American activity spanning back to at least the Late Archaic Period (ca. 5000 to 3000 years before present [B.P.]), and consist of artifacts such as stone tools and pottery, and features such as fire hearths, indicative of campsites and lithic (stone tool) workshops. One site also contained human burials. The Franz Site (19-BN-810), was a burial site identified near Town Landing that consisted of shell middens with pottery sherds, diagnostic Late Woodland (ca. 1000 to 450 B.P.) Levanna projectile points, bifacial tool blades and bone or antler fragments (MHC site files).

The majority of the previously recorded archaeological sites were reported by informants or avocational archaeologists, and only two were investigated by professional or academic archaeologists. As a result, most of the sites is known by general location only and the horizontal and vertical limits of the sites are unknown. Several of the sites were identified in the first half of the twentieth century by avocational archaeologists associated with the Massachusetts Archaeological Society (MAS). Several sites, including several Native American burials, were exposed accidentally during construction activities.

The limited information available about the recorded pre-contact period sites indicates that many of them may date to the Woodland and/or Contact Periods (ca. 3,000-450 years before present [B.P.]). Shell midden sites, villages, and human burials are often associated with this time period at coastal sites in southeastern Massachusetts and on Cape Cod, and the limited database for Orleans follows this general pattern.

The following is a list of archaeological resources that were identified by this cultural resource review:

**Table 3. Unevaluated Pre-Contact Archaeological Sites Recorded within One-Half Mile of the ODWCS Project Area.**

| Site Name | MHC Site # | Towns | Temporal Period | Site Type |
|---|---|---|---|---|
| Peter Hunts Site | 19-BN-208* | Orleans | Woodland | Campsite |
| Fisk Farm Site | 19-BN-373 | Orleans | Woodland | Unknown |
| Oak Ridge Site | 19-BN-490 | Orleans | Transitional Archaic | Campsite/workshop |
| Namskaket Site | 19-BN-491 | Orleans | Late Archaic | Campsite |
| Gove Site | 19-BN-529* | Orleans | Unknown | Unknown |
| Ellis Site | 19-BN-532* | Orleans | Archaic and Woodland | Campsite |
| Cemetery Site | 19-BN-615 | Orleans | Late Archaic | Campsite |
| Estlin Site | 19-BN-616* | Orleans | Late Archaic | Lithic workshop |
| Orleans Elementary School | 19-BN-625* | Orleans | Unknown | Habitation site |
| Unknown | 19-BN-701 | Brewster | Unknown | Lithic workshop |
| Ps1-3-1 | 19-BN-741 | Brewster | Unknown | Flake scatter |
| Forren Site | 19-BN-809 | Brewster | Late Archaic/Early Woodland | Habitation site, lithic workshop |
| Franz Site | 19-BN-810* | Orleans | Late Woodland/Contact | Burial, shell midden, habitation site. |
| Ellis Road | 19-BN-938* | Eastham | Unknown | Flake scatter |

*Sites recorded within the project area.

**Archaeological Sensitivity**

The archaeological sensitivity of the project area is defined by the presence of favorable environmental conditions and the presence of known archaeological sites in similar environmental settings. Well-drained soils near freshwater resources were preferred locations for Native American groups. Soil associations within the Orleans project area mostly consist of well-drained Carver-Hinesburg loamy coarse sands and Carver coarse sands of varying slopes that formed on glacial outwash plains (USDA 1993). The ODWCS project area was ranked according to the potential for the presence of archaeological resources based on information collected during the archival research and walkover survey. Table 2 is a summary of the factors used to develop the archaeological sensitivity rankings.

**Table 2. Archaeological Sensitivity Ranking.**

| Presence of Sites | | Proximity to Favorable Cultural/Environmental Characteristics | | | Degree of Disturbance | | | Sensitivity Ranking |
|---|---|---|---|---|---|---|---|---|
| Known | Unknown | < 150 m | ≥ 150 ≤ 500 m | > 500 m | None/Minimal | Moderate | Extensive | |
| • | | • | | | • | | | High |
| • | | • | | | | • | | High |
| • | | • | | | | | • | Low |
| • | | | • | | • | | | High |
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| | • | | • | | | • | | Moderate |
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| | • | | | • | • | | | Moderate |
| | • | | | • | | • | | Low |
| | • | | | • | | | • | Low |

**Results of the Walkover/Driveover Survey and Preliminary Sensitivity Assessment**

A walkover/drive-over field assessment of the ODWCS project area was conducted by Dianna Doucette, PAL Senior Archaeologist, on February 8, 2017 to examine and document the existing physical condition of the project area, to assess the integrity of the ground surface, to collect data about the current environmental setting, and to look for any surface indications of archaeological sites. A combination of variables affecting archaeological sensitivity, such as evidence of prior ground disturbance or the presence of favorable environmental attributes, was noted throughout the project area (see Table 2, above). The information collected during the walkover survey was used to refine the preliminary sensitivity assessment of the project area and to stratify the project impact areas into zones of high/moderate or low archaeological sensitivity (Figure 4).

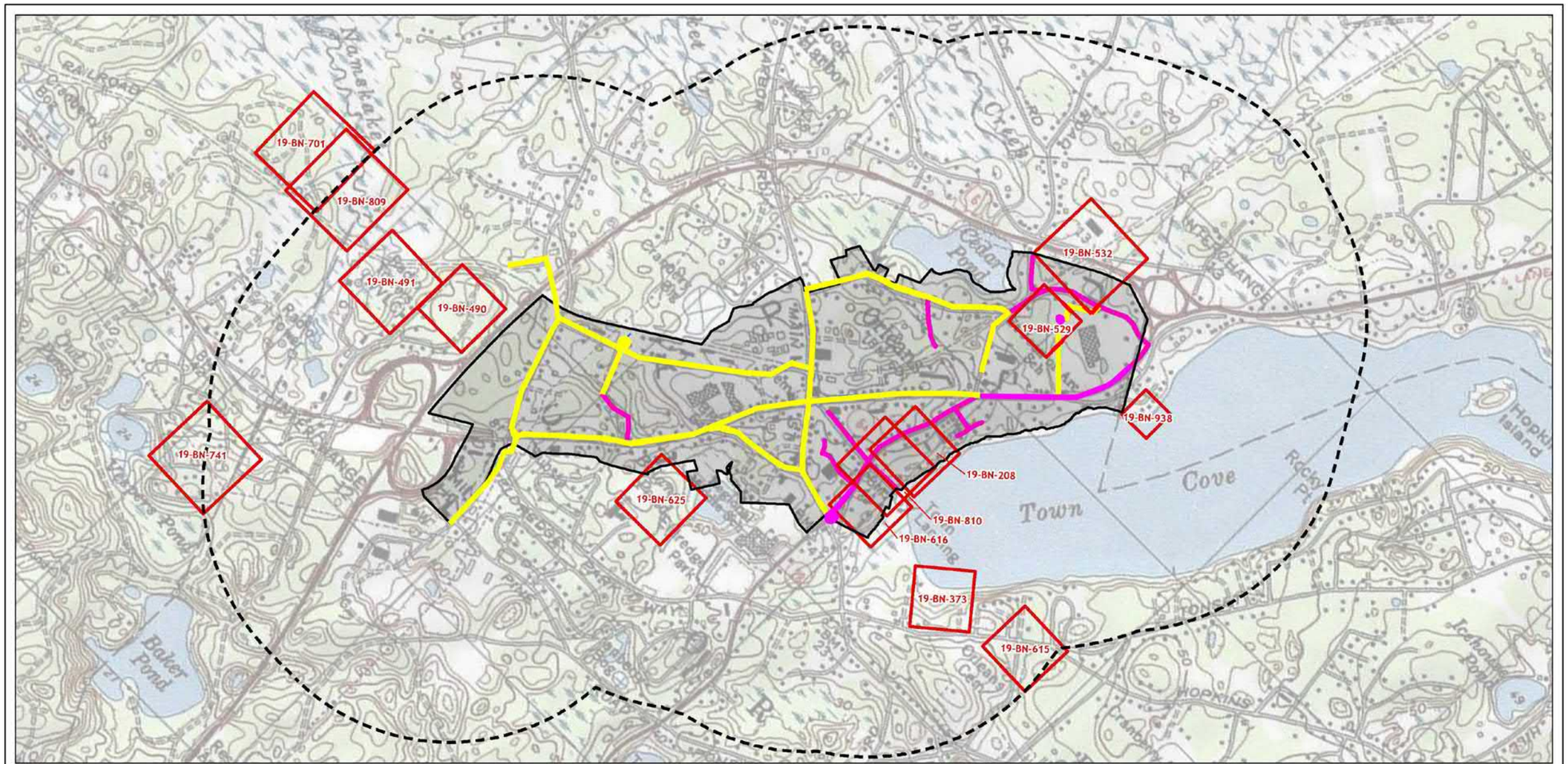


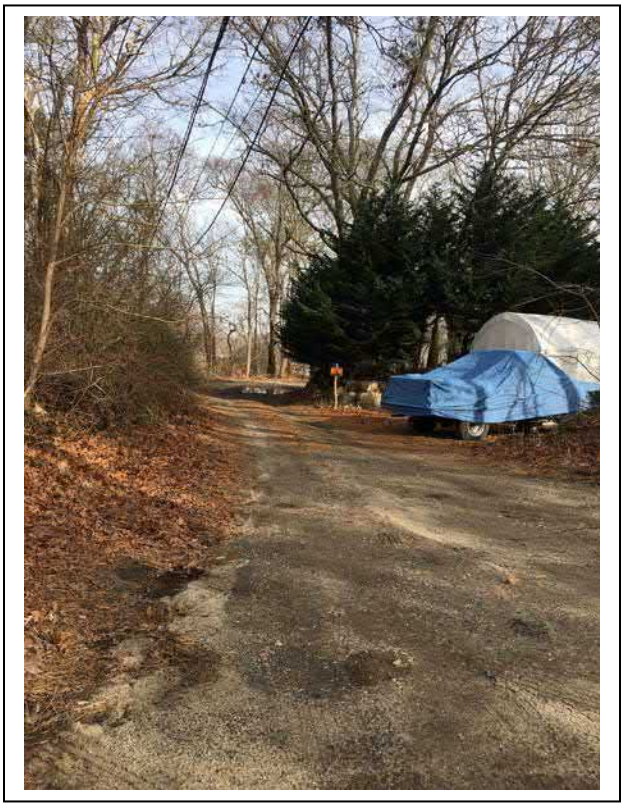

**Figure 4. Recorded archaeological sites within ½ mile and archaeological sensitivity in the Orleans Downtown Area Wastewater Collection System Project Area on the Harwich OE N and Orleans, Massachusetts USGS topographic quadrangles, 7.5 minute series.**

During the field assessment, all roads that will be impacted by the proposed sewer line construction were assessed as well as the three proposed pump station locations. Most of the project's impact areas are located within and below paved roads (Photographs 1, 2, and 3). Exceptions to this include a section of Old Tote Road (Photograph 4). Although the construction will occur primarily within and below the paved roads that have likely been previously disturbed by subsurface utilities, intact soils containing archaeological sites may exist below the pavement.

**Photograph 1. Representative paved road: West Street, view north from the Jail House Tavern.**

**Photograph 2. Old Colony Way at the intersection with Main Street, view east**.

**Photograph 3. Cottage Street, view southeast toward Town Cove**



**Photograph 4. Unpaved section of Old Tote Road, view south**

The three pump station areas are in open, grassy areas that appear to have been previously disturbed. Pump Station #1, on the north side of Old Colony Way, and directly across the street from Old Tote Road, is a flat, open field with three visible ventilation pipes along the edges of the parcel that may be indicative of underground septic utilities or a leaching field (Photograph 5). Soils in this area consist of well-drained Carver-Hinesburg loamy coarse sands that formed on glacial outwash plains.

**Photograph 5. Pump Station #1, Old Colony Way, view northwest.**

Pump Station #2, at the intersection of Chatham Road, Academy Place, and Main Street is an open, grassy park, also with well-drained Carver-Hinesburg loamy coarse sands (Photograph 6). The small triangular park contains three war memorials, as mentioned above, and background research also indicated that the Rock Harbor Academy, and then the Snow Library, were previously in this area. Pump Station #3 is located at the edge of the T.J. Max shopping plaza parking lot, on a grassy strip that consists of excessively drained Carver coarse sands (Photograph 7). This area contains an existing pump station and appears disturbed.

**Photograph 6. Pump Station #2, Academy Place, view north**.

**Photograph 7. Pump Station #3, view north.**

The field assessment focused on looking for any surface indications of archaeological sites, including but not limited to artifact scatters, stone foundations, dams, stone walls, and trash deposits. No evidence of archaeological sites was observed on the ground surface during the field assessment.

Areas of disturbance, such as sand pits or quarries, or areas of recognizable grading, were not visible during the field assessment to suggest that the soils beneath the roads have been displaced, however, it is likely that utilities in the Orleans downtown area, and landscaping and utilities in the new residential areas, created some disturbance.

**Results and Recommendations**

Results of the inventory file review and field assessment were used to develop a sensitivity ranking and predictive statements concerning the potential for the presence of Native American and EuroAmerican cultural resources. Native American archaeological sensitivity was determined by assessing key environmental attributes, the presence of documented cultural resources in and adjacent to the project area, and the degree of disturbance (see Table 2). Key environmental attributes are proximity to fresh or salt water, well-drained soils, and level topography. EuroAmerican archaeological sensitivity is determined by assessing information collected during the background research and walkover. Numerous large-scale surveys have determined that historic EuroAmerican sites are not directly correlated with specific environmental variables and that documentary information is not always accurate. As a result, documentary research used in conjunction with an evaluation of the physical condition of a project area and the presence of visible sites is the most useful approach to determining the sensitivity of a project area.

Information on belowground disturbance within the project area, including geotechnical data and soil boring logs, was also reviewed to help refine the sensitivity. Of the 103 soil boring logs reviewed, 96 (93.2 %) indicate intact soils beneath the pavement. Four of the borings (B-24, 25, 27, and 57) hit a water line, and three were precleared down to five-feet below the surface (B-47, 80, and 120).

Overall, portions of the ODWCS project area is archaeological sensitive for Native American sites dating to the Pre-Contact, Contact, and early Post-Contact periods (ca. 8000 to 300 B.P.) (see Figure 4). The archaeological sensitivity is defined primarily by the project area's physical location within sandy, well-drained soils adjacent to the shoreline and freshwater wetlands and by the presence of previously recorded archaeological sites and documented post-contact period land use. Archaeological evidence of pre-contact period Native American activity could include subsistence-related features such as hearths, food storage/disposal pits, living areas including post molds, lithic workshops, and diagnostic chipped and ground stone tool assemblages. Expected pre-contact site types would include base camps, or logistic field camps and foraging locations in proximity to these brooks where seasonally available (waterfowl, fish) resources could be assured, and burial sites.

The ODWCS project traverses previously designated areas containing recorded Native American camp sites and burial site/s along Town Cove, and has the potential to contain other unmarked burial features and/or pre-contact Native American archaeological sites. Any unmarked Late Woodland Period (ca. 1000 to 450 B.P.) burial features in the project area are likely to resemble those already

identified. The likelihood of Contact or early Post-Contact Period Native American sites along Town Cove is also high to moderate.
The section of Route 28, from Academy Place to where it intersects with Route 6A, the short residential connectors that lie closest to Town Landing (Cottage Street and Cove Road, and Cummings Road), the Route 6A loop around to Canal Road, Jones Road and Liberty Lane in the Cedar Pond area, the southern end of Old Tote Road, and Pump Station #1 and #2 parcels all have been assessed as having a preliminary high archeological sensitivity due to the proximity of recorded archaeological sites and general lack of development. The remaining areas to be impacted could contain sites due to their proximity to wetlands and/or previously recorded sites, however, based on a review of project plans showing existing underground utilities, these areas are assessed as having low archaeological sensitivity.

The EuroAmerican post-contact archaeological sensitivity for land use is moderate to low. The sewer lines run through some of the earliest established business areas and remnants of older buildings and businesses could be present under the present roadways. In addition, several historical markers suggest that eighteenth and possibly seventeenth century meeting places were located along Main Street, Route 6A, Chatham Road. However, much of Orleans consisted of pasture and agricultural land up until residential development began in the mid-twentieth century. Remnants of the Rock Harbor Academy meeting house may be present within the proposed pump station location in the village green at Academy Place Park.

The post-contact historic period sensitivity of the project area is moderate to low based on the historic nature of Orleans and the possibility of post-contact sites to be present under the current streets. Post-contact sites could include cellar holes and foundations related to early settlement patterns and subsistence related activities, and/or evidence of small-scale industrial activities.

**Recommendations**

The ODWCS project area is located adjacent to several archaeological sites that have yielded evidence of Native American activity spanning back to the Late Archaic Period. Although the ODWCS project includes the installation of new sewer lines under roads that have been previously disturbed by subsurface utilities, soil boring logs indicate there are l several roads that have only been graded and paved, but not otherwise disturbed by utility installations**. In these cases, the pavement acts as a preservation cap for sites. Because construction in these linear utility line areas will occur under and within paved roadways, where hand-testing is not possible, PAL recommends that an archaeologist monitor the construction in the high sensitivity areas. These may include areas between existing utilities.** The archaeological monitoring will be conducted under an archaeological permit issued by the State Archaeologist's office at the MHC and in compliance with M.G.L. c. 9, ss. 26-27 C (950 CMR 70). In addition, PAL recommends coordinating with the Mashpee Wampanoag and Wampanoag Tribe of Gay Head/Aquinnah (WTGH/A) Tribal Historic Preservation Officers (THPOs) regarding the proposed project schedule, so that a tribal cultural resource monitor can be present during the fieldwork portion of the project. The THPOs will also be consulted for information that may assist with the archaeological investigations. Informant interviews may also be conducted in order to gather more information about reported sites and/or cultural resources in the project vicinity.

The goal of the archaeological monitoring will be to ensure that if any significant archaeological resources, including human remains and/or burials, are exposed during the construction activities that

they are treated appropriately in accordance with the Massachusetts Unmarked Burial Law (M.G.L. c. 7 s. 38A; c. 9, ss. 26A & 27C; c. 38, s. 6; and c. 114, s. 17, as amended by Chapter 659 of the Acts of 1983, Chapter 386 of the Acts of 1989, and Chapter 140 of the Acts 2003). The monitoring will involve the close visual examination of exposed subsoils to identify any potential archaeological deposits and/or human remains that may be located within construction impact areas. Having a representative from the Mashpee Wampanoag Tribe on-site, as well as an experienced archaeologist, during the construction process to determine the significance of a soil anomaly or artifact/s immediately will enable the project proponent to move forward and avoid work stoppage situations.

Because potentially significant pre- and/or post-contact archaeological deposits could be present beneath the existing roadways and/or other paved areas that have been assigned low archaeological sensitivity, **PAL also recommends that the proponent develop a Post-Review Discoveries Plan, or, an Unanticipated Discoveries Plan (UDP), to formalize procedures guiding the discovery of any significant cultural resources and/or evidence of human remains during construction.** The Plan will be developed in consultation with the MHC, and in accordance with the Unmarked Burial Law, and would be designed to limit construction work stoppages by providing cultural resource training to construction personnel and streamlining notification and action plans for unanticipated discoveries, such as burials.

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**The Commonwealth of Massachusetts**
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

November 16, 2017

Thomas Parece
Town of Orleans
c/o AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559

RE: Downtown Area Orleans Sanitary Sewer Collection System Construction, Orleans, MA. MHC #RC.63369.

Dear Mr. Parece:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the Project Notification Form (PNF) and Cultural Resources Evaluation prepared and submitted by the PAL, Inc., received November 1, 2017, for the project referenced above.

Please submit scaled project plans showing existing and proposed conditions to the MHC for review and comment for each phase of the project. Plans should show wastewater treatment plant location(s), recharge areas, pump stations, equipment storage and materials staging areas and any cross-country sewer right-of-ways. The PNF indicates that the project requires federal permits or approvals. The MHC will continue to review the project pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) in consultation with the involved federal agencies.

Project planners should consider feasible design and locational considerations that meet the engineering requirements, while also seeking to avoid or minimize impacts to historic and archaeological properties. Proposed above-ground construction (e.g. pump stations) in historic areas should be designed to be compatible and sensitive to the historic characteristics of the surroundings. Design elements for new construction in historic areas should consider size, scale, massing, height and materials in developing the specifications, and also consider vegetative screening to minimize visual effects. Any proposed project aspects within the Old King's Highway Regional Historic District may require a Certificate of Appropriateness from the Old King's Highway Regional Historic District Commission.

Existing streets within the project impact areas include paved and/or graded gravel surfaces that contain multiple existing utilities, suggesting proposed project impact areas have been subject to previous disturbance associates with utility and road construction. However, undisturbed portions of project impact areas are archaeologically sensitive, and may contain artifacts, and subsurface soil deposits associated with ancient Native American and historical period occupation and land use in Orleans.

The MHC request the development and implementation of a written Post-Review Discoveries protocol, consistent with the Massachusetts Unmarked Burial Law (Massachusetts General Laws, Chapter 38, Section 6; Chapter 9, Section 26A and 27C; and, Chapter 7, Section 38A; all as amended). The draft protocol should be submitted to the MHC for review and comment.

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

The MHC also requests that archaeological monitoring be conducted by a professional archaeological consulting firm with previous experience on Cape Cod during construction. The program of archaeological monitoring will be conducted under a State Archaeologists Permit (950 CMR 70). Implementation of the protocol and program of archaeological monitoring will facilitate any future consultation that may be required to avoid, minimize or mitigate adverse effects to any significant archaeological resources, including unmarked human burials, identified during project construction.

The MHC looks forward to reviewing the information requested above and to continued consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), and Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 71) and/or MEPA (301 CMR 11). If you have questions or require additional information, please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Barbara Newman, USACOE-NED
Kate Atwood, USACOE-NED
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
DEP-SERO, BRP
Orleans Historical Commission
Deborah C. Cox, PAL, Attn: Dianna Doucette

# The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

July 25, 2018

Martin R. Donoghue
Town of Orleans
c/o AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559

RE: Downtown Area Orleans Sanitary Sewer Collection System Construction, Orleans, MA. MHC #RC.63369.

Dear Mr. Donoghue:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the archaeological report, *Archaeological Machine Monitoring, Orleans Downtown Area Wastewater Collection System, Main Street at Route 6A and Route 28, Orleans, Massachusetts*, submitted by the PAL, for the project referenced above.

Archaeological monitoring conducted by the PAL during trenching within Academy Place and Route 28, from the intersection of Main Street and Route 28 to the intersection of Route 28 and Cummings Road did not identify any archaeological artifacts, features or soil deposits. The MHC looks forward to reviewing the results of additional archaeological monitoring to be conducted within archaeologically sensitive project impact areas during future project phases.

The MHC also looks forward to receiving a copy of the final *Procedures Guiding the Discovery of Unanticipated Historic Properties and Human Remains: Post-Review Discoveries (36 CFR 800.13)* that incorporates the MHC's April 2, 2018 comments.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 70-71), and the Massachusetts Unmarked Burial Law (Massachusetts General Laws, Chapter 38, Section 6; Chapter 9, Section 26A and 27C; and, Chapter 7, Section 38A; all as amended). If you have questions or require additional information, please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Barbara Newman, USACOE-New England District
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Ramona Peters, Mashpee Wampanoag Tribe
Deborah C. Cox, PAL

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# The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

November 21, 2018

Secretary Matthew A. Beaton
Executive Office of Energy & Environmental Affairs
Attn: Page Czepiga, MEPA Unit
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: Comprehensive Wastewater Management Plan, Orleans, MA. MHC #RC.15015. **EEA #14414.**

Dear Secretary Beaton:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the Notice of Project Change (NPC) for the project referenced above. The proposed project change includes the new effluent disposal area at properties off Lot Hollows Road. The MHC is also reviewing aspects of the overall project, including new sewer lines and pump stations, as part of the Downtown Area Orleans Sanitary Sewer Collection System (MHC #RC.63369).

Scaled existing and proposed conditions project plans for each phase of the preferred project alternative should be submitted by the project proponent to the MHC for review and comment as they are developed. The MHC will consult regarding the need to conduct additional identification efforts within archaeologically sensitive project impact areas, and to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

MHC looks forward to reviewing the information requested above, and to continued consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 70-71), and MEPA (301 CMR 11). If you have any questions concerning this review, please contact Jonathan K. Patton, at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: George Meservey, Town of Orleans
Martin Donoghue, AECOM
Thomas Parece, AECOM
Steven McCurdy, DEP-BRP
Sara Korjeff, Cape Cod Commission
Orleans Conservation Commission
Orleans Historical Commission
Deborah C. Cox, PAL, Attn: Dianna Doucette

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April 4, 2019

# The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth

Massachusetts Historical Commission

Secretary Matthew A. Beaton
Executive Office of Energy & Environmental Affairs
Attn: Page Czepiga, MEPA Unit
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: Comprehensive Wastewater Management Plan, Orleans, MA. MHC #RC.15015. **EEA #14414.**

Dear Secretary Beaton:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the second Notice of Project Change (NPC), received March 21, 2019, for the project referenced above. The proposed project change includes the addition of aquaculture in Lonnie's Pond and the Permeable Barriers Demonstration (PBD) Project at Eldredge Park. The aquaculture and PBD project aspects have limited project impact areas that are unlikely to affect significant historic or archaeological resources.

The MHC looks forward to receiving scaled existing and proposed conditions project plans for each subsequent phase of the preferred project alternative as they are developed. The MHC will continue to consult regarding the need to conduct additional identification efforts within archaeologically sensitive project impact areas, and to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources. Project planners should continue to consider feasible design and locational considerations that meet the engineering requirements, while also seeking to avoid or minimize impacts to historic and archaeological properties.

The overall project presented in NPC Figures 1b and 1c includes traditional project aspects that include sub-surface ground impacts (sewer lines, pump stations and effluent disposal areas). The MHC continues to review the results of archaeological monitoring conducted for archaeologically sensitive portions of the Downtown Area Orleans Sanitary Sewer Collection System (MHC #RC.63369) within the overall project. A written Post-Review Discoveries protocol has been developed and implemented for the downtown project aspect. Implementation of the protocol and program of archaeological monitoring will facilitate any future consultation that may be required to avoid, minimize or mitigate adverse effects to any significant archaeological resources, including unmarked human burials, identified during project construction.

MHC looks forward to reviewing the information requested above, and to continued consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 70-71), and MEPA (301 CMR 11). If you have any questions concerning this review, please contact Jonathan K. Patton, at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: George Meservey, Town of Orleans
Jennifer Doyle-Breen, AECOM
Steven McCurdy, DEP-BRP
Sara Korjeff, Cape Cod Commission
Deborah C. Cox, PAL, Attn: Dianna Doucette

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AECOM
250 Apollo Drive
Chelmsford, MA 01824
www.aecom.com

978 905 2100 tel
978 905 2101 fax

May 7, 2019

Mr. Brona Simon, State Historic Preservation Officer
Executive Director and State Archaeologist
The Commomnwealth of Massachusets
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, Massachusetts 02125

**RE: Comprehensive Wastewater Management Plan**
**Orleans, MA. MHC #RC.15015**
**EEA #14414**
**Request for Information Response**

Dear Ms. Simon:

In accordance to your letter dated November 21, 2018, please find enclosed a set of the Downtown Area Collection System and Pumping Station, Contract No. 2019-02, SRF No. 4486 draft drawings for your review and comments.

If you have any questions, please contact this office.

Sincerely yours,

AECOM Technical Services, Inc.

Thomas Parece, P.E.
Asscoiate Vice President

cc: George Meservey, Town of Orleans
Steven McCurdy, DEP-BRP
Sara Korjeff, Cape Cod Commission
Orleans Conservation Commission
Orleans Historical Commission
Deborah C. Cox, PAL
Martin Donoghue, AECOM
Tess Laffer, AECOM

**Massachusetts Department of Environmental Protection**

**Comprehensive Management Plan Approval**

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Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

February 14, 2010

Mr. John Kelly, Town Administrator
Town Hall
19 School Road
Orleans, Massachusetts 02653

RE: ORLEANS – Comprehensive Wastewater Management Plan

Dear Mr. Kelly:

MassDEP has reviewed the Town of Orleans's Final Comprehensive Wastewater Management Plan and Single Environmental Impact Report (FCWMP/SEIR) dated December 2010. The Secretary of the Massachusetts Office of Energy and Environmental Affairs issued a certificate approving the SEIR on January 28, 2011. This certificate acknowledged review and comment by MassDEP. The document also received Cape Cod Commission approval as a Development of Regional Impact on October 13, 2011, a process in which MassDEP provided supporting testimony. While the above actions indicate MassDEP's significant review and implicit approval of the FCWMP/SEIR, please accept this letter as MassDEP's explicit and formal approval of the Town of Orlean's FCWMP/SEIR.

If you have any questions or require further information, please do not hesitate to contact me at (508)946-2814.

Very truly yours,

Brian A. Dudley
Bureau of Resource Protection

BAD/

This information is available in alternate format. Call Michelle Waters-Ekanem, Diversity Director, at 617-292-5751. TDD# 1-866-539-7622 or 1-617-574-6868
MassDEP Website: www.mass.gov/dep
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**Massachusetts Department of Environmental Protection**

**Site Assignment**

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Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

July 5, 2016

Mr. John Kelly, Town Administrator
Orleans Town Hall
19 School Road
Orleans, Massachusetts 02653

RE: ORLEANS – Site Assignment

Dear Mr. Kelly:

In response to your inquiry regarding the necessity of seeking a site assignment for the possible construction of a wastewater treatment facility on land currently occupied by the Tri-town septage treatment facility please note that Chapter 83, Section 6 states, in pertinent part that "[a] town, with the approval of the department of environmental protection, after a public hearing by said department of all parties interested, of which notice shall be given by publication in one or more newspapers, *may purchase land within its limits, or take the same by eminent domain* under chapter seventy-nine, for the treatment, purification and disposal of sewage." (emphasis supplied).

Since the Town of Orleans already owns the land and is not purchasing land or taking land by eminent domain for sewage treatment purposes, no DEP site assignment hearing and approval is required.

If you have any questions or require additional information, please feel free to contact me at (508)946-2814.

Very truly yours,

Brian A. Dudley, Section Chief
Wastewater Management – Cape and Islands

This information is available in alternate format. Call Michelle Waters-Ekanem, Diversity Director, at 617-292-5751. TTY# MassRelay Service 1-800-439-2370
MassDEP Website: www.mass.gov/dep

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ecc: George Meservey, Town Planner

DEP/SERO
Attn: Shaun Walsh

**Orleans, MA - Conservation Commission**

**Determination of Applicability**

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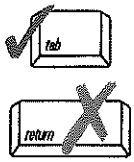
**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands

# WPA Form 2 – Determination of Applicability

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40
Town of Orleans Wetland By-Law Chapter 160

## A. General Information

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.




From:

TOWN OF ORLEANS
Conservation Commission

To: Applicant

John Kelly, Orleans Town Administrator
Name

19 School Rd.
Mailing Address

Orleans | MA | 02653
City/Town | State | Zip Code

Property Owner (if different from applicant):

Town of Orleans
Name

Mailing Address

City/Town | State | Zip Code

1. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

| Title | Date |
|---|---|
| WWTF Site: Road Milling, Repaving, and Fencing Installation | August 2019 |
| | |
| | |

2. Date Request Filed:

8/29/19

## B. Determination

Pursuant to the authority of M.G.L. c. 131, § 40, the Conservation Commission considered your Request for Determination of Applicability, with its supporting documentation, and made the following Determination.

Project Description (if applicable):

The proposed installation of a fence and grading and paving of existing roadway. Work will occur within 100' to Land Subject to Coastal Storm Flowage.

Project Location:

| | |
|---|---|
| 20 Overland Way<br>Street Address | Orleans<br>City/Town |
| 39<br>Assessors Map/Plat Number | 6<br>Parcel/Lot Number |

## B. Determination (cont.)

The following Determination(s) is/are applicable to the proposed site and/or project relative to the Wetlands Protection Act and regulations:

Positive Determination
Note: No work within the jurisdiction of the Wetlands Protection Act may proceed until a final Order of Conditions (issued following submittal of a Notice of Intent or Abbreviated Notice of Intent) or Order of Resource Area Delineation (issued following submittal of Simplified Review ANRAD) has been received from the issuing authority (i.e., Conservation Commission or the Department of Environmental Protection).

☐ 1. The area described on the referenced plan(s) is an area subject to protection under the Act. Removing, filling, dredging, or altering of the area requires the filing of a Notice of Intent.

☐ 2a. The boundary delineations of the following resource areas described on the referenced plan(s) are confirmed as accurate. Therefore, the resource area boundaries confirmed in this Determination are binding as to all decisions rendered pursuant to the Wetlands Protection Act and its regulations regarding such boundaries for as long as this Determination is valid.

☐ 2b. The boundaries of resource areas listed below are not confirmed by this Determination, regardless of whether such boundaries are contained on the plans attached to this Determination or to the Request for Determination.

☐ 3. The work described on referenced plan(s) and document(s) is within an area subject to protection under the Act and will remove, fill, dredge, or alter that area. Therefore, said work requires the filing of a Notice of Intent.

☐ 4. The work described on referenced plan(s) and document(s) is within the Buffer Zone and will alter an Area subject to protection under the Act. Therefore, said work requires the filing of a Notice of Intent or ANRAD Simplified Review (if work is limited to the Buffer Zone).

☐ 5. The area and/or work described on referenced plan(s) and document(s) is subject to review and approval by:

Name of Municipality

Pursuant to the following municipal wetland ordinance or bylaw:

Name | Ordinance or Bylaw Citation

## B. Determination (cont.)

☐ 6. The following area and/or work, if any, is subject to a municipal ordinance or bylaw but not subject to the Massachusetts Wetlands Protection Act:

☐ 7. If a Notice of Intent is filed for the work in the Riverfront Area described on referenced plan(s) and document(s), which includes all or part of the work described in the Request, the applicant must consider the following alternatives. (Refer to the wetland regulations at 10.58(4)c. for more information about the scope of alternatives requirements):

- ☐ Alternatives limited to the lot on which the project is located.
- ☐ Alternatives limited to the lot on which the project is located, the subdivided lots, and any adjacent lots formerly or presently owned by the same owner.
- ☐ Alternatives limited to the original parcel on which the project is located, the subdivided parcels, any adjacent parcels, and any other land which can reasonably be obtained within the municipality.
- ☐ Alternatives extend to any sites which can reasonably be obtained within the appropriate region of the state.

**Negative Determination**

Note: No further action under the Wetlands Protection Act is required by the applicant. However, if the Department is requested to issue a Superseding Determination of Applicability, work may not proceed on this project unless the Department fails to act on such request within 35 days of the date the request is post-marked for certified mail or hand delivered to the Department. Work may then proceed at the owner's risk only upon notice to the Department and to the Conservation Commission. Requirements for requests for Superseding Determinations are listed at the end of this document.

☐ 1. The area described in the Request is not an area subject to protection under the Act or the Buffer Zone.

☐ 2. The work described in the Request is within an area subject to protection under the Act, but will not remove, fill, dredge, or alter that area. Therefore, said work does not require the filing of a Notice of Intent.

☒ 3. The work described in the Request is within the Buffer Zone, as defined in the regulations, but will not alter an Area subject to protection under the Act. Therefore, said work does not require the filing of a Notice of Intent, subject to the following conditions (if any).

☐ 4. The work described in the Request is not within an Area subject to protection under the Act (including the Buffer Zone). Therefore, said work does not require the filing of a Notice of Intent, unless and until said work alters an Area subject to protection under the Act.

## B. Determination (cont.)

☐ 5. The area described in the Request is subject to protection under the Act. Since the work described therein meets the requirements for the following exemption, as specified in the Act and the regulations, no Notice of Intent is required:

Exempt Activity (site applicable statuatory/regulatory provisions)

☐ 6. The area and/or work described in the Request is not subject to review and approval by:

Name of Municipality

Pursuant to a municipal wetlands ordinance or bylaw.

Name

Ordinance or Bylaw Citation

## C. Authorization

This Determination is issued to the applicant and delivered as follows:

☒ by hand delivery on 9/18/19
Date

☐ by certified mail, return receipt requested on
Date

This Determination is valid for **three years** from the date of issuance (except Determinations for Vegetation Management Plans which are valid for the duration of the Plan). This Determination does not relieve the applicant from complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

This Determination must be signed by a majority of the Conservation Commission. A copy must be sent to the appropriate DEP Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/) and the property owner (if different from the applicant).

Signatures:

9/17/19
Date

## D. Appeals

The applicant, owner, any person aggrieved by this Determination, any owner of land abutting the land upon which the proposed work is to be done, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate Department of Environmental Protection Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/) to issue a Superseding Determination of Applicability. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and Fee Transmittal Form (see Request for Departmental Action Fee Transmittal Form) as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Determination. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant if he/she is not the appellant. The request shall state clearly and concisely the objections to the Determination which is being appealed. To the extent that the Determination is based on a municipal ordinance or bylaw and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.

# Request for Determination Of Applicability

RECEIVED
AUG 29 2019
ORLEANS CONSERVATION COMM.

## Wastewater Treatment Facility (WWTF) Site: *Road Milling, Repaving, and Fencing Installation*

**Orleans, Massachusetts**

Submitted To:

**Orleans Conservation Commission**

**Massachusetts Department of Environmental Protection – Southeast Region**

PLANS APPROVED by ORLEANS CONSERVATION COMMISSION
FILE #
BY
DATE 9/17/19
ENGINEER

Prepared For:
**Town of Orleans**

Prepared by:
AECOM

**August 2019**

AECOM
250 Apollo Drive
Chelmsford, MA 01824
aecom.com

August 28, 2019

John Jannell, Conservation
Administrator
Town of Orleans Conservation
Commission
Orleans Town Hall
19 School Road
Orleans, MA 02653

Re: Request for Determination of Applicability
Wastewater Treatment Facility at 20 Overland Way

Dear Mr. Jannell:

On behalf of our client, the Town of Orleans, AECOM respectfully submits the enclosed Request for Determination of Applicability (RDA) for the new Wastewater Treatment Facility and associated site work. Enclosed please find two copies of the RDA, as well as 11 copies of the narrative and associated figure.

The enclosed RDA describes the proposed work at the WWTF site on 20 Overland Way. Proposed activities include: the construction of the new treatment plant and associated buildings; milling and repaving of various access roadways including portions of Overland Way and Oak Ridge Lane; installation of stormwater treatment Best Management Practices (BMPs), consisting of a vegetated filter strip that will discharge to an infiltration basin, with an overflow to an existing pipe underneath Overland Way; pavement and parking areas; installation of a motorized gate and new chain link fence sections; fence removal and repair; WWTF yard piping and sewer mains; and paving, grading, and installation of the proposed effluent disposal system components off of Lots Hollow Road.

All of the proposed WWTF construction activities are located outside of areas subject to jurisdiction except for the milling and repaving of an existing access road, installation of a portion of new fencing, and removal of existing fencing within the Buffer Zone; and installation of a portion of a new proposed fence in Land Subject to Coastal Storm Flowage (LSCSF).

We look forward to discussing the project with the Conservation Commission members at the hearing on September 17th. If there are any questions or additional information needs prior to the site visit and hearing, please feel free to contact me at (978) 905-2968 or Jennifer.Doyle-Breen@AECOM.com.
Yours sincerely,

Jennifer Doyle-Breen
Associate Vice President
AECOM
T: 9789052968
E: jennifer.doyle-breen@aecom.com

Enclosure
cc: John Kelly, Town of Orleans
Thomas Parece, AECOM
Reggie Donoghue, AECOM

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands

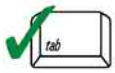
Orleans
City/Town

# WPA Form 1- Request for Determination of Applicability

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

## A. General Information

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



1. Applicant:

John Kelly (Orleans Town Administrator) — Name
jkelly@town.orleans.ma.us — E-Mail Address
19 School Road — Mailing Address
Orleans — City/Town
MA — State
02653 — Zip Code
(508) 240-3700 Ext. 415 — Phone Number
Fax Number (if applicable)

2. Representative (if any):

AECOM — Firm
Jennifer Doyle-Breen — Contact Name
Jennifer.Doyle-Breen@aecom.com — E-Mail Address
250 Apollo Drive — Mailing Address
Chelmsford — City/Town
MA — State
01824 — Zip Code
978-905-2968 — Phone Number
978-905-2101 — Fax Number (if applicable)

## B. Determinations

1. I request the Orleans (Conservation Commission) make the following determination(s). Check any that apply:

☐ a. whether the **area** depicted on plan(s) and/or map(s) referenced below is an area subject to jurisdiction of the Wetlands Protection Act.

☐ b. whether the **boundaries** of resource area(s) depicted on plan(s) and/or map(s) referenced below are accurately delineated.

☒ c. whether the **work** depicted on plan(s) referenced below is subject to the Wetlands Protection Act.

☒ d. whether the area and/or work depicted on plan(s) referenced below is subject to the jurisdiction of any **municipal wetlands ordinance** or **bylaw** of:

Orleans
Name of Municipality

☐ e. whether the following **scope of alternatives** is adequate for work in the Riverfront Area as depicted on referenced plan(s).

## C. Project Description

1. a. Project Location (use maps and plans to identify the location of the area subject to this request):

| | |
|---|---|
| 20 Overland Way | Orleans |
| Street Address | City/Town |
| Map 39 | Parcel 6 |
| Assessors Map/Plat Number | Parcel/Lot Number |

b. Area Description (use additional paper, if necessary):

The proposed project site is the site of the former Tri-Town Septage Treatment Facility located in Orleans, Massachusetts. The site is located east of Route 6 and south of the Cape Cod Rail Trail at 20 Overland Way. The site currently consists of a paved access road (Overland Way), disturbed soils from recent demolition of the septage treatment facility, and forested areas around the periphery of the site. A wooded deciduous swamp, NHESP Estimated Habitat of Rare Wildlife, NHESP Priority Habitat of Rare Species, and the Inner Cape Cod Bay Area of Critical Environmental Concern (ACEC) are located to the west of the site. No portion of the project is located within these sensitive areas. However, a portion of the western edge of the site is located within the Buffer Zone to the wooded deciduous swamp located nearby and a small portion of Land Subject to Coastal Storm Flowage (LSCSF). Please see the project description in Attachment A and the Environmental Constraints map in Attachment B.

c. Plan and/or Map Reference(s):

| | |
|---|---|
| Please see Environmental Constraints figure in Attachment B | August 2019 |
| Title | Date |
| | |
| Title | Date |
| | |
| Title | Date |

2. a. Work Description (use additional paper and/or provide plan(s) of work, if necessary):

The proposed work involves the construction of a new Wastewater Treatment Facility and its appurtenant structures. However, the only work located within an area subject to jurisdiction includes the milling and repaving of an existing access road, installation of a portion of new fencing, and removal of existing fencing within the Buffer Zone; and installation of a portion of a new proposed fence in Land Subject to Coastal Storm Flowage. Please see Attachment A for further details.

## C. Project Description (cont.)

b. Identify provisions of the Wetlands Protection Act or regulations which may exempt the applicant from having to file a Notice of Intent for all or part of the described work (use additional paper, if necessary).

Under 310 CMR 10.02(2)(b)1.p., "pavement repair, resurfacing, and reclamation of existing roadways within the right-of-way configuration provided that the roadway and shoulders are not widened" constitutes a minor activity in the Buffer Zone that is "not otherwise subject to regulation under M.G.L. c. 131, § 40". Please see Attachment A for further details regarding other elements of work within jurisdictional areas.

3. a. If this application is a Request for Determination of Scope of Alternatives for work in the Riverfront Area, indicate the one classification below that best describes the project.

☐ Single family house on a lot recorded on or before 8/1/96

☐ Single family house on a lot recorded after 8/1/96

☐ Expansion of an existing structure on a lot recorded after 8/1/96

☐ Project, other than a single family house or public project, where the applicant owned the lot before 8/7/96

☐ New agriculture or aquaculture project

☐ Public project where funds were appropriated prior to 8/7/96

☐ Project on a lot shown on an approved, definitive subdivision plan where there is a recorded deed restriction limiting total alteration of the Riverfront Area for the entire subdivision

☐ Residential subdivision; institutional, industrial, or commercial project

☐ Municipal project

☐ District, county, state, or federal government project

☐ Project required to evaluate off-site alternatives in more than one municipality in an Environmental Impact Report under MEPA or in an alternatives analysis pursuant to an application for a 404 permit from the U.S. Army Corps of Engineers or 401 Water Quality Certification from the Department of Environmental Protection.

b. Provide evidence (e.g., record of date subdivision lot was recorded) supporting the classification above (use additional paper and/or attach appropriate documents, if necessary.)

## D. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Request for Determination of Applicability and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge.

I further certify that the property owner, if different from the applicant, and the appropriate DEP Regional Office were sent a complete copy of this Request (including all appropriate documentation) simultaneously with the submittal of this Request to the Conservation Commission.

Failure by the applicant to send copies in a timely manner may result in dismissal of the Request for Determination of Applicability.

Name and address of the property owner:

John Kelly (Orleans Town Administrator)
Name

19 School Road
Mailing Address

Orleans
City/Town

MA
State

02653
Zip Code

Signatures:

I also understand that notification of this Request will be placed in a local newspaper at my expense in accordance with Section 10.05(3)(b)(1) of the Wetlands Protection Act regulations.

J. Kelly
Signature of Applicant

8/28/19
Date

Signature of Representative (if any)

August 28, 2019
Date

# ATTACHMENT A

# PROPOSED PROJECT NARRATIVE

## ATTACHMENT A: PROPOSED PROJECT NARRATIVE

### INTRODUCTION

Excess nitrogen in the groundwater is impairing the water quality in coastal waters and estuaries in the town of Orleans, Massachusetts. Because of this, a comprehensive wastewater management plan (CWMP) was prepared and approved in 2011, which recommended sewer installation in approximately 60 percent of Orleans over 20 years. However, funding for the recommended plan failed to be appropriated twice at Town Meeting, leading to the development of a "hybrid" approach that incorporates both traditional and non-traditional technologies to remove the same amount of nitrogen as identified in the CWMP. Implementation of a "hybrid" approach under the Cape Cod 208 Water Quality Plan was approved by both EPA and the Massachusetts Department of Environmental Protection. Various non-traditional technologies were studied and piloted. Permeable reactive barriers (PRBs) were identified as a cost-effective and reliable alternative. Thus, the current design for the overall project includes a collection system, wastewater treatment facility, effluent disposal site, and demonstration project placements for PRBs. In addition, an aquaculture facility is currently operating at Lonnie's Pond as a component of the Town's overall approach to nitrogen removal and was separately reviewed by the Conservation Commission.

The proposed new sewer system will consist of two construction phases that each covers a different area of Orleans: Phase I includes the Downtown Area, and Phase II includes the Meetinghouse Pond Area. This project design reduced the CWMP-proposed collection system area from approximately 60 percent of the town and average daily flow (ADF) of 650,000 gpd (2.46 ML/d) to about 24 percent and ADF of 350,000 gpd (1.32 ML/d).

Phase I consists of the following: construction of a combination of gravity sewers and low-pressure sewers to service the Downtown Area; construction of a Wastewater Treatment Facility (WWTF); and installation of the effluent disposal system. The WWTF is proposed to be constructed at the former Tri-Town Septage Treatment Facility on Overland Way; this facility has been demolished as of April 2019. Phase II is the construction of a combination of gravity sewers and low-pressure sewers to service the Meetinghouse Pond area.

This Request for Determination of Applicability (RDA) is being submitted for the Phase I portion of the project that involves the construction of the WWTF within jurisdictional areas as protected under the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40) and its implementing regulations at 310 CMR 10.00, the Orleans Wetlands Protection Bylaw (Chapter 160), and the Town of Orleans Wetlands Regulations 196A.

Construction activities include: the construction of the new treatment plant and associated buildings, milling and repaving of various access roadways including portions of Overland Way and Oak Ridge Lane, associated grading around the treatment plant, including a vegetated filter strip that will discharge to a proposed stormwater infiltration basin, with an overflow that will discharge to an existing pipe underneath Overland Way, associated WWTF pavement and parking areas, installation of a motorized gate and new chain link fence sections, removal of an existing section of chain link fence, repair of sections of existing fencing, installation of associated yard piping and sewer mains, and paving, grading, and installation of the proposed effluent disposal system components off of Lots Hollow Road.

All of the proposed WWTF construction activities are located outside of areas subject to jurisdiction with the exception of the milling and repaving of an existing access road, installation of a portion of new fencing, and removal of existing fencing within the Buffer Zone; and installation of a portion of a new proposed fence in Land Subject to Coastal Storm Flowage (LSCSF) (Attachment B, Figure 2).

Other Phase 1 project components as well as Phase 2 and potentially PRB installations will be addressed as necessary with additional permit application submittals. Additional details of the subject of this RDA are provided below.

## DESCRIPTION OF THE PROJECT AREA

The proposed project site is the former Tri-Town Septage Treatment Facility located in Orleans, Massachusetts. The site is located east of Route 6 and south of the Cape Cod Rail Trail at 20 Overland Way (Attachment B, Figure 1). The site currently consists of a paved access road (Overland Way), disturbed soils from recent demolition of the septage treatment facility, and forested areas around the periphery of the site. A wooded deciduous swamp, NHESP Estimated Habitat of Rare Wildlife, NHESP Priority Habitat of Rare Species, and the Inner Cape Cod Bay Area of Critical Environmental Concern (ACEC) are located to the west of the site. No portion of the project is located within these sensitive areas, although NHESP Priority Habitat is located along a portion of the western shoulder of Overland Way. A portion of the western edge of the site is located within the Buffer Zone to the wooded deciduous swamp to the west and a small portion of Land Subject to Coastal Storm Flowage (LSCSF) (Attachment B, Figure 2).

## PROPOSED PROJECT ACTIVITIES AND IMPACTS

As indicated above, a small portion of the project activities will be located within areas subject to jurisdiction.

These include:

- Milling and repaving of an existing access road in the Buffer Zone
- Installation of a portion of new fencing in the Buffer Zone
- Removal of existing fencing within the Buffer Zone
- Installation of a portion of a new proposed fence in Land Subject to Coastal Storm Flowage (LSCSF)

**Milling and repaving of an existing access road in the Buffer Zone**

Milling and repaving would occur within approximately 320 square feet of the 0-25-foot Buffer Zone, 3,215 square feet of the 25-50-foot Buffer Zone, and 4,050 square feet of the 50-100 foot Buffer Zone (a total of approximately 7,585 square feet). However, this repaving would be occurring over an existing paved roadway with no increase in the width of the existing pavement. In addition, actual pavement width will be reduced in the vicinity of the proposed motorized gate located to the north of the Buffer Zone area, reducing the total amount of impervious surface associated with Overland Way in this portion of the project site.

**Installation of a portion of new fencing in the Buffer Zone**

Approximately 215 linear feet of chain link fencing will be installed within the 50-100-foot Buffer Zone along the southwestern corner of the site and paralleling the eastern shoulder of Overland Way as it continues northward to the location of the proposed motorized gate. Selective removal of woody vegetation may be required to install this section of fencing, but only to the minimum extent necessary.

**Removal of existing fencing within the Buffer Zone**

The project will also include the removal of a portion of existing fence along the southern portion of the site. A small portion of the fence removal (approximately 20 linear feet) would be located within the 50-100-foot Buffer Zone.

**Installation of a portion of a new proposed fence in Land Subject to Coastal Storm Flowage (LSCSF)**

A section of fencing will run from the western end of the proposed motorized gate, westward to an existing fence that surrounds the site. A portion of this new section (approximately 70 linear feet) will be

located within an area mapped as FEMA 100-year floodplain (LSCSF). Selective removal of woody vegetation may be required to install this section of fencing, but only to the minimum extent necessary.

The Massachusetts Wetlands Protection Act (MA WPA; Chapter 131, Section 40) states: "*No person shall remove, fill, dredge or alter any bank, riverfront area, fresh water wetland, coastal wetland, beach, dune, flat, marsh, meadow or swamp bordering on the ocean or on any estuary, creek, river, stream, pond, or lake, or any land under said waters or any land subject to tidal action, coastal storm flowage, or flooding, other than in the course of maintaining, repairing or replacing, but not substantially changing or enlarging, an existing and lawfully located structure or facility used in the service of the public and used to provide electric, gas, water, telephone, telegraph and other telecommunication services, without filing written notice of his intention to so remove, fill, dredge or alter, including such plans as may be necessary to describe such proposed activity and its effect on the environment and without receiving and complying with an order of conditions and provided all appeal periods have elapsed* ".

This section of the MA WPA does not mention activities in Buffer Zones, but does mention LSCSF, of which a small section of fencing will be installed. There are no defined performance standards in the MA WPA Regulations for LSCSF. However, the installation of chain link fencing will not negatively impact the flood storage capacity of this area or other interests of the MA WPA as they pertain to LSCSF.

However, the Town of Orleans Wetlands Regulations 196A does regulate LSCSF at § 196A-9A. The installation of a short (approximately 70 linear foot) section of chain link fence is not anticipated to adversely affect the performance standards by causing or contributing to the likelihood of the following under the Town of Orleans Wetlands Regulations:

(1) Reduction in the ability of the land to absorb and contain waters.
(2) Reduction in the ability of the land to buffer more inland areas from flooding and wave damage.
(3) Displacement or diversion of flood waters to other areas.
(4) Damage to other structures or property.
(5) Pollution of groundwater, surface water, or salt water.
(6) Reduction of an area's capacity to provide for wildlife.
(7) An increase in the elevation or velocity of flood waters.
(8) Prevention of the migration of resource areas such as salt marshes due to sea level rise.

Therefore, the propose fence installation in LSCSF is not anticipated to result in an alteration of the interests identified for this resource area.

For the proposed activities within the Buffer Zone, the MA WPA Regulations indicates: "*Any activity other than minor activities identified in 310 CMR 10.02(2)(b)2. proposed or undertaken within 100 feet of an area specified in 310 CMR 10.02(1)(a) (hereinafter called the Buffer Zone) which, in the judgment of the issuing authority, will alter an Area Subject to Protection under M.G.L. c. 131, § 40 is subject to regulation under M.G.L. c. f a Notice of Intent.*". Activities for this project within the Buffer Zone include repaving of an existing roadway (Overland Way) with no widening of the roadway and the installation and removal of sections of chain link fencing.

Under 310 CMR 10.02(2)(b)1.p., "*pavement repair, resurfacing, and reclamation of existing roadways within the right-of-way configuration provided that the roadway and shoulders are not widened*" constitutes a minor activity in the Buffer Zone that is "*not otherwise subject to regulation under M.G.L. c. 131, § 40 provided that the work is performed: solely within the buffer zone, as prescribed in 310 CMR 10.02(2)(b)2.a. through q., in a manner so as to reduce the potential for any adverse impacts to the resource area during construction, and with post-construction measures implemented to stabilize any disturbed areas.*" Therefore, the milling and repaving within the Buffer Zone is not regulated under the MA WPA.

The installation of chain link fencing within the Buffer Zone may require the selective removal of woody vegetation, but only to the minimum extent necessary. Given the linear nature of this activity and narrow clearance for the installation of fencing, it is anticipated that fence installation will not result in detrimental impacts to the Buffer Zone present in these locations.

The Town of Orleans Wetlands Regulations 196A regulates Buffer zone and buffer strips at § 196A-7. As discussed above, the portion of repaving work within the Buffer Zone will be located within existing paved roadway. However, repaving activities will not result in an alteration of the existing Buffer Zone nor detrimental impacts to the values protected by the Orleans Wetlands Protection Bylaw and therefore do not appear to be subject to regulation under 196A. The installation of proposed fencing and potential selective removal of woody vegetation within the Buffer Zone would only occur in the outer 50-100-foot portion of the Buffer Zone.

It is anticipated that these activities (the subject of this RDA) would be viewed as not regulated and/or would not result in an alteration to a jurisdictional area as protected under the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40) and its implementing regulations at 310 CMR 10.00, the Orleans Wetlands Protection Bylaw (Chapter 160), and the Town of Orleans Wetlands Regulations 196A.

## PROJECT IMPACT MINIMIZATION AND MITIGATION MEASURES

Sitewide general construction safety procedures would be followed to minimize the potential for spills, releases, or other environmental damage. During construction, work locations would be secured to prevent unauthorized entry and supplemental signs and construction barriers would be used as necessary to provide safety to construction workers during the WWTF construction in accordance with OSHA and other applicable regulations.

All contractors will prepare a spill prevention plan that includes requirements to have absorbent pads and equipment on hand in the event of an accidental release of petroleum products. In addition, to the extent feasible, equipment should use non-petroleum lubricants and fuels. Equipment will be refueled outside of any wetland resource area or Buffer Zone and conducted with a pumped system and spill containment on hand. A spills contingency plan addressing prevention and management of potential releases of oil and/or hazardous materials from pre- and post-construction activities should be presented to workers at the site and enforced. The plan should include, but not be limited to, refueling of machinery, storage of fuels, and potential future on-site activity releases.

Construction activities will conform to current Air Pollution Control Regulations. Measures will be implemented to alleviate dust, noise, and odor nuisance conditions that may occur during the proposed activities. Such measures will comply with the MassDEP's Bureau of Waste Prevention Regulations 310 CMR 7.01, 7.09, and 7.10.

The construction-period impacts of diesel emissions will be mitigated to the maximum extent feasible. All non-road engines will be operated using only ultra-low sulfur diesel (ULSD) with a sulfur content of ≤15 ppm pursuant to 40 CFR 80.510.

Waste material, debris, and trash would be cleaned from the work site at the end of each day and placed in trash barrels and/or dumpsters. Dumping of spoil material, waste, or other debris into wetland resource areas and/or buffer zones will be prohibited.

Erosion and sedimentation control will be maintained throughout the site as necessary to minimize the potential for sediment and erosion impacts to adjacent resource areas. Erosion control (such as straw wattles, compost filter tubes, or other erosion control system as acceptable to the Orleans Conservation Commission) will be installed as shown in Attachment B, Figure 2 to protect the sensitive receptors and

Buffer Zones located to the west of Overland Way.  The limits of erosion control shown in these areas represents the minimum erosion control that will be used.

As components of the overall WWTF project, construction of the elements that are the subject of this RDA will contribute to the overall goals of the CWMP in helping to reduce excess nitrogen in the groundwater and improvement of water quality in coastal waters and estuaries in the town of Orleans.

# Attachment B

## Locus Map

## and

## Environmental Constraints Map

**FIGURE 1.**

**Wastewater Treatment Facility (WWTF) Site:**
**Road Milling, Repaving, and New Gate Installation**

**Locus Map**

**Orleans, MA**

0 250 500 1,000 1,500 2,000 Feet

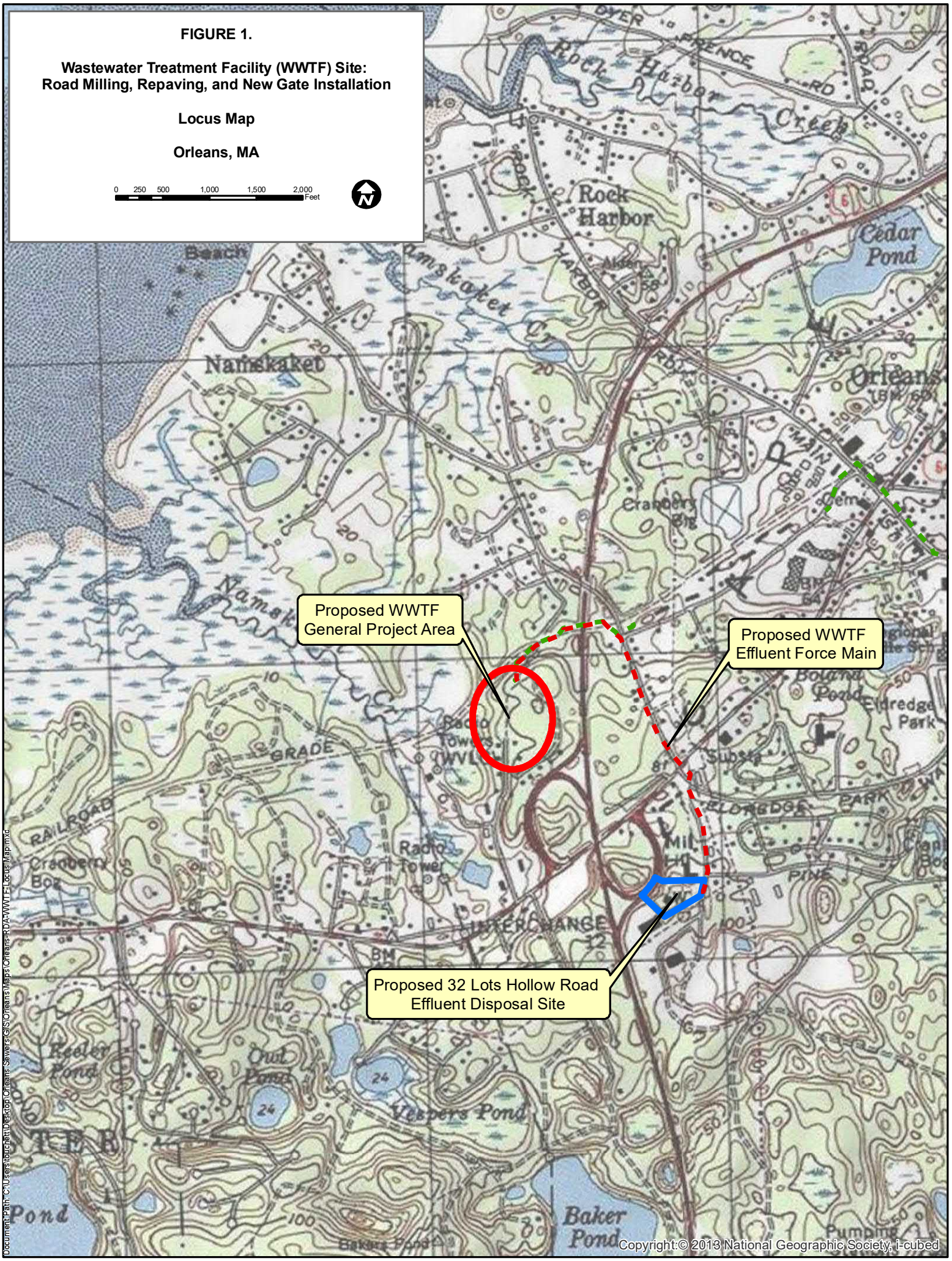



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**FIGURE 2.**

**Wastewater Treatment Facility (WWTF) Site:**
**Road Milling, Repaving, and New Gate Installation**

**Environmental Constraints**

**Orleans, MA**

*August 2019*

0 25 50 100 150 200 Feet

N

Location of proposed fence repair

Approximate location of stormwater infiltration basin overflow discharge pipe end

Proposed stormwater infiltration basin overflow to existing pipe inlet

Proposed stormwater infiltration basin

Location of proposed fence repair

Proposed WWTF Buildings

Proposed new pavement

Area to be repaved

Proposed new fencing

Proposed motorized gate

Existing segment of fencing to be removed

Proposed new fencing

Area to be repaved

## Legend

- Proposed Erosion Control
- Wetland Boundary
- 25-Foot Buffer Zone
- 50-Foot Buffer Zone
- 100-Foot Buffer Zone
- Removal of Existing Fence
- PS Forcemain
- WWTF Effluent Forcemain
- Proposed Fencing
- Proposed Motorized Gate
- Proposed WWTF Buildings
- Fencing Repair Areas
- Proposed Extent of Repaving
- Proposed WWTF Contours
- ACEC
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species

**FEMA-NFHL**

**Flood Zone Designations**

- AE: 1% Annual Chance of Flooding, with BFE

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**FIGURE 3.**

**Lots Hollow Road Disposal Facility**

**Environmental Constraints**

**Orleans, MA**

*August 2019*

0 50 100 200 300 400 Feet

Pump Station Force Main

Proposed WWTF Site

Proposed WWTF Effluent Force Main

Proposed 32 Lots Hollow Road Effluent Disposal Site

**Legend**

- 32 Lots Hollow Road
- Removal of Existing Fence
- PS Forcemain
- WWTF Effluent Forcemain
- Proposed Fencing
- Proposed WWTF Buildings
- Fencing Repair Areas
- Proposed Extent of Repaving
- Proposed WWTF Contours

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**Old King's Highway Regional Historic District Committee**

**Certificate of Appropriateness**

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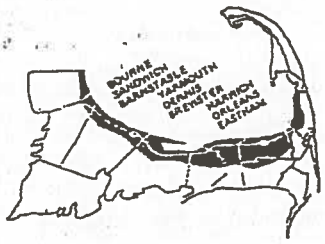
TOWN OF ORLEANS




Application to

Old King's Highway Regional Historic District Committee
in the Town of Orleans for a

CERTIFICATE OF APPROPRIATENESS

AUG 21 2019

BUILDING DEPT

Application is hereby made, in triplicate, for the issuance of a Certificate of Appropriateness under Section 6 of Chapter 470. Acts and Resolves of Massachusetts, 1973, for proposed work as described below and on plans, drawings or photographs accompanying this application for:

CHECK CATEGORIES THAT APPLY:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Exterior Building Construction: | ☑ New Building | ☐ Addition | ☐ Alteration | | |
| | Indicate type of building: | ☐ House | ☐ Garage | ☐ Commercial | ☑ Other | Municipal |
| 2. | Exterior Painting: | ☐ | | | | |
| 3. | Signs or Billboards: | ☐ New Sign | ☐ Existing Sign | ☐ Repainting existing sign | | |
| 4. | Structure: | ☑ Fence | ☐ Wall | ☐ Flagpole | ☑ Other | Existing Fence |

(Please read other side for explanation and requirements)

TYPE OR PRINT LEGIBLY

Date August 21, 2019

ADDRESS OR PROPOSED WORK 20 Overland Way, Orleans, MA 02653 ASSESSORS MAP NO. 32 | 39

OWNER Town of Orleans, MA ASSESSORS LOT NO. 109 | 6, 7 and 8

HOME ADDRESS 19 School Road, Orleans, MA 02653 TEL. NO. (508) 240-3700

FULL NAMES AND ADDRESSES OF ABUTTING OWNERS. Include name of adjacent property owners across any public street or way. (Attach additional sheet if necessary).

See Attached.

AGENT OR CONTRACTOR AECOM Technical Services, Inc. TEL. NO. (978) 905-2354

ADDRESS c/o Thomas Parece, P.E., 9 Jonathan Bourne Drive, Pocasset, MA 02559

DETAILED DESCRIPTION OF PROPOSED WORK: Give all particulars of work to be done (see No. 8, other side), including materials to be used, if specifications do not accompany plans. In the case of signs, give locations of existing signs and proposed locations of new signs. (Attach additional sheet, if necessary).

APPROVED
NOV 07 2019
Old King's Highway
Regional Historic District - Orleans

Signed J. R. Kelly
Owner-Contractor-Agent

Space below line for Committee use.

Received by H.D.C.

Date

Time

By

The Certificate is hereby Date Nov 07 2019

Approved ☐

Disapproved ☐

IMPORTANT: If Certificate is approved, approval is subject to the 20 day appeal period provided in the Act.

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**Massachusetts Department of Environmental Protection**

**Groundwater Discharge Permit**

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Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

March 31, 2020

Mr. John Kelly, Town Administrator
Town of Orleans
19 School Road
Orleans, Massachusetts 02653

RE: ORLEANS – Final Individual Groundwater Discharge Permit, Town of Orleans Wastewater Treatment Facility, 29 Overland Way, Orleans Massachusetts and 32 and 43 Lots Hollow Road
Transmittal No. X282490
Groundwater Discharge Permit No.: 993-0

Dear Mr. Kelly:

In response to your application for a permit to discharge into the ground treated effluent from the proposed Town of Orleans Wastewater Treatment Facility and after due public notice, I hereby issue the attached final permit.

Since no comments objecting to the issuance of the permit were received by the Department during the public comment period, in accordance with 314 CMR 2.08, the permit becomes effective at issuance.

Parties aggrieved by the issuance of this permit are hereby advised of their right to request an Adjudicatory Hearing under the provisions of Chapter 30A of the Massachusetts General Laws and 314 CMR 1.00, Rules for the Conduct of Adjudicatory Proceedings. Unless the person requesting the adjudicatory hearing requests and is granted a stay of the terms and conditions of this permit, the permit shall remain fully effective.

Should you have any questions regarding this matter, please contact me at (508)946-2814 or at brian.dudley@mass.gov.

Very truly yours,

Gerard M. R. Martin for
Brian A. Dudley, Section Chief
Wastewater Management – Cape and Islands

Enclosures (Permit, Fact Sheet)

**This information is available in alternate format. Contact Michelle Waters-Ekanem, Director of Diversity/Civil Rights at 617-292-5751.**
**TTY# MassRelay Service 1-800-439-2370**
MassDEP Website: www.mass.gov/dep

Printed on Recycled Paper

ecc: Mr. Robert Canning, Health Agent
Board of Health
19 School Road
Orleans, MA 02653
Enclosures (Permit, Fact Sheet)

Mr. Tom Parece
AECOM Technical Services Incorporated
9 Jonathan Bourne Drive
Pocasset, MA 02559
Enclosures (Permit, Fact Sheet)

DEP/BWR/Wastewater Management Program/Boston
Attn: Linda Barba
Julianne Ture
Enclosures (Permit, Fact Sheet)

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

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Commissioner

# Individual Groundwater Discharge Permit
# Fact Sheet

## I. APPLICANT, FACILITY INFORMATION, and DISCHARGE LOCATION

**Name and Address of Applicant:** Town of Orleans, 19 School Road, Orleans, Massachusetts 02653

**Name and Address of Facility where discharge occurs:** Wastewater treatment at 29 Overland Way, Orleans, Massachusetts with discharges at 32 and 43 Lots Hollow Road, Orleans, Massachusetts.

**Discharge Information:**

Groundwater Discharge Permit Number: 993-0

The Groundwater Discharge Permit will allow the applicant to discharge 228,900 gallons per day (annual average) with a maximum of 595,100 gallons per day for Phase 1 and 350,000 gallons per day (annual average) with a maximum of 883,800 gallons per day for Phase 2 of treated sanitary wastewater from a municipal wastewater treatment facility to groundwaters of the Commonwealth.

The discharge sites are not in a Zone II or Interim Wellhead Protection Area of any public drinking water supply.

## II. LIMITATIONS AND CONDITIONS

Discharge permit limitations are as listed in the ground water permit and are in conformance with 314 CMR 5.00, the Groundwater Discharge Permit Program.

## III. PERMIT BASIS AND EXPLANATION OF EFFLUENT LIMITATIONS

An Individual Groundwater Discharge permit is required for this discharge in accordance with the Massachusetts Clean Water Act, M.G.L. c. 21, s. 26-53 and 314 CMR 5.03.

Effluent limitations are based upon the location of the discharge, the level of treatment, consideration of human health protection criteria and protection of the groundwaters of the Commonwealth.

The discharge will be via wicks located at 32 Lots Hollow Road. 43 Lots Hollow Road will serve as a backup site.

## IV. COMMENT PERIOD, HEARING REQUESTS, AND PROCEDURES FOR FINAL DECISIONS

The public comment period for this permit is thirty (30) days following public notice in *The Environmental Monitor*. The public notice for this Individual Groundwater Discharge Permit occurred on February 10, 2020

Requests for an adjudicatory hearing must be submitted within thirty (30) days of the issuance/denial of the permit, by any person who is aggrieved by such issuance/denial.

A final decision on the issuance/denial of this permit will be made after the public notice period, and review of any comments received during this period.

## V. STATE CONTACT INFORMATION

Additional information concerning the draft permit may be obtained between the hours of 9:00 a.m. and 5:00 p.m. Monday through Friday excluding holidays, from:

Gerard M.R. Martin

March 31, 2020

for: Brian A. Dudley, Section Chief
Wastewater Management Program – Cape and Islands

DATE

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

# Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

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Secretary

Martin Suuberg
Commissioner

## INDIVIDUAL GROUNDWATER DISCHARGE PERMIT

Name and Address of Applicant: Town of Orleans, 19 School Road, Orleans, Massachusetts 02653

Date of Application: August 29, 2019
Application/Permit No. 993-0

Date of Issuance: March 31, 2020
Date of Expiration: March 31, 2025

Effective Date: March 31, 2020

## AUTHORITY FOR ISSUANCE

Pursuant to authority granted by Chapter 21, Sections 26-53 of the Massachusetts General Laws, as amended, 314 CMR 2.00, and 314 CMR 5.00, the Massachusetts Department of Environmental Protection (the Department or MassDEP) hereby issues the following permit to: **Town of Orleans** (hereinafter called "the permittee") authorizing discharges to the ground from the wastewater treatment facility located at **Town of Orleans Wastewater Treatment Facility, 29 Overland Way, Orleans Massachusetts** with effluent recharge located at **32 and 43 Lots Hollow Road, Orleans, Massachusetts** such authorization being expressly conditional on compliance by the permittee with all terms and conditions of the permit hereinafter set forth.

Gerard M.R. Martin

FOR: Brian A. Dudley, Section Chief
Wastewater Management – Cape and Islands

March 31, 2020
Date

This Information is available in alternate format. Contact Michelle Waters-Ekanem, Director of Diversity/Civil Rights at 617-292-5751.
TTY# MassRelay Service 1-800-439-2370
MassDEP Website: www.mass.gov/dep

Printed on Recycled Paper

I. SPECIAL CONDITIONS

**A. Effluent Limits**

1) The permittee is authorized to discharge into the ground from the wastewater treatment facilities for which this permit is issued a treated effluent whose characteristics within one month of startup and continuing thereafter shall not exceed the following values:

| Effluent Characteristics | Discharge Limitations |
|---|---|
| Flow | Phase 1: 228,900 gpd (annual average)<br>595,100 gpd (maximum day)<br>Phase 2: 350,000 gpd (annual average)<br>883,800 gpd (maximum day) |
| Oil and grease | 15 mg/l |
| Total Suspended Solids (TSS) | 30 mg/l |
| Total Nitrogen ($NO_2 + NO_3 + TKN$) | 10 mg/l |
| Nitrate-Nitrogen | 10 mg/l |
| Biochemical Oxygen Demand, 5-day @20°C ($BOD_5$) | 30 mg/l |
| Settleable Solids | 0.1 ml/l |
| Fecal Coliform | 200 colonies/100 ml |
| Total Residual Chlorine | 4 mg/l |

a) The pH of the effluent shall not be less than 6.5 nor greater than 8.5 at any time or not more than 0.2 standard units outside the range measured at the upgradient monitoring wells (LH-6 and MW-14).

b) Prior to discharging Phase 2 flow, the Permittee shall evaluate the operational experience with the wicks to determine if the wicks at 32 Lots Hollow Road are capable of accommodating the maximum day flow. Pending the results of that evaluation, the Department reserves the right to require development of additional wicks with plans to be submitted by the Permittee through a BRP WP 68 Treatment Works Plan Approval Without Permit Modification.

c) The compliance sampling point for Total Residual Chlorine shall be at the end of the force main prior to discharge into the wicks.

d) Redevelopment and cleaning of the wicks may periodically require dosages of chlorine in excess of the effluent limit. Redevelopment and cleaning procedures and protocols shall be included in the WWTF's Operation and Maintenance Manual (O&M) as approved by the Department. The permittee shall provide the Department with a 24 hour notification in advance of any redevelopment and cleaning activity, except in an instance of extreme emergency in which case notification shall be within 24 hours of emergency redevelopment and cleaning activity.

e) The discharge of the effluent shall not result in any demonstrable adverse effect on the groundwater or violate any water quality standards that have been promulgated.

f) The monthly average concentration of BOD and TSS in the discharge shall not exceed 15 percent of the monthly average concentrations of BOD and TSS in the influent into the permittee's wastewater treatment facility.

g) When the average annual flow exceeds 80 percent of the permitted flow limitations, the permittee shall submit a report to the Department describing what steps the permittee will take in order to remain in compliance with the permit limitations and conditions, inclusive of the flow limitations established in this permit.

## B. Monitoring and Reporting

1) The permittee shall monitor and record the quality of the **influent** and the quality and quantity of the **effluent** prior to discharge to the leaching facilities according to the following schedule and other provisions:

**INFLUENT:**

| Parameter | Minimum Frequency of Analysis | Sample Type |
|---|---|---|
| pH | Daily | Grab |
| Septage (quantity) | Daily | report |
| TSS | Weekly | 24-hr Composite |
| $BOD_5$ | Monthly | 24-hr Composite |
| Oil & Grease | Monthly | Grab |
| Total Nitrogen ($NO_2 + NO_3 + TKN$) | Monthly | 24-hr Composite |
| Sodium | Monthly | Grab |
| Chloride | Monthly | Grab |
| Volatile Organic Compounds | Quarterly | Grab |

**EFFLUENT:**

| Parameter | Minimum Frequency of Analysis | Sample Type |
|---|---|---|
| Flow | Daily | Continuous reading |
| pH | Daily | Grab |
| $BOD_5$ | Monthly | 24-hr Composite |
| Total Nitrogen ($NO_2$+$NO_3$+TKN) | Monthly | 24-hr Composite |
| Nitrate Nitrogen | Monthly | 24-hr Composite |
| Ammonia as Nitrogen | Monthly | 24-hr Composite |
| Total Suspended Solids | Weekly | 24-hr Composite |
| Settleable Solids | Weekly | Grab |
| Total Dissolved Solids | Weekly | Grab |
| Total Solids | Weekly | Grab |
| Oil & Grease | Monthly | Grab |
| Fecal Coliform | Monthly | Grab |
| Total Phosphorus | Quarterly | Grab |
| Orthophosphate | Quarterly | Grab |
| Total Residual Chlorine | If and When Applied | Grab |
| Volatile Organic Compounds | Annually | Grab |

a) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

b) Total Residual Chlorine shall only be reported if it is added to the treatment process as part of wick well maintenance. Use of chlorine shall be noted in the monthly discharge monitoring reports and effluent concentrations shall be noted at that time.

c) Testing for Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Total Solids (TS) is to monitor for solids discharging to the wicks.

2) The permittee shall install the approved monitoring wells at least 90 days prior to treatment facility start-up. The permittee shall install the upgradient monitoring wells, LH-6 and MW-14 and the downgradient monitoring wells LH-7, LH-8 and LH-9 as shown on the approved plan titled "Figure 11, Groundwater Monitoring Locations 32 and 43 Lots Hollow Road" as found in the " Project Summary of the Groundwater Discharge Permit (GWDP) Application 32 and 43 Lots Hollow Road, Town of Orleans, Massachusetts" prepared by AECOM Technical Services, Inc. and dated July 24, 2019. Labels identifying each monitoring well's identification in accordance with the above-referenced approved plan shall be affixed to the steel protective casing of each monitoring well.

The permittee shall monitor, record and report the quality of water in the approved monitoring wells according to the following schedule and other provisions:

| **Parameter** | **Sample type** | **Sampling Frequency** |
|---|---|---|
| pH | Grab | Monthly |
| Static Water Level Elevation | Measurement | Monthly |
| Specific Conductance | Grab | Monthly |
| Total Nitrogen | Grab | Quarterly |
| Nitrate Nitrogen | Grab | Quarterly |
| Total Phosphorus | Grab | Quarterly |
| Orthophosphate | Grab | Quarterly |
| Volatile Organic Compounds | Grab | Annually |

a) Static Water Level shall be expressed as an elevation and shall be referenced to the surveyed datum established for the site. It shall be calculated by subtracting the depth to the water table from the surveyed elevation of the top of the monitoring well's PVC well casing/riser.

b) After one full year of monitoring the Total Phosphorus and Orthophosphate results, the Department may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of the Department, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors. If the Department reduces the frequency of monitoring for Total Phosphorus and Orthophosphate, the Department reserves the right to resume more frequent monitoring if the Department determines that phosphorus levels are impacting downgradient receptors.

3) Any grab sample or composite sample required to be taken less frequently than daily shall be taken during the period of Monday through Friday inclusive. All composite samples shall be taken over a 24 hour period.

4) The permittee shall submit all monitoring reports within 30 days of the last day of the reporting month to MassDEP and to the Board of Health, 59 School Road, Orleans, Massachusetts 02653. All discharge monitoring reports submitted to MassDEP must be submitted through eDEP. To register for electronic submission go to: **http://www.mass.gov/eea/agencies/massdep/service/online/edep-online-filing.html**

## C. Supplemental Conditions

1) The permittee shall notify the Department at least thirty (30) days in advance of the proposed transfer of ownership of the facility for which this permit is written. Said notification shall include a written agreement between the existing and new permittees containing a specific date for transfer of permit, responsibility, coverage and liability between them.

2) A staffing plan for the facility shall be submitted to the Department once every two years and whenever there are staffing changes. The staffing plan shall include the following components:

a) The operator(s)'s name(s), operator grade(s) and operator license number(s);
b) The number of operational days per week;
c) The number of operational shifts per week;
d) The number of shifts per day;
e) The required personnel per shift;
f) Saturday, Sunday and holiday staff coverage;
g) Emergency operating personnel

The initial staffing plan will be submitted to the Department prior to the wastewater treatment facility's clean water test.

3) The permittee is responsible for the operation and maintenance of all sewers, pump stations, and treatment units for the permitted facility, which shall be operated and maintained under the direction of a properly certified wastewater operator.

4) Operation and maintenance of the proposed facility must be in accordance with 314 CMR 12.00, "Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges", and, 257 CMR 2.00, "Rules and Regulations for Certification of Operators of Wastewater Treatment Facilities".

a) The facility has been rated (in accordance with 257 CMR 2.00), to be a Grade 5 facility. Therefore, the permittee shall provide for oversight by a Massachusetts Certified Wastewater Treatment plant operator (Chief Operator) Grade 5 or higher. The permittee will also provide for a backup operator who shall possess at least a valid Grade 5 license.

b) The date and time of the operator's inspection along with the operator's name and certification shall be recorded in the log book on location at the treatment facility. All daily inspection logs consistent with the O&M Manual requirements shall be kept at the facility for a period of three (3) years.

c) Records of operation of wastewater treatment facilities or disposal systems required by the Department shall be submitted on forms supplied by the Department or on other forms approved by the Department for such use. Monthly reports shall be certified by the wastewater treatment plant operator in charge and shall be included in the discharge monitoring reports submitted each month.

5) If the operation and maintenance of the facility is to be contracted to a private concern, the permittee shall submit a copy of the contract, consistent with what is required by the approved Operation & Maintenance manual and signed only by the contractor, to the appropriate MassDEP Regional Office for review and approval ninety (90) days **prior** to the start up of the facility. Along with the contract, a detailed listing of all contract operation obligations of the proposed contractor at other facilities shall also be submitted. The permittee shall not begin operation of the treatment facility until the Department approves the contract.

6) All tests or analytical determinations to determine compliance with permit standards and requirements:

a) Effluent samples shall be collected, transported and stored in accordance with *Standard Methods for the Examination of Water and Wastewater;*

b) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other methods are approved by the Department; and,

c) Samples shall be analyzed by a Massachusetts Certified laboratory unless otherwise approved by the Department.

7) The permittee shall notify the appropriate MassDEP Regional Office, in writing, within thirty (30) days of the following events:

a) The date of treatment plant start up.
b) Any interruption of the treatment system operation, other than routine maintenance.
c) Final shutdown of the treatment system.

8) The permittee shall contract to have any and all solids and sludges generated by the treatment system for which this permit is issued removed off site by a properly licensed waste hauler for disposal at an EPA/MassDEP approved facility. The name and license number of the hauler along with the quantity of wastes removed and the date(s) of removal shall be reported by the permittee in writing to the appropriate MassDEP Regional Office.

9) Simultaneously with the permit renewal application at year fifteen (2035) following the initiation of plant operations, the permittee shall submit two reports to the Department for its review and approval:

   a) An engineering report, prepared by a registered professional engineer, that outlines in sufficient detail what modifications (if any) to the facility or other changes are required to insure that the facility can remain in compliance with its GWDP and other applicable requirements through the next 5 year permit term (year 2040) and beyond; and

10) In the event that effluent limits are not met, or the discharge is determined to impair groundwater quality in accordance with 314 CMR 5.16(1), the permittee may be obligated to modify, supplement or replace the permitted treatment process so as to ensure that the discharge does not impair the ability of the groundwater to act as an actual or potential source of potable water.

11) Pursuant to M.G.L. Chapter 21A, section 18(a), and 310 CMR 4.03, holders of this Permit may be subject to annual compliance assurance fees as assessed each year on July 1st and invoiced by MassDEP. Failure of the Permit holder to pay applicable annual compliance assurance fees shall result in the automatic suspension of the permit by operation of law under the statute. If fee non-payment continues for sixty days or more, MassDEP has the statutory option of revoking the Permit, denying any other pending permit applications filed by the Permit holder or taking other enforcement action. Permit holders are required to notify MassDEP in writing if they wish to relinquish or transfer a permit. Failure to do so will result in the continued assessment of fees.

**D. Appeal Rights**

During the thirty (30) day period following issuance of this permit, a Notice of Claim for an Adjudicatory Appeal may be sent by any person aggrieved (the "Petitioner") by the issuance to:

Case Administrator
Office of Appeals and Dispute Resolution
Massachusetts Department of Environmental Protection
One Winter Street/2nd Floor
Boston, MA 02108

310 CMR 1.01(6)(b) requires the Notice of Claim to: include sufficient facts to demonstrate aggrieved person status; state the facts which are grounds for the appeal specifically, clearly and concisely; and, state relief sought. The permit shall become or remain effective at the end of the 30 day appeal period unless the person filing the Notice of Claim requests, and is granted, a stay of its terms and conditions. If a permit is modified under 314 CMR 2.10, only the modified terms and conditions may be subject to an Adjudicatory Appeal. All other aspects of the existing permit shall remain in effect during any such Adjudicatory Appeal.

Per 310 CMR 4.06, the hearing request to the Commonwealth will be dismissed if the filing fee is not paid. Unless the Petitioner is exempt or granted a waiver, a valid check payable to the Commonwealth to Massachusetts in the amount of $100.00 must be mailed to:

Commonwealth of Massachusetts
Department of Environmental Protection
P.O. Box 4062
Boston, MA 02211

The filing fee is not required if the Petitioner is a city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority effective January 14, 1994, or any municipal housing authority; or, per MGL 161A s. 24, the Massachusetts Bay Transportation Authority. The Department may waive the adjudicatory hearing filing fee for a Petitioner who shows that paying the fee will create an undue financial hardship. A Petitioner seeking a waiver must file, along with the hearing request, an affidavit setting forth the facts believed to support the claim of undue financial hardship.

## II. GENERAL PERMIT CONDITIONS

### 5.16: General Conditions

The following conditions apply to all individual and general permits:

(1) No discharge authorized in the permit shall cause or contribute to a violation of 314 CMR 4.00: *Massachusetts Surface Water Quality Standards*. Upon promulgation of any amended standard, the permit may be modified to comply with such standard in accordance with the procedures in 314 CMR 2.10: *Modification, Suspension, Revocation and Renewal of Permits and General Permit Coverage* and 314 CMR 5.12. Except as otherwise provided in 314 CMR 5.10(3)(c), 5.10(4)(a)2. and 5.10(9), no discharge authorized in the permit shall impair the ability of the ground water to serve as an actual or potential source of potable water. Evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water includes, without limitation, analysis of samples taken in a downgradient well that demonstrates one or more exceedances of the applicable water quality based effluent limitations set forth in 314 CMR 5.10. In those cases where it is shown that a measured parameter exceeds the applicable water quality based effluent limitations set forth in 314 CMR 5.10 at the upgradient monitoring well, evidence that a discharge impairs the ability of the ground water to serve as an actual or potential source of potable water is deemed to exist if a measured parameter in any downgradient well exceeds the level of that same measured parameter in the upgradient well for the same sampling period. A statistical procedure approved by the Department shall be used to determine when a measured parameter exceeds the allowable level.

(2) Duty to Comply. The permittee shall comply at all times with the terms and conditions of the permit, 314 CMR 5.00, M.G.L. c. 21, §§ 26 through 53, and all applicable state and federal statutes and regulations.

(3) Standards and Prohibitions for Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established by § 307(a) of the Federal Act, 33 U.S.C. § 1317(a), for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(4) Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and equipment installed or used to achieve compliance with the terms and conditions of the permit, 314 CMR 12.00: *Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges*, and 257 CMR 2.00: *Certification of Operators of Wastewater Treatment Facilities*. All equipment shall be maintained in an acceptable condition for its intended use.

(5) Duty to Halt or Reduce Activity. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production, discharges, or both, until the facility is restored or an alternative method of treatment is provided. A permittee may not raise as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

(6) Power Failure. In order to maintain compliance with the effluent limitations and prohibitions of the permit, the permittee shall either:

(a) provide an alternative power source sufficient to operate the wastewater control facilities; or

(b) halt, reduce or otherwise control production or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

(7) Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any adverse impact on human health or the environment resulting from non-compliance with the permit. Additionally, the permittee shall take all necessary steps to prevent an operational upset of the PWTF or POTW.

(8) Duty to Provide Information. The permittee and any operator of the permitted facility shall furnish to the Department within a reasonable time as specified by the Department any information which the Department may request to determine whether cause exists for modifying, suspending, revoking and reissuing, or terminating the permit, or to determine whether the permittee is complying with the terms and conditions of the permit.

(9) Inspection and Entry. The permittee shall allow the Department or its authorized representatives to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records required by the permit are kept;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;

(c) Inspect at reasonable times any facilities, equipment, practices, or operations regulated or required under the permit; and

(d) Sample or monitor at reasonable times for the purpose of determining compliance with the terms and conditions of the permit.

(9A) The permittee shall physically secure the treatment works and monitoring wells and limit access to the treatment works and monitoring wells only to those personnel required to operate, inspect and maintain the treatment works and to collect samples.

(9B) The permittee shall identify each monitoring well by permanently affixing to the steel protective casing of the well a tag with the identification number listed in the permit.

(10) Monitoring. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other test procedures are specified in the permit.

(11) Recordkeeping. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and all records of all data used to complete the application for the permit, for a period of at least five years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Records of monitoring information shall include without limitation:

(a) The date, exact place, and time of sampling or measurements;
(b) The individual(s) who performed the sampling or measurement;
(c) The date(s) analyses were performed;
(d) The individual(s) who performed the analyses;
(e) The analytical techniques or methods used; and
(f) The results of such analyses.

(12) Prohibition of Bypassing. Except as provided in 314 CMR 5.16(13), bypassing is prohibited and the Department may take enforcement action against a permittee for bypassing unless:

(a) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
(c) The permittee submitted notice of the bypass to the Department:
1. In the event of an anticipated bypass, at least ten days in advance, if possible; or
2. In the event of an unanticipated bypass, as soon as the permittee has knowledge of the bypass and no later than 24 hours after its first occurrence.

(13) Bypass not Exceeding Limitations. The permittee may allow a bypass to occur which does not cause effluent limitations to be exceeded, but only if necessary for the performance of essential maintenance or to assure efficient operation of treatment facilities.

(14) Permit Actions. The permit may be modified, suspended, or revoked for cause. The filing of a request by the permittee for a permit modification, reissuance, or termination, or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

(15) Duty to Reapply. If the permittee wishes to continue an activity regulated by the permit after the expiration date of the permit, the permittee must apply for and obtain a new permit. The permittee shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department in writing.

(16) Property Rights. The permit does not convey any property rights of any sort or any exclusive privilege.

(17) Other Laws. The issuance of a permit does not authorize any injury to persons or property or invasion of other private rights, nor does it relieve the permittee of its obligation to comply with any other applicable Federal, State, or local law, or regulation.

(18) Oil and Hazardous Substance Liability. Nothing in the permit shall be construed to preclude the institution of any legal action or relieve the permittee of any responsibilities, liabilities, or penalties to which the permittee is or may be subject under § 311 of the Federal

Act, 33 U.S.C. § 1321, and M.G.L. c. 21E.

(19) Removed Substances. Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed in a manner consistent with applicable Federal and State laws and regulations including, but not limited to, the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, and the Federal Act, 33 U.S.C. § 1251 *et seq.*, the Massachusetts Hazardous Waste Management Act, M.G.L. c. 21C, and the Federal Resource Conservation and Recovery Act, 42 U.S.C. § 6901, *et seq.*, 310 CMR 19.000: *Solid Waste Management* and 310 CMR 30.000: *Hazardous Waste*.

(20) Reporting Requirements.

(a) Monitoring Reports. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) at the intervals specified in the permit. If a permittee monitors any pollutant more frequently than required by the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Beginning on December 2, 2017, a permittee shall submit all DMRs electronically, using the electronic reporting system designated by the Department. A permittee may seek a waiver of this requirement by submitting a written request for the Department's approval.

(b) Compliance Schedules. Reports of compliance or non-compliance with, or any progress reports on interim and final requirements contained in any compliance schedule in the permit shall be submitted no later than 14 days following each schedule date.

(c) Planned Changes. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility or activity which could significantly change the nature or increase the quantity of pollutants discharged. Unless and until the permit is modified, any new or increased discharge in excess of permit limits or not specifically authorized by the permit constitutes a violation.

(d) Anticipated Non-compliance. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in non-compliance with permit requirements.

(e) 24 Hour Reporting. The permittee shall report any non-compliance which may endanger health or the environment. Any information shall be communicated orally within 24 hours of the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain: a description of the non-compliance, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance. The following shall be included as information which must be reported within 24 hours:

1. Any unanticipated bypass which exceeds any effluent limitation in the permit; and
2. Any violation of a maximum daily discharge limitation for any of the pollutants required by the permit to be reported within 24 hours.

(f) Other Non-compliance. The permittee shall report all instances of non-compliance not reported under 314 CMR 5.16(20)(a), (b), or (e) at the time monitoring reports are submitted. The reports shall contain the information listed in 314 CMR 5.16(20)(e).

(g) Toxics. All manufacturing, commercial, mining, or silvicultural dischargers must notify

the Department as soon as they know or have reason to believe:

1. That any activity has occurred, or will occur, that would result in the discharge of any toxic pollutant listed in 314 CMR 3.17: *Appendix B - Toxic Pollutants* not limited by the permit, if that discharge will exceed the highest of the following notification levels:

a. 100 micrograms per liter (100 ug/l);

b. 200 micrograms per liter (200 ug/l) for acrolein and acrylonitrile, 500 micrograms per liter (500 ug/l) for 2,4-dinitrophenol, and for 2-methyl-4,6-dinitrophenol, and one milligram per liter (1 mg/l) for antimony;

c. Five times the maximum concentration value reported for that pollutant in the permit application; or

2. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

(h) Indirect Dischargers. All Publicly Owned Treatment Works shall provide adequate notice to the Department of the following:

1. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to § 301 or § 306 of the Federal Act, 33 U.S.C. § 1311 or 1316, if it were directly discharging those pollutants; and

2. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(i) Information. Where a permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit the relevant facts or correct information.

(j) The permittee shall notify the Department in writing within seven days of any change in contract operators.

(21) Signatory Requirement. All applications, reports, or information submitted to the Department shall be signed and certified in accordance with 314 CMR 5.14 and 5.15.

(22) Severability. The provisions of the permit are severable. If any provision of the permit, or the application of any provision of the permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of the permit, shall not be affected thereby.

(23) Reopener Clause. The Department reserves the right to make appropriate revisions to the permit to establish any appropriate effluent limitations, schedules of compliance, or other provisions, as authorized by the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, or the Federal Act, 33 U.S.C. § 1251 *et seq.*, to bring all discharges into compliance with these statutes.

(24) Approval of Treatment Works. All discharges and associated treatment works authorized in 314 CMR 5.00 shall remain in compliance with the terms and conditions of the permit. Any modification of the approved treatment works shall require written approval of the Department prior to the construction of the modification.

(25) Transfer of Permits.

(a) RCRA Facilities. Any permit which authorizes the operation of a RCRA facility subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities* shall be valid only for the person to whom it is issued and may not be transferred.

(b) Transfers by Modification. Except as provided in 314 CMR 5.16(25)(a) and (c), a permit may be transferred by the permittee to a new permittee if the permit has been modified or revoked and reissued in accordance with 314 CMR 5.12(2), or a minor modification is made to identify the new permittee in accordance with 314 CMR 5.12(3) and (4).

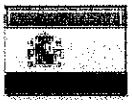
(c) Automatic Transfers. For facilities other than Privately Owned Wastewater Treatment Facilities (PWTFs) that treat at least some sewage from residential uses, hospitals, nursing or personal care facilities, residential care facilities, or assisted living facilities, PWTFs that have been required to establish, fund and maintain financial assurance mechanism(s) pursuant to 314 CMR 5.15(6), and RCRA facilities subject to the requirements of 314 CMR 8.07: *Standards for all other RCRA Facilities*, a permit may be automatically transferred in accordance with 314 CMR 5.12(5).

(26) Permit Compliance Fees and Inspection Information. Except as otherwise provided, any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43, and 314 CMR 5.00 shall submit the annual compliance assurance fee established in accordance with M.G.L. c. 21A, § 18 and 310 CMR 4.00: *Timely Action Schedule and Fee Provisions*, as provided in 314 CMR 2.12: *Applications, Fees and Inspection Information.* The requirement to submit the annual compliance fee does not apply to any local government unit other than an authority. Any permittee required to obtain a ground water discharge permit pursuant to M.G.L. c. 21, § 43 and 314 CMR 5.00, may be required to submit inspection information annually, as provided in 314 CMR 2.12.

**Massachusetts Department of Environmental Protection**
**One Winter Street, Boston MA 02108 • Phone: 617-292-5751**
**Communication For Non-English Speaking Parties - 310 CMR 1.03(5)(a)**

**1 English:**

This document is important and should be translated immediately. If you need this document translated, please contact MassDEP's Diversity Director at the telephone numbers listed below.

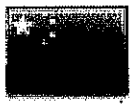


**2 Español (Spanish):**

Este documento es importante y debe ser traducido inmediatamente. Si necesita este documento traducido, por favor póngase en contacto con el Director de Diversidad MassDEP a los números de teléfono que aparecen más abajo.

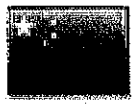
**3 Português (Portuguese):**

Este documento é importante e deve ser traduzida imediatamente. Se você precisa deste documento traduzido, por favor, entre em contato com Diretor de Diversidade da MassDEP para os números de telefone listados abaixo.



**4(a) 中國（傳統）(Chinese (Traditional):**

本文件非常重要，應立即翻譯。如果您需要翻譯這份文件，請用下面列出的電話號碼與Mass DEP的多樣性總監聯繫。



**4(b) 中国（简体中文）(Chinese (Simplified):**

本文件非常重要，应立即翻译。如果您需要翻译这份文件，请用下面列出的电话号码与Mass DEP的多样性总监联系。

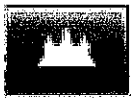
**5 Ayisyen (franse kreyòl) (Haitian) (French Creole):**

Dokiman sa-a se yon bagay enpòtan epi yo ta dwe tradui imedyatman. Si ou bezwen dokiman sa a tradui, tanpri kontakte Divèsite Direktè MassDEP a nan nimewo telefòn ki nan lis pi ba a.

**6 Việt (Vietnamese):**

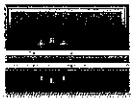
Tài liệu này là rất quan trọng và cần được dịch ngay lập tức. Nếu bạn cần dịch tài liệu này, xin vui

lòng liên hệ với Giám đốc MassDEP đa dạng tại các số điện thoại được liệt kê dưới đây.



**7 ប្រទេសកម្ពុជា (Kmer (Cambodian):**

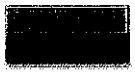
ឯកសារនេះគឺមានសារៈសំខាន់និងគួរត្រូវបានបកប្រែភ្លាម។ ប្រសិនបើអ្នកត្រូវបានបកប្រែ ឯកសារនេះសូមទំនាក់ទំនងឆ្មោតជានាយក MassDEP នៅលេខទូរស័ព្ទដែលបានរាយខាងក្រោម។



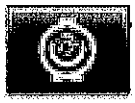
**8 Kriolu Kabuverdianu (Cape Verdean):**

*Es documento é importante e deve ser traduzido imidiatamente. Se bo precisa des documento traduzido, por favor contacta Director de Diversidade na MassDEP's pa es numero indicode li d'boche.*

**9 Русский язык (Russian):**

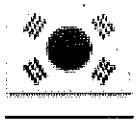


Этот документ является важным и должно быть переведено сразу. Если вам нужен этот документ переведенный, пожалуйста, свяжитесь с директором разнообразия MassDEP по адресу телефонных номеров, указанных ниже.



**10 العربية (Arabic):**

هذه الوثيقة الهامة وينبغي أن تترجم على الفور. اذا كنت بحاجة الى هذه الوثيقة المترجمة، يرجى الاتصال مدير التنوع في MassDEPعلى أرقام الهواتف المدرجة أدناه.

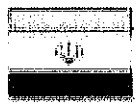


**11 한국어 (Korean):**

이 문서는 중요하고 즉시 번역해야합니다. 당신이 번역이 문서가 필요하면 아래의 전화 번호로 MassDEP의 다양성 감독에 문의하시기 바랍니다.

**12 հայերեն (Armenian):**

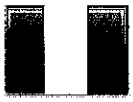
Այս փաստաթուղթը շատ կարեւոր է եւ պետք է թարգմանել անմիջապես. Եթե Ձեզ անհրաժեշտ է այս փաստաթուղթը թարգմանվել դիմել MassDEP բազմազանությունը տնօրեն է հետախոսահամարների թվարկված են ստորեւ.



**13 فارسی (Farsi (Persian):**

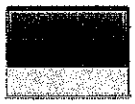
این سند مهم است و باید فورا ترجمه شده است.

اگر شما نیاز به این سند ترجمه شده، لطفا با ما تماس تنوع مدیر MassDEP در شماره تلفن های ذکر شده در زیر.



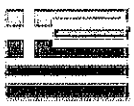
**14 Français (French):**

Ce document est important et devrait être traduit immédiatement. Si vous avez besoin de ce document traduit, s'il vous plaît communiquer avec le directeur de la diversité MassDEP aux numéros de téléphone indiqués ci-dessous.



**15 Deutsch (German):**

Dieses Dokument ist wichtig und sollte sofort übersetzt werden. Wenn Sie dieses Dokument übersetzt benötigen, wenden Sie sich bitte Diversity Director MassDEP die in den unten aufgeführten Telefonnummern.



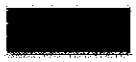
**16 Ελληνική (Greek):**

Το έγγραφο αυτό είναι σημαντικό και θα πρέπει να μεταφραστούν αμέσως. Αν χρειάζεστε αυτό το έγγραφο μεταφράζεται, παρακαλούμε επικοινωνήστε Diversity Director MassDEP κατά τους αριθμούς τηλεφώνου που αναγράφεται πιο κάτω.

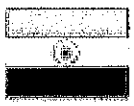
**17 Italiano (Italian):**

Questo documento è importante e dovrebbe essere tradotto immediatamente. Se avete bisogno di questo documento tradotto, si prega di contattare la diversità Direttore di MassDEP ai numeri di telefono elencati di seguito.

**18 Język Polski (Polish):**



Dokument ten jest ważny i powinien być natychmiast przetłumaczone. Jeśli potrzebujesz tego dokumentu tłumaczone, prosimy o kontakt z Dyrektorem MassDEP w różnorodności na numery telefonów wymienionych poniżej.



**19 हिन्दी (Hindi):**

यह दस्तावेज महत्वपूर्ण है और तुरंत अनुवाद किया जाना चाहिए. आप अनुवाद इस दस्तावेज़ की जरूरत है, नीचे सूचीबद्ध फोन नंबरों पर MassDEP की विविधता निदेशक से संपर्क करें.

**DOCUMENT 00862**

**SPECIAL CONDITIONS - MASSDEP POLICY MEMORANDA**

| | |
|---|---|
| Policy Memorandum No. CG-1 | Easements and Rights-of-Way |
| Policy Memorandum No. CG-2 | Permits |
| Policy Memorandum No. CG-3 | Field Controls |
| Policy Memorandum No. CG-4 | Record Drawings |
| Policy Memorandum No. CG-5 | Plan Scale |
| Policy Memorandum No. CG-6 | Borings Logs |
| Policy Memorandum No. CG-7 | Breakdown of Bid Items |
| Policy Memorandum No. CG-8 | Pavement |
| Policy Memorandum No. CG-9 | Pipe Testing |
| Policy Memorandum No. CG-10 | Change Orders |
| Policy Memorandum No. CG-11 | Utility Relocation |
| Policy Memorandum No. CG-12 | Refundable Deposits for Plans and Specifications |
| Policy Memorandum No. CG-13 | Bid Opening Procedures |
| Policy Memorandum No. CG-14 | Payment for Rock Excavation |
| Policy Memorandum No. CG-15 | Traffic Police |
| Policy Memorandum No. CG-16 | Documentation Required to Substantiate Contract Quantities |
| Policy 88-02 | Policy for Review of Sewer Line/Water Supply Protection |

Exceptions:

A. Policy Memorandum No. CG-9 Pipe Testing.

1. Under this Contract only seventy-five (75) percent of the price bid per linear foot of pipeline shall be paid for upon its installation, the balance shall be withheld until such time as pipeline has been successfully tested and accepted by the Owner and the site(s) has been fully restored. This percentage is exclusive of normal Contract retainage.

B. Policy Memorandum No. CG-10 Change Orders

1. Paragraph B., item (5.), delete the number 20% and insert the number 15%.
2. Paragraph B., item (6.), delete the number 7-1/2% and insert the number 5%.

C. Policy Memorandum No. CG-14 Payment for Rock Excavation

1. Under this Contract, Rock and/or Boulder Excavation shall be paid as defined in SECTION 01025, MEASUREMENT AND PAYMENT.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
**DEPARTMENT OF ENVIRONMENTAL PROTECTION**
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

**DEPARTMENT OF ENVIRONMENTAL PROTECTION**
**BUREAU OF RESOURCE PROTECTION**
**DIVISION OF MUNICIPAL SERVICES POLICIES**

The Division of Municipal Services (DMS) has established the following policies for all Division financially-assisted projects.

**POLICY MEMORANDUM NO. CG-1 EASEMENTS AND RIGHTS OF WAY**

Prior to the approval of financial assistance for construction, the owner shall obtain and shall thereafter retain, a fee simple or such estate or interest in the site of construction and rights of access as will assure undisturbed use and possession for the purpose of construction and operation for the estimated life of the project. The Division may refuse to approve financial assistance until it has received from the owner sufficient assurances that such interests have been obtained. Unless the Division otherwise notifies the owner, the certificate (under pains and penalties of perjury) of the owner's legal representative shall constitute such sufficient assurance.

Additional cost which result from interruptions of construction or extensions of contract time caused by the owner's failure to obtain the necessary interests in land shall be ineligible for financial assistance, and all such additional costs shall be borne by the owner.

**POLICY MEMORANDUM NO. CG-2 PERMITS**

The owner shall be responsible for identifying and obtaining all federal, state, local and railroad permits required by the nature and location of construction, including but not limited to building construction permits and permits for street and highway cuts and openings, and all such permits shall be listed in a separate permits section of the contract documents. To the extent possible, such permits shall be obtained by the owner prior to the solicitation of bids for construction, and copies of all permits so obtained shall be included in the said permits section. The status of the application for each permit, including the permit conditions, and costs, not obtained prior to the solicitation of bids shall also be indicated in the contract documents permits section. The Division may refuse to approve financial assistance for construction unless and until it has received from the owner sufficient assurances that all necessary permits have been or will be obtained prior to the commencement of construction.

The contractor shall be responsible for obtaining all permits required of his equipment, work force, or particular operations (such as blasting) in the performance of the contract and not otherwise specified in the two preceding paragraphs as to be obtained by the owner. These permit fees shall be paid by the contractor.

The owner shall be responsible for the payment of all other permit fees required by the construction.

The following permits shall not be eligible for financial participation by the Department of Environmental Protection (DEP).

- Permits and insurance for construction in railroads' rights of way;
- Building permits;
- Permits for opening public streets and other public or municipal rights of way;
- Permits for the use of explosives;
- Permits for the Disposal of waste materials; and
- Permits and fees for connecting to municipal utilities.

*Permits required by extraordinary circumstances and not specifically excluded from eligibility above may be eligible for DEP participation. For such permits to be so eligible, the owner or his representative must notify the DEP project engineer in advance of obtaining such permit and receive from the engineer specific agreement that such permit will be eligible for DEP participation. Eligibility for such participation will not be made retroactively.*

*Additional costs which result from interruptions of construction or extensions of contract time resulting from the owner's or the contractor's failure to obtain the necessary permits may be ineligible for participation.*

**POLICY MEMORANDUM NO. CG-3 FIELD CONTROLS**

The Owner shall be responsible for indicating on the contract drawings all easement limits and all property and other control lines for locating the principal component parts of the work together with those elevations and bench marks used in the design of the work, all hereinafter referred to as "field controls". Where easement and property limits have not previously been established in the field, the owner shall be responsible for establishment of such limits. From the information provided by the Owner, unless otherwise specified, the Contractor shall develop and make all layouts required for construction, such as slope stakes, batter boards, stakes for pipe locations and other working points, lines, elevations and cut sheets.

Whenever he has reason to believe that an error exists or whenever he is otherwise unable to locate the field controls, the contractor shall promptly notify the owner and the owner's engineer of such error with appropriate documentation.

**POLICY MEMORANDUM NO. CG-4 RECORD DRAWINGS**

The Owner shall be responsible for the preparation of all record drawings required by this contract. This responsibility may be delegated to the Owner's representative. The responsibility for preparation of record drawings shall not be delegated or transferred to the contractor. They may use the contractor's and sub-contractor's certified AS BUILT drawings along with their own marked up set in the preparation of the Record Drawings.

Division approved contract drawings shall be revised upon completion of the contract to reflect any changes made and/or final quantities, as appropriate.

**POLICY MEMORANDUM NO. CG-5 PLAN SCALE**

Unless otherwise approved in advance by the Division, the horizontal scale for construction plans for non-structural facilities shall be 1" = 40'. A larger horizontal scale shall be used where appropriate to show sufficient detail to construct the project. The vertical scale for construction plans for non-structural facilities shall be 1" = 4'. Based on the best information available at the time of their preparation, the location of underground utilities and support structures for overhead utilities shall be shown on the plans.

Unless otherwise exempted in advance by the Division, construction plans shall be updated whenever the date of the advertisement for bids for the construction of such facilities is more than one year after the date of approval by the Division or EPA; and in the case of approval by both such agencies, the later approval date shall be used in determining the need for update.

The consulting engineer shall receive adequate compensation for updating plans and specifications, and such additional cost shall be eligible for assistance to the extent not otherwise prohibited by USEPA and Division regulations and program guidance.

*All revision, or review without need for revision, shall be noted and dated on the plans prior to advertisement of the project for bid.*

**POLICY MEMORANDUM NO. CG-6 BORINGS LOGS**

*All soil borings shall be taken as close as practicable to the construction line, and the location of all such borings shall be clearly indicated on the contract drawings. The plan view shall show the location and boring number of each boring. The profile view shall show the location, elevation, and depth of each soil boring, the location of each change in soil stratum, the groundwater level, and the average of blow counts at each five foot interval. As a minimum, boring logs to be submitted with the plans and specifications shall show the name of the company taking the borings, the soil classification, the number of blows per foot of penetration, the groundwater elevation, and the date on which the borings were taken.*

As part of the submission of plans and specification for approval, the owner's representative shall include written justification for the lesser frequency and depth of borings where their interval is more than approximately 300' or their depth is less than 50% below depth of pipe invert.

**POLICY MEMORANDUM NO. CG-7 BREAKDOWN OF BID ITEMS**

The following items shall, where applicable, be listed separately in the bid documents.

**1.** Mobilization

**2.** Pavement

a. Municipal
   i. temporary
   ii. permanent

b. State
   i. temporary
   ii. permanent

**3.** Concrete cradle or encasement (to be identified where applicable)

4. Rock-Excavation

5. Wood or steel sheeting left in place

6. Excavation of unsuitable materials below grade

7. Select and/or borrow material

8. Dewatering

9. Special Dewatering (coffer dam)

Mobilization costs are the costs of initiating the contract, exclusive of the cost of materials. Payment for mobilization shall be a lump sum at the price bid for this item in the proposal and shall be payable when the contractor is operational on the site. For purposes of this policy, "operational" shall mean the substantial commencement of work on site.

The lump sum price bid for mobilization shall not exceed five per centum (5%) of the total amount of the bid.

**POLICY MEMORANDUM NO. CG-8 PAVEMENT**

All roads and trenches therein shall be refilled and repaved in accordance with specifications provided by the owner in the contract documents. Please note that this policy may be excludable on Federally assisted projects where bid alternative items may be required (i.e. trench width vs. full width pavement). You are advised to seek project specific clarification.

Loan eligibility shall be limited to the following:

A. Where the depth of the pipe invert is 0 to 8', the maximum pavement widths which shall be eligible for financial assistance are as follows:

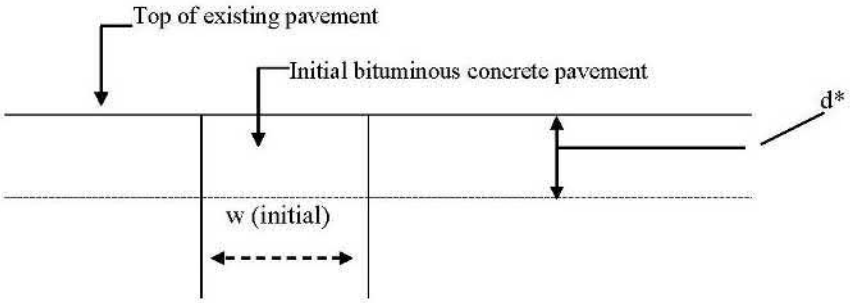
| Nominal Pipe Diameter | Maximum Eligible Widths | |
|---|---|---|
| | Initial Pavement | Permanent Trench |
| 0-24" | 6'-6" | 8'-6" |

Where the nominal pipe diameter is greater than 24" the maximum eligible width for Initial re-paving shall be the nominal diameter of the pipe plus four (4) feet, and for permanent trench re-paving the maximum eligible width shall be the nominal pipe diameter plus six (6) feet.

B. For each additional four (4) feet (or fraction thereof) of pipe invert depth, add three feet to the eligible width limits stated in paragraph A.

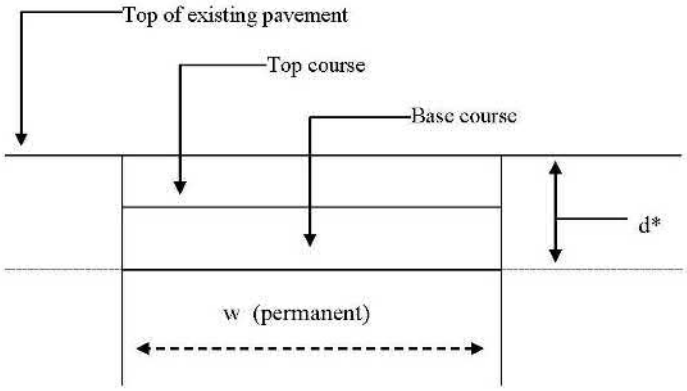
At the design phase of a project the owner has the option to elect either Initial Pavement with Option I (Permanent Trench replacement) or Initial with Option II (curb to curb over initial)

Initial Pavement




d*= depth of existing pavement to a maximum of 3 inches (see general notes #3)
w = maximum eligible Initial pavement width as described in paragraphs "A" & "B" on page DEP-DMS-CG's-P4.

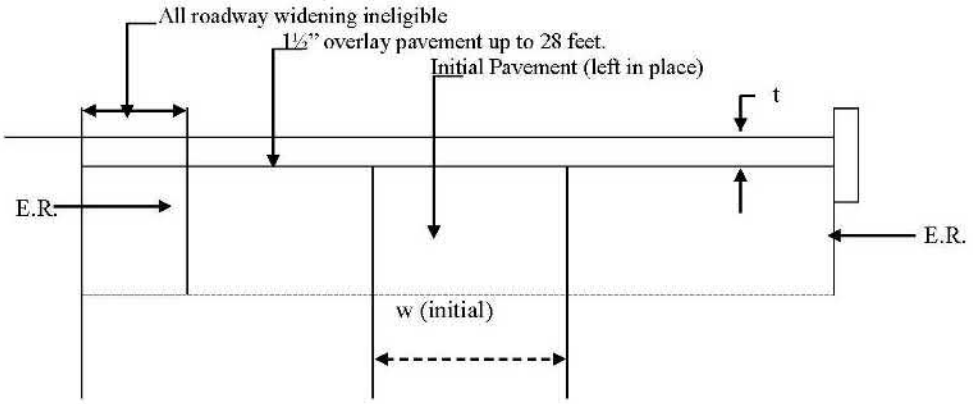
OPTION I Permanent Trench Pavement




d*= depth of existing pavement trench to a maximum of 3 inches (see general notes #3)
w = maximum eligible permanent pavement width as described in paragraphs "A" & "B". equals initial width plus 2 feet and includes:

- Cutting edges for the permanent trench
- Removal of initial patch plus two feet of existing pavement
- Fine grading/compacting gravel
- Placement of Permanent Trench pavement in two courses.

OPTION II Curb to Curb Pavement (overlay pavement for roadways up to 28 feet)




E.R.= edge of existing paved roadway
t = one and one half inch (1½") overlay of bituminous concrete pavement

GENERAL NOTES:

1. Repavement of settled areas and crown restoration within the trench limits shall be the responsibility of the contractor.
2. Leveling outside the trench limits shall be the responsibility of the owner.
3. Sewer trench re-fill and pavement re-paving on public ways under the jurisdiction of the Massachusetts Department of Public Works, the Metropolitan District Commission, or other such agency shall be in accordance with permit(s) issued therefor by that Department or Commission, as the case may be.
4. The Division will consider requests for increase in the participating pay limits defined in paragraphs A and B, when such increases are, in the Division's opinion, reasonable. Such requests should be documented in writing and submitted to the Division in a timely manner.
5. Projects which deviate from the above options are required to seek Division review and approval.

**POLICY MEMORANDUM NO. CG-9 PIPE TESTING**

Monthly payment estimates shall be prepared in accordance with contract documents. All pipe shall be tested in accordance with the contract documents and sound engineering practice. If, after 60 days following submission of a monthly payment estimate for pipe items, the pipe for which payment is requested has not been successfully tested, the owner may withhold up to 10% of the amount requested for such pipe items until the pipe has been so tested. However, in the case of a major (pipe diameter 24 inches or greater) interceptor pipe installation, sums retained by the owner pursuant to this policy memorandum shall not exceed two per centum (2%) of the costs of such pipe items.

**POLICY MEMORANDUM NO. CG-10 CHANGE ORDERS**

Executed change orders submitted to the Division for review and processing for financial assistance must be prepared on the attached Change Order Forms (CG-10, Attachment 1, pages A-1 & A-2) with a duplicate copy, calculation sheet(s) (CG-10, Attachment 2), and all other supporting documentation necessary for evaluation. Failure to comply with these instructions will result in delays in processing the change order and/or limited financial assistance.

M.G.L. c.44, s.31C requires that the auditor, accountant, or other municipal officer having similar duties must certify that adequate funding in an amount sufficient to cover the total cost of the change order has been made. Change orders will not be processed or approved until this certification is made on the face of the Change Order Form (CG-10 Attachment 1).

Payment of Change Orders:

Payment of all change orders shall be in accordance with the relevant provisions of Massachusetts General laws, Chapter 30, Section 39G for non-building construction and Section 39K for building construction.

Payment of change orders shall be made in accordance with one of the following three methods:

A. Existing unit prices as set forth in the contract; or

B. Agreed upon lump sum or unit prices; or

C. Time and materials

A. Payment for work for which there is a unit price in the contract:

Where the contract contains a unit price for work and the Engineer orders a change for work of the same kind as other work contained in the contract and is performed under similar physical conditions, the contractor may accept full and final payment at the contract unit price(s) for the acceptable quantities.

B. Payment for work or materials for which no price is contained in the contract:

If the Engineer directs, the contractor shall submit promptly in writing to the Engineer and offer to do the required work on a lump sum or unit price basis, as specified by the Engineer. The stated price, either lump sum or unit price, shall be divided so as to show that it is the sum of:

(1) The estimated cost of labor, plus

(2) Direct Labor Cost, plus

(3) Material and Freight Costs, plus

(4) Equipment Costs, plus

(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),

(6) In the case of work done by a subcontractor and amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,

(7) Credits for work deleted from the contract.

C. Payment for work on a time and materials basis:

Unless an agreed lump sum and/or unit price is obtained from above and is so stated in the change price, the contractor shall accept as full payment for which no other agreement is contained in contract, and amount equal to:

(1) The estimated cost of Labor, plus

(2) Direct Labor Cost, plus

(3) Material and Freight Costs, plus

(4) Equipment Costs, plus

(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),

(6) In the case of work done by a subcontractor and amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,

(7) Credits for work deleted from the contract.

Explanation of items (1) through (7) as outlined in "B" and "C":

(1) Labor – Only those workers employed on the project who are doing the extra work, including the foreman in charge, are allowable. General foremen, superintendents, or other supervisory personnel are considered to be included in the overhead markup as provided in items (5) and/or (6). Hourly labor rates in excess of those as listed in the contract wage rates (Federal or State, whichever applies require documentation. As a minimum, an explanation and the appropriate copy of the certified payroll are required.

(2) Direct Labor Costs - These costs are limited to those which are required in the contract document. Coverage in excess of the contract provisions, secured by the contractor/subcontractor(s) at his option, are ineligible for financial assistance. The following list of typical direct labor charges is provided for your assistance and is in no way intended to be complete or all encompassing:

- Workman's Compensation
- Federal/State: Social Security Tax and Unemployment Tax;
- Health, Welfare and Pension Benefits; (this cost is included in the wage rates appearing in the Mass. Wage Rates of the contract specifications)
- Liability Insurance: Bodily Injury; Excess Umbrella Property damage Public Liability
- Blasters Insurance
- Builders Risk Insurance
- Experience Modification Insurance
- Surcharges

If applied to any required direct labor costs.

Following award and prior to execution of a construction contract, the contractor and filed sub-bidders (where applicable) shall submit for review by the owner, documentation to establish the Direct Labor Cost percentage(s) (Direct Labor markup percentage(s)).

The documented direct labor markup for this contract may be adjusted on an annual basis as measured from the date the contract is executed. The contract agreement will provide for the establishment of the Direct Labor Cost percentage.

(3) Material and Freight – Only those materials required as a result of the change order and reasonable freight charges for delivery of same are allowable.

(4) Equipment – Only the equipment required as a result of the change order is allowable. Equipment rental rates shall be governed by the current Nielson/Dataquest Rental Rate bluebook for Construction Equipment (the "Bluebook"). In determining the rental rate the following shall apply:

(a) For equipment already on the project – the monthly prorated rental rate by the hourly use shall be applicable;

(b) For equipment not on the project the daily rate, the weekly rate, or monthly rate will prevail, whichever will prove to be most cost effective. Small tools and manual equipment are examples of costs not allowable under this item. These costs are considered to be included in the overhead markup as provided in items (5) and/or (6)

(1 month (normal use) = 176 hours)

(5) & (6) Overhead and Profit – All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

(7) Credits – Work deleted, material and equipment removed from the contractor, stored and/or returned shall be credited to the cost of the change order, less costs.

The Contractor shall furnish itemized statements of the cost of the work ordered and shall give the Engineer access to all accounts, bills and vouchers relating thereto; and unless the Contractor shall furnish such itemized statements, and access to all accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is sought by the Engineer. Deviations from any of the above will be reviewed for financial assistance on a case-by-case basis.

The change order will be prepared in such manner as to clearly separate Eligible and Ineligible Costs.

Attachment 1 Page A-1

**CHANGE ORDER FORM**

SRF Number _____
Public Entity _____
Contract Number _____
Change Order Number _____

Contract Amount (As Bid) $ _____

Net Change in Contract Price (this change order) $ _____

Total Adjusted Contract Price (including this and all other change orders) $ _____

This change order extends the time to complete the work by _____ calendar days.

The extended completion date is _____

This change order checked by _____ _____
(Chief) Resident Engineer Date

This change order is requested by: _____

This change order is recommended by: _____

_____ _____ _____
Consultant Engineer P.E. Number Date

The undersigned agree to the terms of the change order.

_____ _____
Contractor Date

_____ _____
Owner Date

Certification of Appropriation under M.G.L. c.44, §31C: Adequate funding in an amount sufficient to cover the total cost of this change order is available.

By: _____ _____
Certification Officer (Auditor, accountant, treasurer) Date

**0Do not write below: this space reserved for STATE AGENCY APPROVAL**

**1DEP/DMS**

Attachment 1 Page A-2

CHANGE ORDER FORM (Continued)

**2Public Entity** _____

SRF No: _____ Contract No. _____ Change Order No. _____

**3Contract Title:** _____

**4Owner's Name:** _____

**5Owner's Address:** _____

**6Contractor's Name:** _____

**7Contractor's Address:** _____

Description of Change

Reason for Change

Attachment 2 - Page B-1

CALCULATION SHEET

| | | | | | |
|---|---|---|---|---|---|
| (1) | Labor | | | | |
| | Foreman | 10 hrs @ $10.00/hr. | $ 100.00 | | |
| | Engineer | 10 hrs @ 8.50/hr | 85.00 | | |
| | Operator | 10 hrs @ 9.50/hr | 95.00 | | |
| | Laborers | 24 hrs @ 7.00/hr | 168.00 | | $448.00 |
| (2) | Direct Labor Cost (use the agreed upon Direct Labor Cost) | | | | |
| | * (30)% of $448 | | | | |
| | * (Used for example purposes only) | | | | 134.00 |
| (3) | Materials & Freight | | | | |
| | 150 l.f. of 12" pipe @ $2.00/l.f. | | $ 300.00 | | |
| | 15 v.f. precast SMH | | 1,700.00 | | |
| | Freight (slip # _____ Enclosed) | | 25.00 | | 2,025.00 |
| (4) | Equipment | | | | |
| | 1 Backhoe | 10 hrs @ $80.00/hr | $ 800.00 | | |
| | 1 Truck-crane | 10 hrs @ $100.00/hr | 1,000.00 | | |
| | | | | | 1,800.00 |
| | Total (Items 1 through 4) | | | | 4,407.00 |
| (5) | 20% markup for Overhead, Profit | | | | |
| | 20% of $4,407 | | | | 881.00 |
| (6) | 5% markup for general contractor (if subcontractor is involved) | | | | |
| | 5% of $4,407 | | | | 220.00 |
| (7) | Credits (deductibles) | | | | -323.00 |
| | | | | Total Cost | $ 4,965.00 |

Reminder: Provide support documentation as necessary i.e. vouchers, correspondence, Calculation, photographs, reports……

**POLICY MEMORANDUM NO. CG-11 UTILITY RELOCATION**

The construction of treatment facilities, sewers, pumping stations, force mains and appurtenant work can cause the relocation of utilities. Costly relocation can sometimes be minimized by early communication and cooperation of the representatives of the municipality (owner) and the utilities.

Every possible effort should be made by the owner and each utility to establish the location of existing utilities in the vicinity of the proposed construction. The owner or its consulting engineer should make every reasonable effort to design the proposed construction so that relocation of existing utilities is minimized whenever possible. If the proposed construction is in an area of many existing utilities or in an otherwise critical area, the utilities are encouraged to mark the location of their existing utilities at the site during the design phase of the project.

During the design phase of the project, the municipality should provide timely notice to all utilities known or thought to have facilities in or proximate to the site of such future construction.

**POLICY MEMORANDUM NO. CG-12 REFUNDABLE DEPOSITS FOR PLANS AND SPECIFICATIONS**

For each set of project plans and specifications provided, the owner may require a deposit in form of cash or other appropriate security, in an amount sufficient to cover the costs of production of such plans and specifications.

Upon return of the plans and specifications to the owner within a reasonable time and in good condition, such deposit shall be refunded.

Actual mailing costs, if any, shall be borne by the party requesting such plans and specifications.

**POLICY MEMORANDUM NO. CG-13 BID OPENING PROCEDURES**

As a minimum, bid documents shall be reviewed/inspected for conformance to the following bid opening procedure in the order presented below. Failure to comply with any of these steps shall render the bid non-responsive and upon determination of such non-responsiveness, such bid shall be rejected immediately, set aside, and shall receive no further consideration.

Bid Opening Procedure

Step #1. Timeliness – The bid must be filed at the place and within the time specified therefore in the invitation to bid, and no bid shall be accepted after such time. The time at which a bid is filed should be time/date stamped or otherwise prominently noted on the bid;

Step #2. Bid Security – Properly executed bid security, in the amount and terms specified in the invitation to bid (equal to 5% of Base Bid or Highest Possible Amount considering all alternatives) shall be placed in a seal envelope and attached to the outside of the envelope containing the bid at the time of its submission;

A. Bid Bond

The Bid bond must be dated On or Before the Bid Date;
Issued by a Bonding Company Licensed in Massachusetts;
Accompanied by a Current Power of Attorney;
Signed by Surety;

B. Check

The Check must be a Certified, Cashiers or Bank Treasurer's;
Dated On or Before the Bid Date;

Step #3. Bid Signature – The bid and all accompanying documents so required shall be signed by the bidder or its authorized representative before submission;

Step #4. Addenda – All addenda shall be sent certified mail, return receipt requested, by the owner to all individuals and organizations which have received plans and specifications and shall be mailed not later than five days prior to the date established for submission of bids. All bidders shall include with their bids written acknowledgement of receipt of all addenda, which acknowledgement may be on a form provided therefore by the owner.

Alternates – Any Alternates shall be acknowledged.

Step #5. Written Dollar Amounts – The total dollar amount of each bid shall be read, and the three lowest bids shall be selected for further consideration. The remaining bids shall then be set aside. The three apparent low bids shall be read to determine whether the unit price for each line item of each bid has been written therein in words. If it has not, such bid shall be rejected and shall receive no further consideration. Bid amounts shall be consistent (words vs. numbers) and if words and numbers differ, the words govern. This procedure shall then be repeated with the next apparent low bid until three are acceptable which have all the unit prices written in words, at which time the lowest bid shall be announced as the apparent low bidder, and the bid opening procedure shall be closed.

The Division recommends that this policy memorandum be included in all contract specifications and that the owner's evaluator(s) use the attached form (CG-13 Attachment #1) for bid opening procedures.

The Contractor's Bid Opening Checklist also attached hereto, is for use by each contractor to assure that his bid conforms with this policy memorandum. It is recommended that the checklist (CG-13 Attachment #2) be included in information for bidders, or at the end of the bid proposal, or in some other prominent part of the bid specifications

**FORM FOR BID OPENING PROCEDURES**

(to be completed by the owner's evaluator(s))

CONTRACT NO.: _____ DATE: _____

CONTRACT NAME: _____ BID OPENING TIME: _____

*All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with any one of the requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.*

*A = Acceptable* *N-R = Non-Responsive (explain reasons on supplemental sheet & attach)*

| BIDDER | | 1. TIMELINESS | 2. BID SECURITY | 3. SIGNATURE | 4. ADDENDA ALTERNATIVES | 5. WRITTEN DOLLAR AMOUNTS | COMPLIANCE (CIRCLE ONE) | |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | YES | NO |
| 2 | | | | | | | YES | NO |
| 3 | | | | | | | YES | NO |
| 4 | | | | | | | YES | NO |
| 5 | | | | | | | YES | NO |
| 6 | | | | | | | YES | NO |
| 7 | | | | | | | YES | NO |
| 8 | | | | | | | YES | NO |
| 9 | | | | | | | YES | NO |
| 10 | | | | | | | YES | NO |
| 11 | | | | | | | YES | NO |
| 12 | | | | | | | YES | NO |

DEP/DMS

Evaluator(s) _____

_____

_____

CG-13 Attachment #1

BID OPENING PROCEDURES
CONTRACTORS CHECKLIST

CONTRACT NO.: _____ BIDDER: _____ DATE: _____

All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with one or more of the following requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.

| ITEM | REQUIREMENTS | COMPLIANCE (CIRCLE 1) | | REASONS FOR REJECTION |
|---|---|---|---|---|
| 1. Timeliness | Bid filed w/in time specified | Yes | No; Rejected | |
| 2. Bid Security | Appropriate and properly Executed security w/bid. | Yes | No; Rejected | |
| 3. Signature | Bid signed by authorized Representative | Yes | No; Rejected | |
| 4. Addenda | 8All addenda acknowledge<br>Any alternative | Yes | No; Rejected | |
| 5. Dollar Amount | Dollar amount in words Specified for each line item in bid | Yes | No; Rejected | |

DEP/DMS Attachment #2

**POLICY MEMORANDUM NO. CG-14 PAYMENT FOR ROCK EXCAVATION**

There shall be in the contract documents a separate pay item for rock excavation. For such purposes, "rock" shall mean igneous, sedimentary, metamorphic, and conglomerate rock, which for excavation must be drilled, blasted, broken, or ripped by power tools. Boulders and concrete structures one cubic yard or greater, however removed, are included within this definition of rock for payment purposes. At the option of the owner or his representative a separate pay item for boulders, concrete structures, or concrete road base may be used.

| Depth From Ground Surface To Invert Pipe | Pay Width (Nominal Pipe Diameter) | |
|---|---|---|
| | 0-24" | Over 24" |
| * 0 – 12' | 5'0" | D+3'0" |
| * Over 12' – 20' | 7'0" | D+5' |

Engineer's plans and specifications shall establish pay limits below pipe and structures.

- See CG-14 Attachment #1 (typical cross section)

Payment width for depths over twenty feet (20') shall be determined on a case-by-case basis consistent with the foregoing chart.

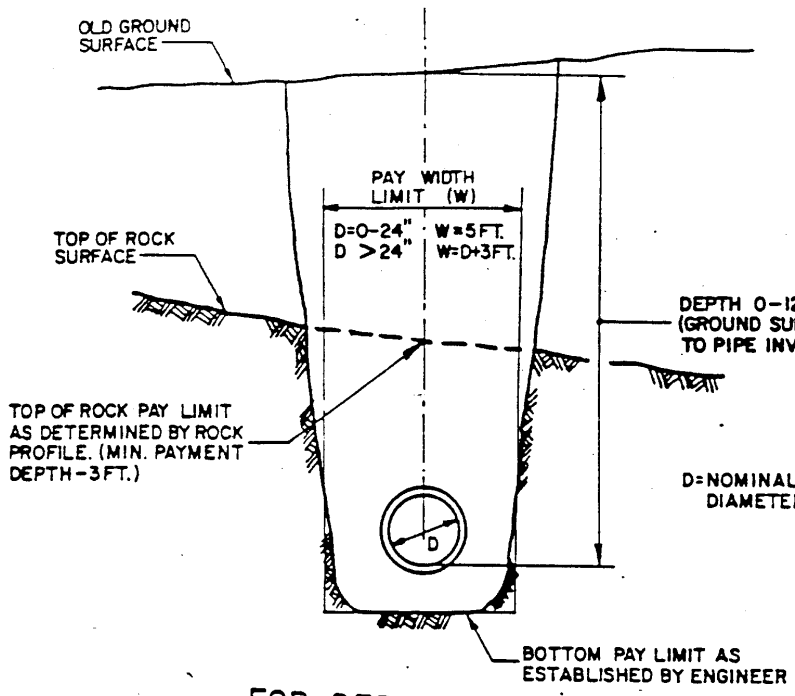
The pay limit for rock removal outside proposed manholes shall commence one foot (1') outside the widest dimension of the structure of shall be the maximum connecting trench width, whichever is greater.

Payment depth for rock which is encountered in a trench shall be no less than three feet (3') when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.

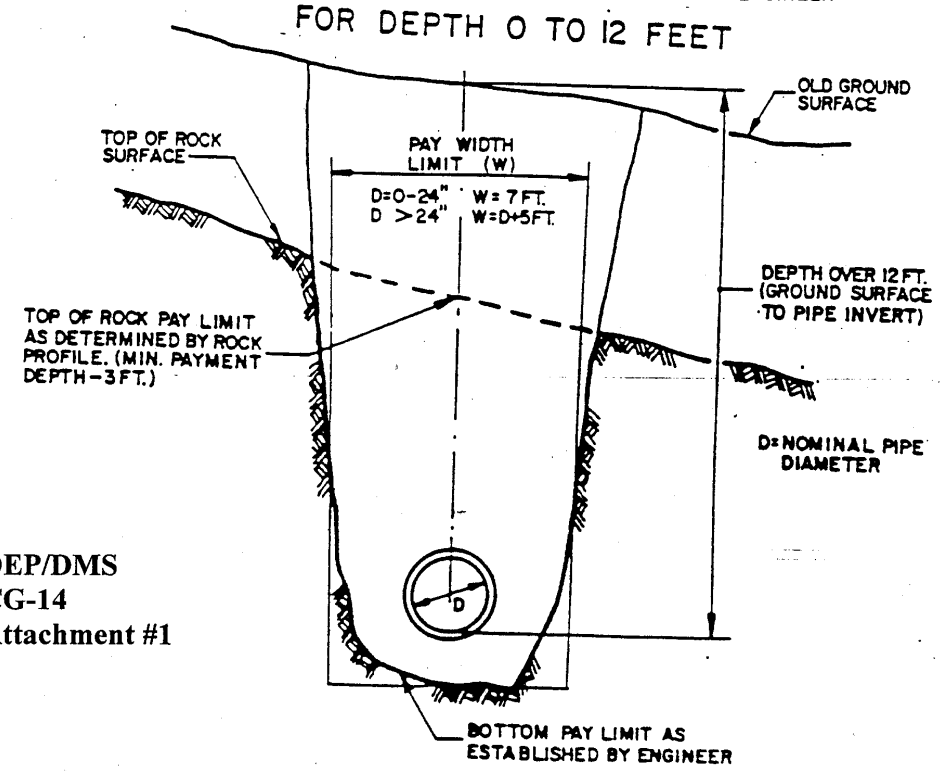
Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

Boulders encountered within the pay limits of excavation, whose volume is one cubic yard or greater, part of which extends outside said limits shall be paid in accordance with the actual volume excavated.

# CG-14 ROCK EXCAVATION




FOR DEPTH 0 TO 12 FEET




**DEP/DMS**
**CG-14**
**Attachment #1**

FOR DEPTH OVER 12 FEET AND UP TO 20 FEET

**POLICY MEMORANDUM NO. CG-15 TRAFFIC POLICE**

The reasonable costs for police details required for traffic control on a construction project which receives financial assistance shall be considered as an eligible administrative cost. A police detail item shall not be included as a bid item in the contract documents.

"Police" as used in this memorandum includes local, county, capital, state, regular and auxiliary police.

Owner's Responsibility

It shall be the owner's responsibility to submit in writing the hourly rate of pay to be established for detailed traffic police and each change in rate during the course of the project. It is the owner's responsibility to arrange, document and pay for such police details. The owner or its representative shall meet with the police chief or other officer in charge of police detail duty to review contract needs. The owner shall maintain a daily record of the following:

a. Officer's name
b. Hours worked
c. Location of assignment
d. Hourly rate

**POLICY MEMORANDUM NO. CG-16 DOCUMENTATION REQUIRED TO SUBSTANTIATE CONTRACT QUANTITIES**

| Unit | Documentation required |
|---|---|
| Acres (A) | Location, station, offset and calculations.<br>Location = Street right-of-way, etc.<br>Station = Point on Baseline;<br>Offset = Distance left or right of Baseline |
| Cubic Yard (C.Y.) | Location, stations, widths, depths, calculations and Cross sections as necessary |
| Each (Ea.) | Location, station, and offset |
| Gallon (Gal.) | Location, stations, calculations (if appropriate) and delivery slips. |
| Hour (Hr.) | Hours and location. |
| Linear Feet (L.F.) | Location, stations, and offsets. |
| Month (Mo.) | Location, period of time and calculations if applicable. |

| | |
|---|---|
| 1000 Foot Board Measure (MFBM) | Location, stations, offset, elevations, grade, and calculations. Attach invoices where applicable. |
| Pound (Lb.) | Locations, stations, and calculations (if applicable). Attach Delivery weight slips. |
| Square Feet (S.F.) | Locations, stations and calculations |
| Square Yard (S.Y.) | Locations, stations and calculations |
| Ton | Locations, stations and calculations (if applicable). Attach Delivery weight slips. |
| Vertical Feet (V.F.) | Locations, stations, elevations, and offsets. |

Notes:

1. All of the above, that apply must be submitted with a final payment request or change order as applicable.
2. Where in place measurement is not possible or practical, delivery slips may be used to substantiate quantities.
3. Change orders – See CG-10 in which some of the above may be applicable in justifying materials, equipment and labor.
4. When necessary, itemized quantities must be separated into eligible and non-eligible units with separate calculations to justify eligible costs.
5. Overruns and underruns of any specific item shall be explained with an appropriate sentence or paragraph.
6. On all quantities, units of payment shall be maintained at the project site and shall be updated daily so that upon field inspection by the C.O.E., EPA or DMS, the quantities paid to date can be substantiated.
7. In the case of unforeseen conditions, photos should be submitted with the applicable item in addition to the recommended documentation.
8. Documentation of units of payment shall be clearly legible and cross referenced to the applicable sheets of the record drawings.
9. For record drawings policy, please see CG-4.

*DMS Policies 1 through 16 Approved By: Division of Municipal Services*

# *DWS POLICY 88-02*
# *DEPARTMENT OF ENVIRONMENTAL PROTECTION*
# *POLICY FOR REVIEW OF SEWER LINE/WATER SUPPLY PROTECTION*

The Department of Environmental Protection seeks to protect existing and potential water supplies from the potentially negative effects of leaking sewer lines through the adoption of a Department policy on this subject.

The following restrictions will apply to new sewer construction statewide:

Gravel Packed Wells

~ Within the 400 foot radius protective distance around gravel packed wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Tubular Wells

~ Within the 250 foot radius protective distance around tubular wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Gravel Packed and Tubular Wells

~ Within a minimum radius of 2,640 feet or unless otherwise documented by an appropriate study specifically defining the area of influence and approved by the Division of Water Supply, all sewer lines and appurtenances will be designed and constructed for maximum water tightness.

- Force Mains or Pressure Sewers: shall be tested at 150% above maximum operating pressure or 150 p.s.i. whichever is greater. Testing shall conform to the requirements of the American Water works Association (AWWA) standard c 600.

- Gravity Sewers: shall be tested by approved methods which will achieve test results for infiltration or exfiltration of less than 100 gallons/inch diameter/mile/24 hours.

- Manholes: shall be installed with watertight covers with locking or bolted and gasketed assembles. Testing for infiltration/exfiltration shall conform to the same standards as the maximum allowed for pipes in the manhole as required for gravity sewers, indicated above.

- Satisfactory test results for Force Mains, Manholes and Gravity Sewers shall be performed prior to the expiration of the contractor's one year guarantee period.

- All pumping stations within this zone shall have standby power high water alarms telemetered to an appropriated location that is manned at all times. An emergency contingency plan must be developed by the owner and approved by the BRP.

- A minimum of Class B bedding as defined by WPCF-MOP9 must be used for all piping.

- Service connections (laterals and house connections) shall be rigidly inspected by the appropriate municipal official. Certified inspection reports shall be submitted to the BRP.

Bedrock Wells

The above requirements are the same for bedrock wells, with the Department reserving the right to require more stringent controls on a case-by-case basis.

Surface Water Supplies

~ Within 100 feet of all surface water supplies and tributaries all sewer lines and appurtenances are prohibited except as required to cross tributaries or to eliminate existing or potential pollution to the water supply. In the latter case, watertight construction methods shall be use.

~ Tributary stream crossings shall employ watertight construction methods of sewer lines and manholes. Watertight construction must extend 100 feet to either side of the stream.

~ Within 1,000 feet of surface water supplies and tributaries, all pumping stations shall have standby power and high-water alarms telemetered to an appropriate location that is manned at all times. An emergency contingency plan must be developed by the owner of the wastewater treatment facility and submitted to the BRP for approval.

~ Beyond 1,000 feet and within the watershed of surface water supplies the Department may in specific circumstances after review, require additional controls.

Potential Public Water Supplies

The above requirements also apply to potential public water supplies.

Baseline Date Requirements

Two (2) copies of an appropriately scaled map(s) shall be submitted to the Department which details the proposed sewers and/or appurtenances and also includes the following:

(1) the location of all nearby existing or potential surface water supplies, tributaries thereto, and watershed boundaries;

(2) the location of existing and potential public and municipal potable groundwater supply wells.

The Department reserves the right to impose more restrictive measures than those contained in this policy as deemed appropriate.

Definitions

○ Appurtenances – all attachments to sewer lines necessary for the transport and operation and maintenance of sewer lines, including manholes, pumping station, siphons, etc.

○ Area of influence – that area of an aquifer which contributes water to a well under the most severe recharge and pumping condition that can be realistically anticipated (i.e. pumping at the safe yield of the well for 180 days without any natural recharge occurring). It is bounded by the groundwater divides which result from pumping the well and by the contact of the edge of the aquifer with less permeable materials such as till and bedrock. At some locations, streams and lakes may form recharge boundaries.

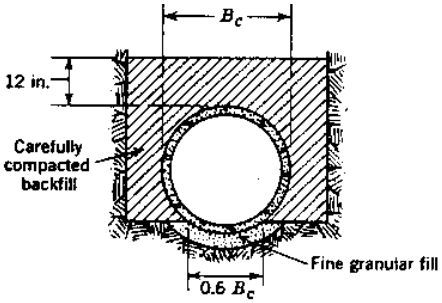
○ Potential public water supply – areas designated by communities for water supply purposes where land has been set aside and Department approved pump tests conducted and surface water supplies as defined below.

○ Surface Water Supply – Waters classified as Class A by the DWPC.

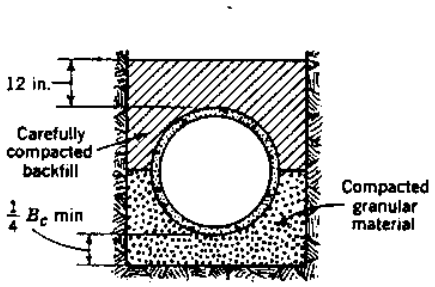
○ Public Water Supply Systems – as defined in 310 CMR 22.02 (DEP Drinking Water Regulations).

○ Class B Bedding – as defined in WPCF Manual of Practice No. 9.

APPROVED: (Signature on File)



Shaped bottom with tamped backfill, load factor 1.9



Compacted granular bedding, load factor 1.9

**Class B---First-Class Bedding** – Class B bedding may be achieved by either of two construction methods:

a. Shaped Bottom with Tamped Backfill. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 in. (5 cm) greater than the radius to the outside of the pipe and with a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 in. (30 cm) above the top of the pipe. Shaped trench bottoms are difficult to achieve under current construction conditions.

b. Compacted Granular Bedding with Tamped Backfill. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of one-fourth the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 in. (30 cm) over the top of the pipe shall be filled with carefully compacted material.

**END OF SECTION**

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**SECTION 00902**

**PROJECT SIGN**

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes furnishing all labor, equipment, tools and materials, and performing all operations in connection with furnishing, erecting, maintaining and removal / legal Disposal of the Project Sign as specified herein.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The Contractor shall include the cost for one sign as specified herein.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Drawing showing layout Project Sign.
2. Scope of supply of all materials and hardware.

### 1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed to not degrade the quality of the Project Sign.

**1.06 - DESIGN CRITERIA**

A. The Contractor shall erect a sign at the project site identifying the project information as specified herein.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

**PART 2 - PRODUCTS**

**2.01 - SUBMITTAL PROCEDURES**

A. Panel

1. Material: APA rated A-B grade – Exterior
2. Dimensions: 4-feet x 8-feet x ¾-inch

B. Posts

1. Material: Pressure Treated
2. Dimensions: 4-inch x 4-inch x 12-feet

C. Hardware shall be 5/16-inch Type 304 stainless steel nuts, washers and bolts

D. Finish

1. Front side (background) shall consist of at least three coats of white outdoor enamel paint.
2. Rear side shall be painted with one coat of white outdoor enamel paint.
3. Lettering shall be 4-inch high and either Helvetica or Arial Font and shall be painted with two coats of black outdoor enamel paint.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings.

C. Notify subcontractors involved or affected by this work and coordinate the work with them.

**3.02 – INSTALLATION, MAINTENANCE AND REMOVAL**

A. Installation

1. The sign shall be erected within 14 days after shop drawing approval and prior to the start of any construction.
2. The Project Sign shall be installed at a location identified in the field with the Engineer.
3. The Project Sign shall be installed level with the top of the sign 8 feet above natural ground and installed vertically to a minimum depth of 3-feet below natural ground.
4. Install with four nuts and bolts per post with one washer front and back.

B. Maintenance

1. The Contractor shall maintain the Project Sign throughout the direction of construction.
2. The Contractor shall repair, repaint, and/or replace the Project Sign as required to ensure that the sign

C. Removal

1. The sign shall be removed and legally dispose of within 14 days of substantial completion.
2. The location shall be restored in accordance with SECTION 02485, LOAMING AND SEEDING.

**3.03 – CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

See Attached Figure

# Downtown Area WWTF and Effluent Disposal
# Contract No. 2019-01 and SRF No 4486

Owner
Town of Orleans, MA

Owners Project Manager
Tighe & Bond
Worcester, MA

Engineer
AECOM Technical Services, Inc.
Pocasset, MA

Contractor
Name TBD
Address TBD

This Project is Funded and Administered by the US Environmental Protection Agency and the Massachusetts Department of Environmental Protection

Project Cost
$ TBD

**DOCUMENT 00945**

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

| | |
|---|---|
| Project Name: | Downtown Area WWTF and Effluent Disposal<br>Contract No. 2019-01 and SRF No. 4486 |
| Agreement Date: | |
| Owner: | Town of Orleans, MA, 139 Main Street, Orleans, MA 02653 |
| Completion Date: | |
| Contractor: | |
| Contract For: | |

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To: _____

From: _____

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

Date of Substantial Completion: _____

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of Contractor to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by Contractor within 30 calendar days of the above date of Substantial Completion.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

Owner:
1. _____
2. _____
3. _____
4. _____
5. _____

Contractor:
1. _____
2. _____
3. _____
4. _____
5. _____

The following documents are attached to and made a part of this Certificate:

1. _____
2. _____
3. _____
4. _____
5. _____

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Executed by Engineer on:

| | |
|---|---|
| | AECOM Technical Services, Inc. |
| Date | Consultant Engineer |
| | Signature |
| | Thomas Parece, P.E. |
| | Name |
| | Associate Vice President |
| | Title |

Contractor accepts this Certificate of Substantial Completion on:

| | |
|---|---|
| | |
| Date | Contractor |
| | Signature of Contractor |
| | Name |
| | Title |

Owner accepts this Certificate of Substantial Completion on:

| | |
|---|---|
| | Town of Orleans, MA |
| Date | Owner |
| | Signature of Owner |
| | John Kelly |
| | Name |
| | Town Administrator |
| | Title |

**END OF DOCUMENT**

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**DOCUMENT 00950**

**WAIVER OF LIENS**

| | |
|---|---|
| Project Name: | Downtown Area WWTF and Effluent Disposal<br>Contract No. 2019-01 and SRF No. 4486 |
| Agreement Date: | |
| Owner: | Town of Orleans, MA, 139 Main Street, Orleans, MA 02653 |
| Completion Date: | |

The undersigned Contractor hereby swears under penalty of perjury that (1) all previous progress payments received from the Owner on account of Work performed under the Contract referred to above have been applied by the undersigned to discharge, in full, all obligations of the undersigned incurred in connection with Work covered by prior Estimates for Partial Payment under said Contract, being Estimates Number 1 through 6 inclusive; and (2) all labor, materials and equipment incorporated in said Project or otherwise listed in or covered by these Estimates for Partial Payment are free and clear of all liens claims, security interests and encumbrances, except those listed below by obligee, nature and amount of obligation and covered by appropriate Bond or Bonds, as listed beside each obligation and attached to and made a part of this certification.

| Obligation | Bond |
|---|---|
| | |

Date

Contractor

Signature of Officer of the Contractor

Name of Officer of the Contractor

Title

State of: County of:

Subscribed and sworn to before me this day of

personally appeared known to me, who being duly sworn, did depose and save that he is the (Officer) of the Contractor above mentioned; that he executed the above statement on behalf of said Contractor and that all of the statements contained therein are true, correct and complete.

Notary Public

My Commission Expires:

**END OF DOCUMENT**

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**DOCUMENT 00960**

**CERTIFICATE OF FINAL PAYMENT AND COMPLETION OF WORK**

| | |
|---|---|
| Project Name: | Downtown Area WWTF and Effluent Disposal<br>Contract No. 2019-01 and SRF No. 4486 |
| Agreement Date: | |
| Owner: | Town of Orleans, MA, 139 Main Street, Orleans, MA 02653 |
| Completion Date: | |

FINAL CERTIFICATION OF CONTRACTOR

_____(Contractor), _____ (address) agrees to accept $_____ as full and final payment for all work completed under this Contract dated _____ with the Town of Orleans, MA for Contract No. 2019-01, Downtown Area WWTF and Effluent Disposal.

I certify that all construction has been carried out in substantial compliance with the Contract Documents, and that all labor, equipment, materials and Subcontractors have been or will be paid in accordance with the requirements of the General Laws of the Commonwealth of Massachusetts.

| | |
|---|---|
| Date | Contractor |
| | Signature of Officer of the Contractor |
| | Name of Officer of the Contractor |
| | Title |

**END OF DOCUMENT**

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**DOCUMENT 00965**

**TRANSFER OF TITLE**

Project Name: Downtown Area WWTF and Effluent Disposal
Contract No. 2019-01 and SRF No. 4486

Agreement Date: _____

Owner: Town of Orleans, MA, 139 Main Street, Orleans, MA 02653

_____, (Contractor), a corporation, or a partnership,

or an individual, having a principal place of business in _____

hereby transfers and conveys to the Town of Orleans, MA (Owner), title to the following material(s) delivered and stored at the

designated storage area(s) at _____

upon the receipt of $ _____, which amount is to be included in the Application and Certification

For Payment No. _____

Therefore, upon the receipt of the sum of $ _____ * paid by the Owner, the Contractor

waives all of its statutory lien rights regarding the following material. The storage, transportation, protection and ultimate installation of this material remain the responsibilities of the Contractor.

* Amount subject to reduction by applying applicable retainage percentage according to the terms of the Contract between the Owner and Contractor.

Title to the following material is being transferred by this document:

1. _____
2. _____
3. _____
4. _____
5. _____

In witness whereof, the Contractor has caused this instrument to be executed by its duly authorized representative.

| | |
|---|---|
| Date | Contractor |
| | Signature of Officer of the Contractor |
| | Name of Officer of the Contractor |
| | Title |

State of: County of:

Subscribed and sworn to before me this day of

personally appeared known to me, who being duly sworn, did depose and save that he is the (Officer) of the Contractor above mentioned; that he executed the above statement on behalf of said Contractor and that all of the statements contained therein are true, correct and complete.

Notary Public

My Commission Expires:

**END OF DOCUMENT**

**SECTION 01020**

**ALLOWANCES**

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1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS – Not Used ..... 2
1.05 - ALLOWANCES FOR PRODUCTS ..... 2
1.06 - SELECTION OF PRODUCTS UNDER ALLOWANCES ..... 2
1.07 - ADJUSTMENT OF COSTS ..... 3
PART 2 - PRODUCTS - Not Used ..... 4
PART 3 - EXECUTION - Not Used ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. Include all costs related to the scheduled allowances in the applicable bid item of DOCUMENT 00300, BID FORM. Allowance amounts listed herein have been estimated. Actual paid invoice amounts shall be used for reimbursement purposes.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Include in the Contract Price, scheduled allowances included under the applicable Bid Item of DOCUMENT 00300, BID FORM specified in the respective specification sections and listed below:

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - ALLOWANCES FOR PRODUCTS**

A. The amount of each allowance unless otherwise specified in SECTION 01025, MEASUREMENT AND PAYMENT:
   1. The cost of the product for service.
   2. Applicable taxes.

B. In addition to the amount of each allowance, include, except as specified herein, in the Contract Sum the Contractor's costs for:
   1. Handling at the site, including unloading, uncrating, and storage.
   2. Protection from the elements and from damage.
   3. Labor for installation and finishing, except where labor is specified to be a part of the Allowance.
   4. Other expenses required to complete the installation.
   5. Contractor's and Subcontractor's overhead and profit.

C. The scheduled allowances are as follows:

**SCHEDULED ALLOWANCES**

| Item Number | Description | Amount | Bid Item |
|---|---|---|---|
| 1 | Electric Company Connection/Service Fee | $125,000 | 2.J. |
| 2 | Telephone Company Connection/Service Fee | $30,000 | 2.K. |
| 3 | Gas Company Connection/Service Fee | $30,000 | 2.L. |
| 4 | Planting Operations | $30,000 | 2.M. |
| 5 | Section 11333 - Septage Receiving Station | $400,000 | 2.N. |
| 6 | Section 11399 - Effluent Disk Filters | $450,000 | 2.O. |
| 7 | Section 11600 - Sequencing Batch Reactors | $550,000 | 2.P. |
| 8 | Section 11365 - Rotary Drum Thickeners | $225,000 | 2.Q. |
| 9 | Compressed Air System | $30,000 | A-1B |
| 10 | Performance Testing | $50,000 | 2.R. |
| 11 | Diesel Fuel for Emergency Generator | $20,000 | 2.S. |

**Notes:**

1. Item No. 1 - The allowance is for the cost by the Electric Company to provide all labor, materials, tools, and equipment required for providing electrical service to the WWTF and Effluent Disposal Site.
2. Item No. 2 – The allowance is for the cost by the Telephone Company to provide all labor, materials, tools, and equipment required for providing telephone service to the WWTF.
3. Item No. 3 - The allowance is for the cost by the Gas Company to provide all labor, materials, tools, and equipment required for providing gas service to the WWTF.

4. Item No. 4 - The allowance is for the cost of the Contractor to provide all labor, materials, tools, and equipment required to purchase and plant landscaping at the WWTF and/or Effluent Disposal Site.
5. Item No. 5 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Septage Receiving Station as specified in Section 11333, Septage Receiving Station and as included in the manufacturer's proposal.
6. Item No. 6 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Effluent Disk Filters as specified in Section 11399, Effluent Disk Filters and as included in the manufacturer's proposal.
7. Item No. 7 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Sequencing Batch Reactors as specified in Section 11600, Sequencing Batch Reactors and as included in the manufacturer's proposal.
8. Item No. 8 - The allowance is for the cost of the preselected equipment manufacturer to furnish all materials required for the Rotary Drum Thickeners as specified in Section 11365, Rotary Drum Thickeners and as included in the manufacturer's proposal.
9. Item No. 9 - The allowance is for providing a complete Compressed Air System, including all equipment, piping, labor and accessories in accordance with SECTION 11140, COMPRESSED AIR SYSTEMS
10. Item No. 10 - The allowance is for the cost of the Performance Testing in accordance with SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.
11. Item No. 11 - The allowance is for the cost of the providing Diesel Fuel for the Emergency Generator in accordance with SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

**1.06 - SELECTION OF PRODUCTS UNDER ALLOWANCES**

A. Engineer's duties are as follows:
   1. Make selection in consultation with the Owner and obtain Owner's written decision, designating:
      a. Product, model and finish.
      b. Accessories and attachments.
      c. Cost to the Contractor, delivered to the Project Site or installed, as applicable.
   2. Transmit Owner's decision to the Contractor.
   3. Prepare Change Orders.

B. Contractor's duties are as follows:
   1. Obtain proposals from suppliers and installers when requested by the Engineer.
   2. Make appropriate recommendations for consideration by the Engineer.
   3. Notify the Engineer promptly of:
      a. Any reasonable objections the Contractor may have against any supplier, or party under consideration for installation.
      b. Any effect on the construction schedule anticipated by selections under consideration.

**1.07 - ADJUSTMENT OF COSTS**

A. Should the net cost be more or less than the specified amount of the allowance, the Contract Price shall be adjusted accordingly by Change Order.
   1. The amount of the Change Order will recognize any changes in handling costs at the Project Site, labor, installation costs, overhead, profit and other expenses caused by the selection under the allowance.

B. Submit any claims for anticipated additional costs at the Project Site, or other expenses caused by the selection under the allowance, prior to execution of the Work.

C. Submit documentation or actual additional costs at the Project Site, or other expenses caused by the selection under the allowance, within 60 days after completion of execution of the Work.

D. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.

E. At Contract closeout, reflect all approved changes in Contract Price in the final statement of accounting.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION - Not Used**

**END OF SECTION**

**SECTION 01025**

**MEASUREMENT AND PAYMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The purpose of this section is to define the basis of measurement and payment for each of the unit price or lump sum items listed in DOCUMENT 00410, FORM OF GENERAL BID. If no quantity or bid item appears in DOCUMENT 00410, FORM OF GENERAL BID for any of the following described items, no Work of that description is anticipated on the project.

B. The Contractor shall become acquainted with all Work associated with each Payment Item and shall have no claim for additional compensation due to unfamiliarity with the Work required to complete each Item in accordance with the Contract Documents.

C. No payment will be made for any item of Work until all documentation required by the Contract Documents has been reviewed and approved by the Engineer. No payment will be made for additional materials that are not installed on the Project. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.

**1.02 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.03 - PAYMENT ITEMS**

| Item | Description |
|---|---|
| PART I - MOBILIZATION / DEMOBILIZATION | |
| 1 | Mobilization/Demobilization |
| PART II – WWTF RELATED WORK | |
| 2A | Wastewater Treatment Facility |
| 2B | Effluent Disposal |
| 2C | Rock and/or Boulder Excavation |
| 2D | Replacement of Unsuitable Material Below Trench Grade |
| 2E | Replacement of Unsuitable Material Above Trench Grade |
| 2F | Experimental Excavation |
| 2G | Sheeting and/or Shoring Ordered Left in Place |
| 2H | Existing Perimeter Fence Repairs |
| 2I | Perimeter Fence and Gates |

| Item | Description |
|---|---|
| PART III – FILED SUBBIDS | |
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories |
| 3B | Section 05500, Miscellaneous Metal Work |
| 3C | Section 07160, Bituminous Dampproofing, Section 07900, Joint Sealants and Section 07840, Firestopping |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows |
| 3F | Section 08810, Glass and Glazing |
| 3G | Section 09300, Tile Work |
| 3H | Section 09900, Painting |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation |
| 3L | Division 16 – Electrical (All Sections) |
| PART IV - ALTERNATIVES | |
| A-1 | Addition of the Equipment Storage Facility |
| A-2 | Addition of Fiber Optic Conduits and Handholes |
| A-3 | Addition of Tracer Wire |
| A-4 | Addition of SBR Transfer Pump No. 4 |
| A-5 | Addition of SBR Blower No. 4 |
| A-6 | Addition of Two SBR Aeration Diffuser Grids (1 per SBR Tank) |

**1.04 - BASIS OF MEASUREMENT AND PAYMENT**

**PART I – MOBILIZATION / DEMOBILIZATION**

**ITEM 1 - MOBILIZATION/DEMOBILIZATION**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include transporting, mobilization, demobilization, utility connection fees, permits, licenses, bonds, insurance and all other incidental Work relative thereto.

B. Measurement. Measurement for mobilization/demobilization shall be made based on the lump sum amount bid as approved by the Engineer.

C. Payment. Payment for mobilization/demobilization listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the lump sum price bid under this Bid Item. The amount of this lump sum shall not exceed five (5) percent of the Contract amount, excluding Item 1, and no payment shall be made in excess of this amount. An amount of seventy-five (75) percent of the amount bid under Item 1 (exclusive of normal Contract retainage) will be made when the Contractor has mobilized to the Project site(s) and is ready to start construction. The remaining twenty-five (25) percent (exclusive of normal Contract retainage) will be made following demobilization from the Project site(s) following final completion and acceptance of the work by the Owner.

**PART II – WWTF RELATED WORK**

**ITEM 2A - WASTEWATER TREATMENT FACILITY**

A. General. The lump sum price bid for construction of the Wastewater Treatment Facility shall include all Work described in these Specifications, notices, Division 0 through Division 16 inclusive, and Contract Drawings, except for those items priced separately (Part I, Part II and Part III). All Allowances specified in SECTION 01020, ALLOWANCES shall be included under this Bid Item.

B. Measurement. The methods of measurement shall be based on the completed installation of the Wastewater Treatment Facility, as specified, based on the schedule of values approved by the Owner.

C. Payment.

1. Payment for Wastewater Treatment Facility listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under Item 2A based on a schedule of values approved by the Owner.

2. All Allowances specified in SECTION 01020, ALLOWANCES shall be included under this Bid Item. Payment for the allowances under Item 2A which are listed in SECTION 01020, ALLOWANCES shall be based upon the actual time and materials or Lump Sum as approved by the OWNER. If the actual costs exceed the allowance, the difference will be paid by the Owner. Should the actual cost be less than the allowance, the Owner will retain the difference. Refer to SECTION 01020, ALLOWANCES.

**ITEM 2B – EFFLUENT DISPOSAL**

A. General. The lump sum price bid for construction of the Effluent Disposal shall include all Work described in these Specifications, notices, Division 0 through Division 16 inclusive, and Contract Drawings, except for those items priced separately (Part I, Part II and Part III).

B. Measurement. The methods of measurement shall be based on the completed installation of the Effluent Disposal, as specified, based on the schedule of values approved by the Owner. The Contractor shall include the cost for 20-vertical feet of permanent steel casing in each Wick.

C. Payment.

1. Payment for Effluent Disposal listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under Item 2B based on a schedule of values approved by the Owner.

2. Payment for permanent steel casing in each Wick shall be based on the actual number of vertical feet provided.

**ITEM 2C - ROCK AND/OR BOULDER EXCAVATION**

A. General. The price bid under Item 2C shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include excavation, drilling and blasting, furnishing and placing replacement material, removal and legal disposal of rock, backfilling and compaction, monitoring blasts, and any other incidental Work relative thereto.

B. Measurement. Measurement of rock and/or boulder excavation shall be made based on the volume removed and replaced as approved by the Engineer computed, as follows:

1. Only boulders greater than one (1) cubic yard in volume, defined by the Engineer as removable only by blasting, shall be measured and paid for under this Bid Item. Measurement shall be based on the length, width and depth of boulders excavated within the trench limits.

2. Rock in pipe trenches shall be measured from its surface to a point six (6) inches below the invert of the pipe and, as follows:

a. For pipe twenty-four (24) inches or less in diameter a width of five (5) feet for depths twelve (12) feet or less and a width of seven (7) feet for depths greater than twelve (12) feet.

b. For pipe greater than twenty-four (24) inches in diameter a width of three (3) feet plus the inside diameter of the pipe for depths of twelve (12) feet or less and a width of five (5) feet plus the inside diameter of the pipe for depths greater than twelve (12) feet.

3. Rock or boulders encountered in other excavations, which are to be paid for separately, shall be measured from its surface to a point one (1) foot below the base of structure and to a width of one (1) foot outside the face of the structure.

4. Where more than one (1) pipe is installed in the same trench, payment shall be made on the basis of a common trench with the maximum trench width of seven (7) feet.

C. Payment. Payment for rock and/or boulder excavation listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under Item 2C.

1. No additional payment will be made for frost removal or for any other materials encountered in the excavations, no matter how stiff or compact of consistency, even if blasting is required for removal. Soft or disintegrated rock that can be removed without the use of explosives shall not be paid for under this Bid Item.

2. No additional payment will be made for rock and/or boulder excavation where existing utilities are removed and relaid to facilitate the Work within the trench limits defined hereinbefore.

3. Masonry or concrete structures encountered during the course of constructing the Work, which require blasting for removal, shall be paid for subject to the limits and conditions described herein.

4. No payment will be made for excavation of rock and/or boulders beyond the specified limits.

**ITEM 2D and ITEM 2E - REPLACEMENT OF UNSUITABLE MATERIAL**

A. General. The prices bid under Item 2D and Item 2E shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include excavation, sheeting or shoring not ordered left in place, dewatering, removal and legal disposal of unsuitable materials, filter cloth, furnishing and placing replacement materials, transportation, backfilling, compaction and any other incidental Work relative thereto.

B. Measurement. Measurement for replacement of unsuitable material above and below trench grade and/or subgrade shall be made based on the volume removed and replaced as approved by the Engineer and, as follows:

1. Unsuitable material below trench grade shall be measured from a point six (6) inches below the invert of pipe to the bottom of the excavation and a total width of three (3) feet plus the inside diameter of pipe for pipe twenty four (24) inches or less in diameter (minimum four (4) feet) for trench depths twelve (12) feet or less and five (5) feet plus the inside diameter of the pipe for trench depths greater than twelve (12) feet.

2. Unsuitable material above trench grade shall be measured from a point one (1) foot plus the thickness of permanent pavement thickness below the existing pavement surface or from a point six (6) inches below the existing unpaved surface to a point one (1) foot above the pipe and a total width of three (3) feet plus the inside diameter of pipe for pipe twenty four (24) inches or less in diameter (minimum four (4) feet) for trench depths twelve (12) feet or less and five (5) feet plus the inside diameter of the pipe for trench depths greater than twelve (12) feet.

3. Unsuitable material below precast concrete manholes shall be measured from a point six (6) inches below the base of the manhole to the bottom of the excavation and to a width of two (2) feet plus the outside diameter of the manhole.

4. Unsuitable material below foundations for structures shall be measured from the bottom of foundation varying in width on a forty-five (45) degree angle down and out two (2) feet from the bottom edges of foundation to a depth approved by the Engineer.

C. Payment. Payment for replacement of unsuitable material above and below trench grade and/or subgrade listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under the applicable division of Item 2D and Item 2E.

1. No payment will be made for replacement of suitable material above trench grade when suitable excess excavated material is available from other excavations made under this Project.

2. Bedding material placed from a point six (6) inches below the invert of pipe, to a point one (1) foot above the top of the pipe shall be included for payment under the applicable pipe laying Bid Item.

3. When more than one (1) pipe is installed in the same trench, payment will be based on a common trench with a minimum width of seven (7) feet.

4. No payment will be made for unsuitable material replaced beyond the limits approved by the Engineer.

**ITEM 2F - EXPERIMENTAL EXCAVATION**

A. General. The price bid under Item 2F shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include notification of utility owners, machine and/or hand excavation to locate utilities, backfill, compaction, maintaining utility marking locations, repair to utilities damaged while performing experimental excavations, temporary bituminous concrete patch, furnishing assistance to the Engineer and all other incidental Work relative thereto.

B. Measurement. Measurement of experimental excavation shall be made based on the volume excavated and backfilled as approved by the Engineer.

C. Payment. Payment for experimental excavation listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per cubic yard under Item 2F. No payment will be made for any cost associated with damages caused to existing utilities made during the performance of experimental excavation operations.

**ITEM 2G - SHEETING AND/OR SHORING ORDERED LEFT IN PLACE**

A. General. The price bid under Item 2G shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for complete and permanent earth support system(s), located at locations approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement of sheeting and/or shoring ordered left in place shall be made based on the square feet of sheeting and/or shoring left in place as approved by the Engineer, computed as follows.

1. Measurement of the length of sheeting and/or shoring left in place shall be the actual measured horizontal length of sheeting and/or shoring installed.

2. Measurement of the depth of sheeting and/or shoring left in place shall be made vertically from one (1) foot below the bottom of the structure slab to five (5) feet below finish grade.

C. Payment. Payment for sheeting and/or shoring ordered left in place listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the unit price bid per square foot under Item 2G.

1. No payment will be made for sheeting and/or shoring left in place outside of the measurement for payment limits specified.

**ITEM 2H - EXISTING PERIMETER FENCE REPAIRS**

A. General. The price bid under Item 2H shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for Existing Perimeter Fence Repairs, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on a percentage complete, as approved by the Engineer.

C. Payment. Payment for Existing Perimeter Fence Repairs listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under Item 2H.

**ITEM 2I - PERIMETER FENCE AND GATES**

A. General. The price bid under Item 2I shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified for the new Perimeter Fence and Gates and removal and legal disposal of the existing wood stockade fence as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on a percentage complete, as approved by the Engineer.

C. Payment. Payment for Perimeter Fence and Gates listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under Item 2I.

**PART III – FILED SUBBIDS**

A. General. The lump sum price bid for subbids for all work described in the Contract Documents.

B. Measurement. Measurement shall be based on the work required in the following sections of the Specifications:

| Item | Description |
|---|---|
| 3A | Section 04120, Stone Veneer and Section 04200, Unit Masonry and Accessories |
| 3B | Section 05500, Miscellaneous Metal Work |
| 3C | Section 07160, Bituminous Dampproofing, Section 07840, Firestopping, and Section 07900, Joint Sealants |
| 3D | Section 07610, Metal Roofing and Section 07710, Roof Specialties |
| 3E | Section 08500, Fixed Windows and Section 08550, Windows |
| 3F | Section 08810, Glass and Glazing |
| 3G | Section 09300, Tile Work |
| 3H | Section 09900, Painting |
| 3I | Section 15300, Automatic Wet-Pipe Sprinkler Systems |
| 3J | Section 15400, Plumbing and Section 15195, Natural Gas Piping |
| 3K | Section 15500, Heating, Ventilating and Air Conditioning and Section 15520, HVAC Insultation |
| 3L | Division 16 – Electrical (All Sections) |

C. Payment. Payment for subbids shall be at the lump sum price bid for all work described in the Contract Documents.

**PART IV – ALTERNATIVES**

**ITEM A-1 – EQUIPMENT STORAGE FACILITY**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for Equipment Storage Facility, as approved by the Engineer, and all other incidental Work relative thereto.

B. Measurement. Measurement shall be made based on providing the Equipment Storage Facility, as approved by the Engineer.

C. Payment. Payment for Equipment Storage Facility listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-2 - FIBER OPTIC CONDUITS AND HANDHOLES**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include placement of conduits, handholes, fiber optic cable, radio communications as shown on the contract drawings and all other incidental Work relative thereto in place of providing radio communications at the WWTF, Pump Station No. 2 and Pump Station No. 3 as shown on the contract drawings and Pump Station No. 1 and Effluent Disposal Site (Addendum No. 5).

B. Measurement. Measurement shall be made based on providing the Fiber Optic Conduits and Handholes, as approved by the Engineer. Contractor shall include: (a) the cost to provide (i.e. furnish, install, terminate and test fiber optic cable, etc.) fiber optic conduits, handholes and fiber optic cable at the WWTF Site and Effluent Disposal Site; and (b) the cost to provide (i.e. furnish, install, terminate and test fiber optic cable, etc.) fiber optic cable in the fiber optic conduits and handholes installed as part of Contract No. 2019-02 , Downtown Area Collection System and Pumping Stations.

C. Payment. Payment for Fiber Optic Conduits, Handholes and Fiber Optic Cable listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-3 – TRACER WIRE**

**A.** General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include placement of tracer wire, connectors, termination points, grounding, testing and all other incidental Work relative thereto. The Work of this section shall be provided by the General Contractor.

B. Measurement. Measurement shall be made based on providing the Tracer Wire, as approved by the Engineer.

C. Payment. Payment for Tracer Wire listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under this Bid Item.

**ITEM A-4 – SBR TRANSFER PUMP NO. 4**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for SBR Transfer Pump No. 4, as approved by the Engineer, and all other incidental Work relative thereto. All equipment, piping, valves, electrical work and instrumentation and the like for SBR Transfer Pump No. 4 shall be furnished in accordance with drawings and specifications for SBR Transfer Pumps No. 1, 2 and 3. All piping, valves and fittings and the like shown in "gray" or "dashed" on the Drawing 10 D-102 - Facility Lower Plan II shall be included as part of the scope of work of Bid Item A-4. The work is shown on the following drawings:

1. Drawing 00 D-006 - Process Flow Diagram I
2. Drawing 10 D-102 - Facility Lower Plan II
3. Drawing 10 E-006 - WWTF – Electrical Single Line Diagram II – MCC.10-1
4. Drawing 10 E-102 - WWTF – Lower Level – Power Plan II
5. Drawing 10 DI-603 - SBR Transfer Pumps P&ID

C. Measurement. Measurement shall be made based on providing SBR Transfer Pump No. 4, as approved by the Engineer.

D. Payment. Payment for SBR Transfer Pump No. 4listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under this Bid Item.

**ITEM A-5 – SBR BLOWER NO. 4**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for SBR Blower No. 4, as approved by the Engineer, and all other incidental Work relative thereto. All equipment, piping, valves, electrical work and instrumentation and the like for SBR Blower No. 4, shall be furnished in accordance with drawings and specifications for SBR Blowers No. 1, 2 and 3. All piping, valves and fittings and the like shown in "gray" or "dashed" on the Drawing 10 D-103 - Facility Lower Plan III shall be included as part of the scope of work of Bid Item A-5. The work is shown on the following drawings:

1. Drawing 00 D-006 - Process Flow Diagram I
2. Drawing 10 D-103 - Facility Lower Plan III
3. Drawing 10 E-005 - WWTF – Electrical Single Line Diagram I – SWBD.10-1
4. Drawing 10 E-102 - WWTF – Lower Level – Power Plan II
5. Drawing 10 DI-610 - SBR Blowers P&ID

B. Measurement. Measurement shall be made based on providing SBR Blower No. 4, as approved by the Engineer.

C. Payment. Payment for SBR Blower No. 4listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**ITEM A-6 – SBR AERATION DIFFUSER GRIDS**

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, for two SBR Aeration Diffuser Grids (1 per SBR Tank), as approved by the Engineer, and all other incidental Work relative thereto. All equipment, piping, valves

and the like for thirds SBR Aeration Diffuser Grid in each SBR Tank, shall be furnished in accordance with drawings and specifications for the first two SBR Aeration Diffuser Grids furnished in each SBR Tank. The SBR Drawings show the locations of the three aeration grids in each basin. Two aeration grids in each basin are to be furnished under the Base Bid and associated allowance for SECTION 11600, SEQUENCING BATCH REACTORS. The third aeration grid in each basin are to be furnished under this bid item. The work is shown on the following drawings

1. Drawing 15 D-101 - SBR Lower Plan I *
2. Drawing 15 D-102 - SBR Lower Plan II *
3. Drawing 15 D-103 -SBR Upper Plan I *
4. Drawing 15 D-104 -SBR Upper Plan II *
5. Drawing 15 E-101 - SBRS – Power Plan

*Two Base Bid Diffusers Shown and the Third Diffuser Shown Horizontally

C. Measurement. Measurement shall be made based on providing two SBR Aeration Diffuser Grids (1 per SBR Tank), as approved by the Engineer.

D. Payment. Payment for two SBR Aeration Diffuser Grids (1 per SBR Tank) listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum bid under the Bid Item.

**PART 2 - PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF SECTION**

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**SECTION 01026**

**PAYMENT PROCEDURES**

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PART 2 – PRODUCTS – Not Used ..... 3
PART 3 – EXECUTION – Not Used ..... 3

## PART 1 – GENERAL

### 1.01 - FORMAT

A. Form of General Bid, submitted by the Successful Bidder, as modified by any executed Change Order, will be the basis of all payments to the Contractor. The Engineer may require further breakdown of certain lump sum items to be included as deemed necessary by the Engineer. The Form of General Bid will serve as the basis for progress payments and will be incorporated into a form of Application for Payment as specified herein.

B. Contractor shall submit two Applications for Payment and invoices, covering the Work, less retainage, as specified in the Agreement, performed in each calendar month, for each month for the duration of the Work.

C. Contractor shall submit to the Engineer an Application for Payment on the specified form, provided by the Engineer in Microsoft Excel format, and attach a separate invoice, for the Work completed in the calendar month covered by that Application for Payment. Contractor shall submit each Application for Payment using AECOM Form S702 – Application and Certification for Payment, and AECOM Form S703 – Continuation Sheet, attached to this Specification. The Form of General Bid shall form the basis for Form S703.

D. The Engineer shall return, without review, any invoice not accompanied by completed S702 and S703 forms.

### 1.02 - SUBMITTAL PROCEDURES

A. Contractor shall submit original Application for Payment and invoice, and one copy of each, to the Engineer's Work Order Representative for review.

B. Once invoice is approved by Engineer, Contractor shall submit invoice to Owner per the requirements in the Agreement.

C. Contractor shall submit invoices at intervals not less than 30 days. Contractor shall submit an invoice for each month no later than the invoice closing date of the following month as set by the Engineer.

D. Contractor shall prepare a final Application for Payment and invoice as specified in Specifications SECTION 01700, CONTRACT CLOSEOUT.

**1.03 - APPLICATIONS FOR PAYMENT**

A. An Application for Payment form is attached with this Specification. A completed copy of the attached AECOM Forms S702 and S703 shall accompany each invoice.

B. Applications for Payment shall be executed and certified by signature of authorized officer of Contractor in the space indicated on Form S702.

C. Contractor shall list original Work Order amount, and each authorized Change Order and Work Change Directive, listing Change Order or Work Change Directive number and dollar amount.

D. Retainage in the amount of 5 percent shall be withheld as specified in the Agreement. This retainage shall be itemized on the Form S702 and Form S703 form.

E. Fair market value for work not completed shall be withheld as specified in the Agreement. This fair market value shall be itemized on the Form S702 and Form S703 form

**1.04 - INVOICES**

A. Each invoice shall be accompanied by the specified Application for Payment form and shall show the following:

1. The date of the Contract Documents.
2. Purchase Order Number.
3. Purchase Order Date.
4. A description of the Work performed (the description of the Work shall document site location, Project code number, and detail the actual Work performed and completed).

B. Invoices that include previously approved Work performed on a Time and Materials (T&M) or Cost Plus (CP) basis shall be supported with copies of daily time sheets, and Contractor shall attach photocopies of receipts for all materials and expenses claimed as T&M or CP Work. Lack of complete documentation for T&M or CP Work will be just cause for refusal by the Engineer to certify payment for such claimed costs, pending submittal of required documentation. All documentation shall be submitted and approved prior to invoice submittal. Contractor shall submit backup copies of all required paperwork that was previously submitted as a part of a daily or weekly submittal.

C. Each invoice shall be accompanied by Certified Payroll for the entire period of the invoice.

**1.05 - SUBSTANTIATING DATA**

A. The Engineer may request substantiating data for any claimed payment. When the Engineer requires substantiating data, Contractor shall submit within 30 days data justifying quantities of Work and dollar amounts in question. The Engineer may conditionally approve any claimed payment pending submittal of acceptable substantiating data. Unsubstantiated claims for payment will result in withholding of the unsubstantiated amounts from subsequent payment claims.

B. Contractor shall submit one copy of substantiating data with cover letter for each request for substantiating data. Each submittal of substantiating data shall show Application for Payment number, date and pay item by number and description.

**1.06 - PAYMENT PROCEDURES**

A. For unit price bid items, the product of the actual measured quantities suitably installed and accepted and the unit prices from the accepted bid proposal constitutes the extended total for payment. The extended total is the unit price times the quantity indicated. An adjustment of the unit price bid for an item in the proposal will only be considered if the actual quantity furnished and installed is greater than 25 percent above or below the estimated quantity. Said adjustment will only be applicable to that measured quantity which is 25 percent above or below the estimated quantity. For Lump Sum items suitability installed and completed the lump sum amount listed in the accepted bid proposal constitutes the total for payment.

B. Progress Payments; Retainage. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, and in accordance with the applicable Massachusetts General Law during construction. All such payments will be measured by the schedule of values established in

C. Article 14.01 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

D. Progress payments will be made in an amount equal to 95 percent of Work completed (with the balance being retainage) but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with the General Conditions.

E. Final Payment. Upon final completion and acceptance of the Work in accordance with the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER.

**PART 2 – PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF TEXT**

SEE ATTACHED PAYMENT FORM

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**APPLICATION AND CERTIFICATION FOR PAYMENT** **Form S702** PAGE ONE OF PAGES

TO: Town of Orleans, MA

PROJECT: Downtown Area WWTF and Effluent Disposal

APPLICATION NO:

Distribution to:
☐ ENGINEER
☐ CONTRACTOR

FROM CONTRACTOR:

PERIOD ENDING:

ENGINEER'S PROJECT NO:

CONTRACT FOR:

CONTRACT DATE:

Application is made for payment, as shown below, in connection with the Contract. AECOM Form S703 Continuation Sheet is attached.

1. ORIGINAL CONTRACT PRICE $ _____
2. Net change by Change Orders $ _____
3. CONTRACT PRICE TO DATE (Line 1 + 2) $ _____
4. TOTAL COMPLETED & STORED TO DATE (Column G on Continuation Sheet) $ _____
5. RETAINAGE/FAIR MARKET VALUE:
   a. 5% of Completed Work (Column D + E on Continuation Sheet) $ _____
   b. Materials Stored to Date (Column F on Continuation Sheet) $ _____
   c. Fair Market Value for Work Not Completed $ _____
   Total $ _____
6. TOTAL EARNED LESS RETAINAGE / FAIR MARKET VALUE (Line 4 Less Line 5 Total) $ _____
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate) $ _____
8. CURRENT PAYMENT DUE $ _____
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 Less Line 6) $ _____

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief, the Work covered by this Application for Payment has been completed in accordance with the Specifications and Drawings, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By:_____ Date:_____

State of: County of:
Subscribed and sworn to before me this ___ day of _____, ____
Notary Public:
My Commission expires:

ENGINEER'S RECOMMENDATION FOR PAYMENT

In accordance with the Agreement, Specifications and Drawings, based on on-site observations and the data comprising the application, the Engineer recommends that to the best of the Engineer's knowledge, information and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Specifications and Drawings, and the Contractor is entitled to payment of the Amount Recommended.

AMOUNT RECOMMENDED $ _____

(Attach explanation if Amount Recommended differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

| CHANGE ORDER SUMMARY | ADDITIONS | DEDUCTIONS |
|---|---|---|
| Total changes approved in previous months by Owner | | |
| Total approved this Month | | |
| TOTALS | | |
| NET CHANGES by Change Order | | |

ENGINEER:

By: _____ Date: _____

OWNER:

By: _____ Date: _____

**CONTINUATION SHEET** **Form S703** PAGE __ OF __ PAGES

1. Form S702, APPLICATION AND CERTIFICATION FOR PAYMENT,

APPLICATION NO:

APPLICATION DATE:

including Contractor's signed certification is attached.

2. In tabulations below, amounts are stated to the nearest dollar. PERIOD ENDING:

3. Use Column I on contracts where variable retainage for line items may apply.

| A | B | C | D | E | F | G | | H | I |
|---|---|---|---|---|---|---|---|---|---|
| ITEM NO. | DESCRIPTION OF WORK | SCHEDULED VALUE | WORK COMPLETED | | MATERIALS PRESENTLY STORED (NOT IN D OR E) | TOTAL COMPLETED AND STORED TO DATE (D+E+F) | % (G/C) | BALANCE TO FINISH (C - G) | RETAINAGE / FAIR MARKET VALUE |
| | | | TOTAL FROM PREVIOUS APPLICATION | THIS PERIOD | | | | | |
| | | | | | | | | | |
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| | | | | | | | | | |
| | GRAND TOTALS | | | | | | | | |

**SECTION 01030**

**SPECIAL REQUIREMENTS**

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**PART 1 - GENERAL**

**1.01 - SCOPE**

A. The Work of this section includes the furnishing of all labor, materials, tools and equipment required to perform Special Requirements as specified herein.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for Work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT and as follows:

1. All costs associated with locating, maintaining location marks, excavation, refilling, compaction, repairing utilities broken due to the Contractor's operations, time delays relative to existing utilities and all other Work associated with utilities shall be included for payment under the applicable pipe laying item included in DOCUMENT 0410, BID FORM.

2. All costs associated with the legal disposal of excess materials shall be borne by the Contractor.

3. No additional payment will be made for corrective work associated with furnishing and installing bedding materials for refill of excavations carried to grades lower than specified. If inadequate dewatering methods cause softening of subgrade areas then remove the unsuitable material and replaced with common fill and shall be borne by the Contractor.

4. No payment will be made for temporary shoring of trench walls utilizing trench boxes and/or steel plates. Where timber or steel sheeting is used and is not specified to be paid for separately and ordered left in place by the Engineer, the Contractor has the option of leaving it in or removing it after it has been cut off one (1) foot above the top of the pipe.

5. Pay all fees for permits associated with blasting operations. Unauthorized excavations in rock, or excavations made beyond or below the specified limits shall be refilled and compacted with common fill and shall be borne by the Contractor. Perform blasting operation(s) in such a manner that no existing utilities are disturbed. All damage to existing utilities or roadway surfaces outside the trench limits caused by the Work of the Contractor or its Subcontractor(s) shall be repaired and/or replaced immediately and shall be borne by the Contractor.

6. No additional payment will be made for the relocation and/or support of any obstruction encountered along the line of Work.

7. Testing, puddling and/or jetting of trenches utilizing the Owner's water system may be available, however the Owner does not guarantee that its water supply will be available at any time during the duration of the Project. Contractor is responsible for making all arrangements and gathering necessary permissions from the Owner's water district for use of water. Use of water shall be at the Contractor's expense. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

8. Provide detailed plan(s) to the Owner and/or appropriate governing body for all proposed detours and/or partial roadway closings made necessary by the Work. Obtain written approval for all proposed detours and/or partial roadway closings prior to the start of Work. No payment will be made for Work performed in areas of the Project that require an approved traffic management plan until it has been secured. All work shall be in accordance with SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE.

9. All costs associated with repairing settlement of trenches shall be borne by the Contractor.

10. All costs associated with meeting the requirements of all permits shall be borne by the Contractor and shall be included for payment under the applicable items included in DOCUMENT 00410, BID FORM.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit to the Engineer for approval, shop drawings, certificates of compliance and/or catalog cuts for all items to be furnished under this Contract. All submittals shall be provided in accordance with DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Digital Videodisc Recording

1. Prior to the start of construction, video record, in color, the entire Project site(s) in the presence of the Engineer. Video recordings shall be in digital videodisc (DVD) format. Particular attention shall be made to the existing condition of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, and any other items that might be affected by the Work.

2. Video recordings shall be of excellent quality including clear and concise audio descriptions of the existing site(s) conditions. A copy of the first completed video recording shall be furnished to the Engineer, prior to the start of construction, in order to establish the requirement for visual and audio quality. Two (2) copies of all video recordings shall be provided to the Engineer. Any recordings furnished which, in the opinion of the Engineer, are of poor quality or incomplete, shall be redone at no additional cost to the Owner.

3. Video recordings shall be made by the Contractor in the presence of the Owner/Engineer.

4. No construction activities shall commence until the video recordings have been completed, submitted to the Engineer and approved by the Engineer.

C. Health and Safety Plan

1. Prior to the start of construction, prepare and submit a site-specific Health and Safety Plan which includes consideration of all known and potential hazards at the site. Work may not proceed at the project site until the Contractor’s Health and Safety Plan has been received by the Engineer.

2. Contractor shall be cognizant of the minimum standards set forth in OSHA 29 CMR 1910.120. The Health and Safety Plan shall include, but not be limited to the following:
    a. Identification of Contractor's Site Safety Officer.
    b. Identification of hazards and risks associated with the Project.
    c. Contractor's standard operating procedures, including personnel training and field orientation.
    d. Respiratory protection training requirements.
    e. Levels of protection and selection of equipment procedures.
    f. Type of medical surveillance program.
    g. Personal of hygiene requirements and guidelines.
    h. Zone delineation of the Project site.
    i. Site security and entry control procedures.
    j. Field monitoring of site contaminants.
    k. Contingency and emergency procedures.
    l. Listing of emergency contacts.
3. The personal protective equipment required to provide the appropriate level of dermal and respiratory protection shall be determined based on the results of continuous air monitoring performed by the Contractor and the standards set forth in the Contractor's Health and Safety Plan.

D. Utilize the Shop Drawing Transmittal Forms supplied by the Engineer for all required submittals.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - SPECIFICATIONS AND DRAWINGS**

A. All Work shall conform to these specifications and the accompanying drawings entitled:

TOWN OF ORLEANS, MASSACHUSETTS
DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
CONTRACT NO. 2019-01
SRF CONTRACT NO. 4486

Dated January 2020 consisting of 268 sheets, all made by the Engineer, on file with the Owner, and any changes, drawings, plans, and directions that may be furnished from time to time by the Engineer.

**1.08 - PROGRESS OF WORK**

A. Promptly start and continue actual construction Work under this Contract with the necessary equipment to properly execute and complete the Work in the specified time. No cessation of construction activities will be allowed without the written approval of the Owner.

B. Furnish to the Engineer a progress schedule for the Work prior to the start of construction.

C. Furnish to the Engineer a "two-week look ahead" that summarizes the anticipated construction activities. The "two-week look ahead" shall be provided to the Engineer on Thursday of every week throughout the duration of the Project.

**1.09 - DETOURS AND ROAD ACCESSIBILITY**

A. Contact the responsible heads of the MassDOT, Department of Public Works and Natural Resources, Fire Department, Police Department, and other appropriate governing bodies of the municipality having jurisdiction over all or part of the proposed Project, in order to obtain all necessary permits and determine the requirements of these governing bodies, with regards to traffic control.

B. There are no guarantees that total roadway closures will be permitted. Incorporate into the construction schedule the ability to maintain one (1) lane of traffic at all times during the execution of the Work and complete the Work within the Completion date. Where the roadway under construction is the only means of vehicular access to a particular area provide continual access to the area for residents and emergency vehicles.

C. Wherever detours are permitted, the size, construction and location of signs shall conform to local and state requirements and/or standards. Detour routes shall be adequately posted to assist the motorist to return to the normal route of travel for the duration of the Work and for a minimum of two (2) weeks prior to the start of construction in the areas of the Project affected by the Work.

D. Detours and road accessibility shall be in accordance with SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE and as shown of the drawings.

**1.10 - CHANGE IN AMOUNT OF WORK**

A. The Owner reserves the right to increase or decrease the amount of any item of the Work listed as may be found desirable or necessary during the carrying out of this Contract and the unit prices included in DOCUMENT 00410, BID FORM shall apply without change to such variation in the quantity of each of the Bid items to the extent provided by law.

B. Based on the actual work required, the increase or decrease in the quantity of any bid item of the Work included in DOCUMENT 00410, BID FORM shall apply without changes to the unit prices.

**1.11 - SCOPE OF WORK AND SEQUENCE OF CONSTRUCTION**

A. The Work to be done under this Contract consists of furnishing and installing a Wastewater Treatment Facility and Effluent Disposal as specified and/or as shown on the Contract Drawings.

B. The scope of work includes constructing: (a) 350,000 gpd Sequence Batch Reactor Wastewater Treatment Facility located at 20 Overland Way; (b) effluent disposal five 5 wick wells located at 34f Lots Hollow Road; and (c) and appurtenances all appurtenances as specified herein and/or as shown on the drawings in order to provide wastewater service to the Downtown Area of Orleans, MA.

C. The Work of the Project shall be completed within 654 calendar days following execution of the Contract Document, using not more than 372 working days via the following:

1. Preparation, Submittal and Approval of Shop Drawings and Permits

    a. Wastewater Treatment Facility – 140 calendar days; and

    b. Effluent Disposal – 75 calendar days.

2. Construction

    a. Wastewater Treatment Facility and Effluent Disposal shall be completed within 624 calendar days using not more than 352 working days and working Mondays through Fridays, 8 hours per days; and

b. Final Site Restoration completed within 30 calendar days, using not more than 20 working days and working Mondays through Fridays, 8 hours per days.

D. For the protection of life and property all backfilling operations shall follow closely behind pipe laying. Insure that no excavation is left open, unguarded, or water filled during any period of time when Work is not actually in progress. It is the purpose and intent that all excavations and backfill, including consolidation operations, and temporary surfacing within an area be accomplished expeditiously before proceeding to other Work areas.

E. The Owner reserves the right to schedule the Work at any location within the Project area. At the same time the Owner may schedule the suspension of Work at any location. Construction in seasonally heavily traveled roadways shall be avoided during the heavily traveled period.

F. The Work of this Contract may require existing utilities to be bypassed, removed and relaid. The Contractor shall pay for all costs associated with this Work at no additional cost to the Owner except as specified in SECTION 01025, MEASUREMENT AND PAYMENT.

G. The Owner has obtained various permits for this Project, which are included as DOCUMENT 00858, SPECIAL CONDITIONS – PERMITS AND LICENSES. Meet all requirements/conditions of these permits during the construction of this Project. All costs associated with this Work shall be borne by the Contractor and included in the prices bid under the applicable items of DOCUMENT 00410, BID FORM.

H. Cleanup/restoration of all disturbed areas shall be completed each and every week or after a maximum of 500 linear feet of pipeline installation, throughout the duration of the Project. Cleanup/restoration consists of, but is not limited to, restoration of the area to preconstruction conditions, removal of all excess materials, removal of all pipe, fittings, manholes, removal of all construction equipment and materials, and removal of all construction debris. Failure to comply with this requirement may result in withholding the fair market value for the cleanup/restoration of all disturbed areas not completed from monthly payment requests until this requirement has been met.

I. Pre-blasting of ledge is not allowed on this Project. No payment will be made for ledge removal on this Project in areas where pre-blasting has occurred.

J. All damage to existing utilities, roadways, and the like shall be repaired and/or replaced by the Contractor as approved by the utility company and shall be borne by the Contractor.

K. The control of dust shall be accomplished by the application of clean water. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the control of dust shall be provided by the Contractor at no additional cost to the Owner. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner. The use of calcium chloride to control dust is not allowed.

L. The compaction of trenches shall be accomplished by puddling and/or jetting. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However, the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the puddling and/or jetting of trenches shall be provided by the Contractor at no additional cost to the Owner. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

M. The testing of tanks and/or pipelines shall be accomplished by using clean water. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However, the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the testing of tanks and/or pipelines shall be provided by the Contractor at no additional cost to the Owner. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

N. Except for an emergency condition as approved by the Owner in writing, premium wages will not be paid for Work performed on Sunday, holiday or work days longer than eight (8) hours. All costs incurred by the Owner caused by the Contractor's Work performed on Sunday, holiday or work days longer than eight (8) hours shall be borne by the Contractor which will be deducted from monthly payment requests.

O. No construction activity shall be allowed on the Project on the following dates, unless otherwise approved by the Owner:

- New Year's Day - January 1*
- Martin Luther King Jr. Day - Third Monday in January
- Presidents' Day - Third Monday in February
- Patriot's Day – Third Monday in April
- Memorial Day - Last Monday in May
- Independence Day - July 4
- Labor Day - First Monday in September
- Columbus Day - Second Monday in October
- Veterans' Day - November 11
- Thanksgiving Day - Fourth Thursday in November
- Christmas Day - December 25

*If a holiday falls on a Sunday, the day following is observed as the legal holiday

All construction equipment and materials not incorporated in the Work to date shall be removed from the Work areas where construction activity is ceased. All excavations shall be backfilled and paved as specified and/or directed by the Engineer. Incorporate this requirement into the Project Schedule. Failure to comply with this requirement will result in no payment for work performed.

P. The Contractor shall secure use of space that they have legal access to for the temporary buildings specified under SECTION 01500, TEMPORARY FACILITIES. The temporary buildings shall not be placed along the edge of roadways. The Contractor shall be responsible for clearing, grubbing, grading, providing of grading materials, permits, and full restoration of the temporary building location(s).

Q. All equipment, material and supplies to be provided under this contract shall be American made.

**1.11 - EXISTING UTILITIES**

A. The location and size of existing sewers, drains, culverts, water mains, gas mains, cables, service pipes, and other utilities shown on the Contract Drawings, were obtained from the results of surveys and existing records and are shown as approximate only, to guide the Bidders in the preparation of their Bid. The various utility companies will determine the location and depth of existing utilities by marking them out upon the ground and by experimental excavations by the Contractor prior to and as the Work progresses. The Contract Drawings do not show the exact location and depth of all utilities, nor do they show all utilities or the number of lines for each utility that may be encountered.

B. Assume that there are existing utility connections to each and every building or structure along the line of Work, whether they appear on the Contract Drawings or not. Notify the proper utility companies and obtain and preserve the marked location(s) of all existing utilities that may be encountered along the line of Work, until such time as such markings are no longer required.

C. Experimental trench excavations are to be made prior to commencing pipe laying operations. Excavate by hand as necessary in advance of the trenching equipment to determine the exact location and depth of each utility that may be encountered. Excavation equipment shall not be used within three (3) feet of the utility to be crossed. Continue to excavate by hand around these utilities after ascertaining their exact location and depth.

D. Experimental excavations shall be made at all existing potable water mains located within ten (10) feet of the proposed gravity sewer(s) and/or force mains prior to commencing trench excavations. Determine the exact location, materials of construction, size and elevation of these existing water main(s). The location and depth of the proposed gravity sewer(s) and/or force mains shown on the Contract Drawings shall be adjusted as approved by the ENGINEER, in order to maintain the required separation as specified herein, and to maintain a continuous upward or downward slope for force mains and to maintain the necessary line and grade for gravity sewers.

E. All utilities interfered with or damaged shall be replaced and/or repaired immediately. Carefully bed, tamp and fully consolidate refill material around and under all existing utilities encountered or crossed unless otherwise specified as approved by the Engineer.

F. Protection of all existing utilities in the vicinity of the Work and the assurance of uninterrupted service from existing utilities throughout construction is the responsibility of the Contractor.

G. In the event that the Contractor's Work results in damages to existing utilities, provide all necessary materials, equipment and labor necessary to satisfactorily repair damaged utilities immediately at no cost to the Owner.

H. Notify the Water Utility 24 hours prior to connecting to and/or bypassing any existing water main, or as required by the utility. Do not operate any existing water system valves. All such operations shall be coordinated with and performed by Water Utility personnel.

**1.12 - VISITS TO THE SITE(S)**

A. Before submitting a Bid, visit the site(s) to examine existing conditions and become thoroughly acquainted with the effort required to perform the Work.

B. Study the Contract Documents and compare the same with the information gathered during examination of the site(s), as no extra compensation will be authorized for extra Work caused by unfamiliarity with the site(s) and/or Contract Documents or the conditions peculiar to this Project.

**1.13 - DISPOSAL OF EXCESS MATERIAL**

A. All pavement road base, surplus suitable material removed from the excavations, loam not required for re-use in the Work shall be legally disposed of by the Contractor.

B. Legally dispose of all unsuitable material removed as part of the Work.

**1.14 - TECHNICAL SPECIFICATIONS**

A. Where reference is made to ASTM, AWWA, AASHTO specifications or other associations, it is understood that the latest revisions as of the date of the Contract Documents shall apply.

**1.15 - PERMITS, FEES AND BONDS**

A. Obtain and comply with all required permits, pay all fees and provide all bonds necessary to complete the Work as specified. Be solely responsible for performing any necessary acts and providing any materials required in order to comply with any and all terms and conditions set forth in any permits and licenses.

B. Refer to DOCUMENT 00858, SPECIAL CONDITIONS - PERMITS AND LICENSES for all permits, which have been obtained for the Project. The Owner has not obtained all permits and licenses required for this Project. The Contractor shall obtain and pay for any other permits required to complete the Project including but not limited to Road Opening Permit, Blasting, and Phase II General Stormwater Permit for small construction projects.

**1.16 - NOTIFICATION OF CONSTRUCTION**

A. At least 5 business days prior to initiating excavation Work, notify the following entities, in writing, of where and when excavation(s) are scheduled.

1. Town of Orleans Department of Public Works and Natural Resources – (508) 240-3790
2. Town of Orleans Highway Department – (508) 240-3790
3. Town of Orleans Water Department – (508) 255-1200
4. Town of Orleans Fire and Rescue – (508) 255-0050
5. Town of Orleans Police Department - (508) 255-0117
6. Dig Safe – 811
7. MassDOT, District 5 Highway Division – (508) 824-6633
8. AECOM – (508)-237-7161

**1.17 - BOUNDS AND PROPERTY MARKERS**

A. Prior to initiating construction, engage an independent Registered Land Surveyor (in the State where the Project is located) to provide permanent reference points for all bounds and property markers along the line of the Work that may be disturbed during construction. Submit copies of all ties to the bounds and property markers to the Engineer prior to excavation at the site(s).

B. Any bounds or markers disturbed shall be replaced utilizing the services of a Professional Land Surveyor in the State where the Project is located. The cost of replacing markers disturbed by the Contractor's operations shall be at the Contractor's expense.

**1.18 - TWENTY-FOUR HOUR EMERGENCY SERVICE**

A. Maintain a 24-hour, 7-day a week telephone service. The Contractor’s emergency personnel and equipment shall be within 30 minutes travel time to the Project site(s) in order to handle emergency requirements such as, but not limited to, settled trenches, clogged drains, and rain damage and/or any other emergency situation relating to the Contractor’s Work. A list of the personnel and their telephone numbers, pager numbers, and cell phone numbers, shall be submitted to the Engineer, the Owner and to the local Police and Fire Departments.

B. This requirement shall apply for the duration of the Project and shall be updated as necessary. This list shall be submitted on the Contractor's letterhead and shall state that should an emergency arise during the implementation of the Project, these people are to be contacted. Submit this letter to the Engineer prior to initiating construction.

**1.19 - UNIFORMED POLICE OFFICERS**

A. Payment of uniformed police officers used for pedestrian and vehicle control on this Project are to be paid for directly by the Owner without any Contractor involvement other than the Contractor's input as to traffic control requirements and canceling of planned details.

B. Uniformed police officers are paid a four (4) hour minimum. If arrangements have been made for uniformed police officers and inclement weather or other factors prohibit Work, contact the Police Department no later than 5:30 a.m. of the day of scheduled Work to cancel the police detail.

C. Should the Contractor fail to notify the Police Department as required, the Contractor shall assume all costs for the four (4) hour minimum police details not canceled in time. Separate billings will be issued by the Police Department for non-canceled police details and the Contractor shall pay such bills on a monthly basis.

D. No uniformed private security forces shall be employed in this capacity without the express written approval of the Owner.

**1.20 - HOURS OF OPERATION**

A. The Contractor, including all subcontractors, materialmen, and all other relating to this Project, shall conform to the following Work schedule.

1. No outdoor activity on or adjacent to the site will be permitted before 7:00 a.m. or after 5:00 p.m., unless other arrangements are made with the Owner.

2. No outdoor activity shall take place on Saturdays, Sundays, legal holidays recognized by the Owner, and the days preceding legal holidays as noted in herein, except for emergency conditions, which, if practical, shall be reviewed and approved by the Owner.

**1.21 - DISPOSAL OF DEBRIS**

A. During the prosecution of the Work, maintain the Project site(s) and adjoining areas in a neat and orderly manner and eliminate the accumulation of construction debris. A rubbish container shall be kept at the Project site(s) at all times and be emptied as required to prevent odors and vermin.

B. Store and remove all debris from the Project site(s) and legally dispose of the debris in accordance with federal/state/local regulations. Should the Contractor neglect or refuse to maintain the Project site(s) free of accumulated debris, the Owner reserves the right to have the service performed by others and cost thereof deducted from monthly progress payment requests.

C. At the conclusion of the Work, remove and legally dispose of any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from construction operations, and leave the entire Project site(s) of the Work in a neat and orderly condition.

**1.22 - RECORD DRAWINGS**

A. Throughout the course of completing the Work, continually maintain a set of record drawings that incorporate all approved changes made by the Contractor and all subcontractors to the Drawings included in the executed Contract between the Owner and the Contractor. Clearly and concisely mark up the individual Drawings and/or incorporate sketches that show approved changes made during the execution of the Work. Following completion of the Work, incorporate all approved changes electronically into one (1) complete set of record drawings. Record drawings shall be complete in every way and shall show the full extent of the executed Work. Special attention shall be given to concealed Work.

B. Change Orders, Addenda items and field changes shall be included where applicable. Additional specific requirements relative to record drawings may be called for in the individual sections of the Specifications. Submit a review copy to the Engineer for approval and make any revisions required by the Engineer in order to make the record drawings complete. After acceptance by the Engineer, deliver a full scale reproducible hard copy and a compact disk with Auto Cad files of the record drawings to the Engineer.

C. Tie cards (8 ½ inches by 11 inches) of all exterior buried utilities such as but not limited to piping, tubing, conduits, wye/tee connections, fittings, cleanouts, and valves, shall be fully dimensioned both horizontally and vertically, so that the exterior buried utilities can be located in the field. A minimum of three (3) ties shall be provided for each item requiring a tie. Submit the tie cards on a weekly basis or as directed by the Engineer. If, in the opinion of the Owner and/or Engineer, insufficient data is provided to properly locate the exterior buried utilities, uncover the buried utilities and perform the necessary measurements and provide updated tie cards at no additional cost to the Owner.

D. An electronic copy of the Engineer’s Auto Cad files shall be made available to the Contractor for the purpose of completing the required computer drafted record drawings.

**1.23 - PHOTOGRAPHS OF THE PROJECT**

A. Once a month employ the services of a professional photographer to take 48 digital color photographs of the Work in progress. View and orientation of the photographs shall be as determined by the Engineer in the field.

B. Proofs of the digital color photographs shall be submitted to the Engineer for final selection of up to 24 photographs. If 24 photographs cannot be selected from the 48 proofs taken, as determined by the Engineer, then the Contractor shall take an additional 48 photographs for review at no additional cost to the Owner. Formally submit the 24 photographs selected by the Engineer as 8 inch by 10 inch color glossy prints on a monthly basis.

C. In the event that insufficient progress has been made in the previous month to justify the total number of photographs specified above, the Owner reserves the right to have additional views taken in any succeeding month so that the total number will be equal to 24 times the number of months in the Contract period.

D. Each digital photograph shall be identified by a neatly typed index given the Project's name Contractor's name, the date taken, the subject, and the orientation (looking north, looking south, etc.).

E. At the completion of the Contract, all digital images shall become the property of the Owner and shall be delivered to the Owner. Any view not properly identified or otherwise not acceptable will not be counted in the total number of photographs required.

**1.24 - INITIAL OPERATION OF NEW FACILITIES**

A. Operation and maintenance manuals shall be submitted to the Engineer in accordance with DOCUMENT 00700, GENERAL CONDITIONS at least one (1) month prior to the scheduling of any manufacturers training.

B. Perform pressure and/or leakage testing of all pipelines, storage tanks and basins prior to prestart-up testing of all equipment and/or systems. Provide the initial filling of all pipelines, storage tanks and basins with potable water as necessary for start-up of individual systems throughout the facility.

C. Initial start-up of new equipment and/or systems shall not commence until all of the manufacturers services, checkout, and training have been completed as approved by the Engineer.

D. Perform an 8 hour or less, if approved by the Engineer, prestart-up test of all individual equipment prior to incorporating equipment into their appropriate systems.

E. Perform an 8 hour or less, if approved by the Engineer, prestart-up test of all systems prior to conducting the performance test of the facility.

F. Provide all labor, power, chemicals, operations and maintenance from the initial start-up of the individual equipment and systems until the final performance test of the facility is accepted by the Owner as substantially complete at no additional cost to the Owner.

**1.25 - CONTINUOUS OPERATING CRITERIA**

A. Conduct operations in such a manner and sequence that shall neither result in a disruption of the amenities, nor interfere with the functional organization and workings of existing facilities.

B. Furnish, install and operate any piping, equipment and appurtenances necessary to provide the temporary services, facilities, and bypasses required during construction including, but not limited to, bypass pumping, flow barriers and diversions.

C. The Owner will operate and maintain all existing systems and equipment. Notify and coordinate with the Owner all temporary modifications to existing facilities operations required for construction within, or interfacing with, the existing facilities. Operate and maintain all proposed facilities until such time as the Owner accepts them.

D. A carefully planned and detailed construction schedule must be submitted to the Engineer for approval before any construction starts, showing the proposed sequences of operation and the methods to be used for maintaining continued operations of existing facilities.

E. Refer to SECTION 01500, TEMPORARY FACILITIES for additional requirements.

**1.26 - SCHEDULE OF VALUES**

A. Submit a schedule of values for use in preparing the monthly progress payments described in the DOCUMENT 00700, GENERAL CONDITIONS.

B. The schedule of values shall be prepared in conformance with the following format:

1. General Conditions
    a. Subheadings
2. All Structures
    a. Subheadings by specification division and section
3. General Site Work
    a. Subheadings by specification division and section
4. Unit Prices by Individual Items
5. Filed Sub-bid Categories
    a. Subheadings by specification division and section
6. Change orders by individual items shall be added as approved by the Owner.

C. In addition to the above, each equipment line item in the schedule of values shall include the following breakdown:

1. Shop Drawings (10 percent of equipment value)
2. Equipment
3. Installation
4. Manufacturers' Checkout and Startup (2 percent of equipment value)
5. Equipment testing (10 percent of equipment value)
6. Manufacturers' Training of Owner Personnel (1 percent of equipment value)

7. Spare Parts (1 percent of equipment value)

8. Operation and Maintenance Manuals (1 percent of equipment value)

D. The schedule of values shall be submitted to the Engineer for review and approval at least 30 calendar days prior to the first progress payment request. The acceptable schedule of values shall be used for the duration of the Project.

**1.27 - OPERATION AND MAINTENANCE MANUALS**

A. Except as otherwise specified, four (4) copies of the Manuals shall be provided for each item of equipment, or system provided. Completed manuals shall be submitted to the Engineer no later than 60 days following approval of shop drawings.

B. All elements and components of the equipment or system shall be included in the Manuals.

1. The Manuals shall be customized including but not limited to all options, types, sizes, and configurations, shall be indicated, either as one (1) enclosure within the manuals listing them or by eliminating all incorrect references at each occurrence within a standard type of manual.

2. The Manuals shall contain a bill of materials which shall be a parts list detailing the part manufacturer and his catalog number of each equipment part. The Manuals shall include all necessary instructions for the operation, maintenance, repair, assembly, and disassembly of the equipment or system in accordance with the manufacturer's recommendations including troubleshooting charts and lubrication and maintenance schedules.

3. All drawings, plates, lists, schematics, and the like shall be included in the Manuals.

4. Any malfunction of, or damage to the equipment or system resulting from incomplete or incorrect instructions in the Manuals for the guarantee period specified elsewhere in this specification shall be repaired and/or replaced at no additional cost to the Owner.

5. The Manuals shall include a complete parts list, current parts price list, and recommended spare parts list.

6. Any and all capabilities for specified future modification; alteration or reconfiguration shall be completely indicated and described within the Manual.

7. The manuals shall contain the name, address, business telephone numbers and service telephone numbers for the manufacturer and its local distributor/representative.

8. Each Manual for each item of equipment or system shall be bound separately in a permanent binder.

C. The form entitled "Operation and Maintenance Manual Review checklist" shall be utilized and submitted for each specification section to insure completeness of the manual. The form is attached to the end of this section.

D. The Engineer has the right to reject the Manuals submitted as being unsatisfactory or to require the submittal of additional information. The new Manuals or additional information shall be submitted no later than 30 days following notification by the Engineer.

**1.28 - MANUFACTURER'S SERVICES**

A. Installation and Start-up

1. Make arrangements with each equipment supplier or manufacturer to furnish the services of a factory-trained service engineer who is specifically trained on the type of equipment being furnished for the sole purpose and use of the Owner and Engineer to assist during installation and start-up of all equipment and systems furnished by that supplier or manufacturer.

2. Minimum length of time specified for this service shall be exclusive of travel time and of correction of defects, testing, and training.

3. The manufacturer's engineer will verify, in writing, that the equipment has been installed and serviced so as to be acceptable to the equipment manufacturer in order that it will provide safe and efficient operation as intended by the Engineer and the manufacturer. The Engineer will provide a form entitled "Certification of Proper Equipment Installation" which is to be signed by the manufacturer’s representative and the Contractor’s representative for each piece of equipment.

B. Correction of Defects

1. Nothing specified herein shall provide relief of the responsibility of providing sufficient service to place all equipment or systems into satisfactory operation.

2. All time and materials needed to correct defective equipment shall be provided at no cost to the Owner.

C. Testing

1. Prior to testing, each equipment supplier or manufacturer shall furnish a written certification that the equipment is ready for operation. A copy of this certification shall be furnished to the Engineer.

2. Furnish the labor, tools, equipment, power, and clean water necessary to perform field-testing to determine that the supplied equipment including controls and alarms meets hydraulic, electric, mechanical and performance requirements. All tests shall be performed in the presence of the Engineer.

D. Training

1. Wherever called for in the Specifications, have each equipment supplier or manufacturer furnish the services of a fully qualified field service engineer to provide operator training in the complete operation and maintenance of all equipment furnished by that supplier or manufacturer.

2. The minimum length of time specified for this service shall be exclusive of travel time and shall follow and be exclusive of installation and start-up, correction of defects and testing.

3. Schedule training sessions in conjunction with and as approved by the Engineer. This training will be witnessed and verified by a representative appointed by the Engineer. The Engineer has the right to reject the training by the equipment supplier or manufacturer and to require additional training. The items addressed by the training session shall include, but not be limited to, system description, system operation, system disassembly and reassembly, lubrication, routine maintenance, corrective maintenance, use of operation and maintenance manual, system troubleshooting and ordering of spare parts.

4. The Engineer will provide a form entitled "Verification of Manufacturer's Equipment Training" which is to be signed by all parties at the completion of each training session.

**1.29 - SPARE PARTS**

A. Spare parts for all equipment shall be supplied to the Owner as specified. Spare parts shall be individually protected and packaged in a suitable container for long-term storage with the contents therein properly identified on the outside of the container.

B. The Engineer will provide a form entitled "Spare Parts Inventory" which is to be fully completed and submitted to the Engineer for each piece of equipment requiring spare parts.

**1.30 - SPECIALTY TOOLS**

A. Any specialty tools required for the adjustment, operation and/or maintenance of any equipment included in the Work shall be furnished with the respective equipment.

**1.31 - STATUTORY REQUIREMENTS IN GENERAL**

A. Owner and Contractor recognize that other rights, duties, and obligations with respect to public construction contracts are also provided by statute, notwithstanding the fact that they may not be specifically enumerated herein. Accordingly, any provisions required by statute to be included in this contract shall be deemed to be so included as though fully set forth herein. However, compliance with a statute does not diminish the Contractor’s responsibilities hereunder.

B. Contractor shall keep fully informed of all existing and future State and Federal Laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the Work, or the materials used or employed in the Work, or in any way affecting the conduct of the Work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same and of all provisions required by law to be made a part of this Contract, all of which provisions are hereby incorporated by reference and made a part thereof.

C. If any discrepancy or inconsistency is discovered in the Contract Documents for this Work in relation to any such law, ordinance, regulation, order or decree, report the same to the Engineer in writing. Contractor shall, at all times, observe and comply with, and cause all agents and employees to observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees; and shall protect and indemnify the Owner and Engineer and all of its and their officers, agents, and servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by itself or its employees or subcontractors.

D. All materials furnished and Work done shall comply with all State and Federal laws and regulations.

**1.32 - RELATION OF SEWER MAINS TO WATER LINES**

A. Horizontal Separation

1. Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water mains.

2. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:

a) It is laid in a separate trench;

b) It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth; and

c) In either case the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

B. Vertical Separation

1. Whenever sewers must cross under water mains, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstruction with slip-on or mechanical-joint cast-iron pipe, or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

2. When a sewer crosses above a water main, the following measures will be taken:

a) Both pipes will be encased in concrete for a distance of 10 feet on either side of the crossing; or

b) The sewer will be encased in concrete and the water main will be constructed of mechanical joint ductile iron pipe for a distance of 10 feet on either side of the crossing.

C. Special Conditions

1. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main shall be constructed of slip-on or mechanical-joint cast-iron pipe or prestressed concrete cylinder pipe and the sewer constructed of mechanical-joint cast-iron pipe and both services shall be pressure tested to assure water tightness.

**1.33 - UTILITY COORDINATION**

A. Contractor shall be responsible for contacting and coordinating with utility companies prior to commencing work in the area of utilities.

B. Special requirements may be necessary for work in the vicinity of some utilities and easements. Requirements may include but are not limited to the following; surface marking of crossings and easements, temporary fencing, temporary pipe support, additional padding or steel plates for heavy equipment, and coordination with utility field personnel.

**1.34 - EPA CONSTRUCTION GENERAL PERMIT**

A. Construction activities associate with the project are anticipated to disturb one or more acres and as such would be regulated under the National Pollutant Discharge Elimination System (NPDES) stormwater program.

B. Construction stormwater discharges are permitted under the Construction General Permit (CGP) and requires compliance with permit requirements, such as the development of a Stormwater Pollution Prevention Plan (SWPPP). Contractor shall be responsible for preparing and submitting an EPA Notice or Intent (NOI) through the EPA's electronic NOI system (eNOI). A copy of the SWPPP shall be provided to the Owner and Engineer. Contractor shall be responsible for creating the required SWPPP, updating this document as necessary to reflect changes, implementing the SWPPP and performing the required inspections,.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION – Not Used**

**END OF TEXT**

SEE FOLLOWING FORMS

1. Verification of Manufacturer's Equipment Training
2. Operation and Maintenance Manual Review Checklist
3. Spare Parts Inventory
4. Certification of Proper Equipment Installation

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**VERIFICATION OF**

**MANUFACTURER'S EQUIPMENT TRAINING**

| | | | |
|---|---|---|---|
| CLIENT: Town of Orleans, MA | | ENGINEER: AECOM Technical Services, Inc. | |
| PROJECT: Downtown Area Collection System and Pumping Stations, Contract No. 2019-02 | | CONTRACTOR: | |
| Equipment: | | | |
| Specification Section: | | | |
| Date of Training: | | | |
| Instructor(s): | | | |
| Title: | | | |
| Representing: | | | |
| Facility Staff in Attendance | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| AECOM Representative(s): | | | |
| Contractor's Representative(s): | | | |
| ____ System Description | | ____ Corrective Maintenance | |
| ____ System Operation | | ____ Use of Manufacturer's Manual | |
| ____ System Disassembly and Reassembly | | ____ Ordering Spare Parts | |
| ____ Lubrication | | ____ Other | |
| ____ Routine Maintenance | | | |
| I have performed the training described above and concur with this verification. | | | |
| Witnessed by: | | Manufacturer's Instructor Signature | |
| | | | |
| Title | Date | Title | Date |

**OPERATION AND MAINTENANCE MANUAL**

**REVIEW CHECKLIST**

| | | |
|---|---|---|
| CLIENT: Town of Orleans, MA | | ENGINEER: AECOM Technical Services, Inc. |
| PROJECT: Downtown Area Collection System and Pumping Stations, Contract No. 2019-02 | | CONTRACTOR: |
| Equipment: | | |
| Specification Section: | | |
| Equipment Transmittal No.: | | |
| O&M Manual Transmittal No.: | | |
| | 1. | Correct number of copies of Operation and Maintenance Manual Supplied |
| | 2. | General |
| | | a. Manual Customized |
| | | b. Manual contains information on complete system (design, installation, operation and maintenance instructions) |
| | | c. All material contained in manual is legible |
| | | d. Permanent Binder and Labeled |
| | | e. Index |
| | 3. | Contact Information |
| | | a. Name, address, and telephone number of manufacturer |
| | | b. Name, address, and telephone number of nearest source of replacement parts and service |
| | 4. | Equipment Information |
| | | a. Equipment drawings, schematics, plates, and layouts |
| | | b. Equipment Performance Curves |
| | | c. Lubrication Schedule |
| | | d. Maintenance Schedule |
| | | e. Trouble Shooting Guide |
| | | f. Parts List (part manufacturer, catalog number, etc.) |
| | | g. Current Part Costs |
| | | h. Recommended Spare Parts |
| | | I. Special Tools Required |
| Remarks: | | |
| | | |

**SPARE PARTS INVENTORY**

| | |
|---|---|
| CLIENT: Town of Orleans, MA | ENGINEER: AECOM Technical Services, Inc. |
| PROJECT: Downtown Area Collection System and Pumping Stations, Contract No. 2019-02 | CONTRACTOR: |
| Equipment: | |
| Specification Section: | |
| AECOM Representative(s): | |

| Part Number | Part Description | Quantity | Owner | Initial Date | Initial Date |
|---|---|---|---|---|---|
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**CERTIFICATION OF PROPER**

**EQUIPMENT INSTALLATION**

| | |
|---|---|
| CLIENT: Town of Orleans, MA | ENGINEER: AECOM Technical Services, Inc. |
| PROJECT: Downtown Area Collection System and Pumping Stations, Contract No. 2019-02 | CONTRACTOR: |
| Equipment: | |
| Specification Section: | |
| Date of Equipment Inspection: | |
| Manufacturer's Representative(s): | |
| Representing: | |
| Contractor's Representative(s) | |
| Equipment Installation | |
| ____ Equipment Mounting / Supports | ____ Lubrication |
| ____ Safety (guards and/or signage) | ____ Calibration |
| ____ Electrical System | ____ Spare Parts |
| ____ Instrumentation and/or Control System | ____ Other _____ |
| Corrective Action Required: | |
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| | |
| | |
| | |
| | |
| Corrective Action Completed: | |
| | |
| | |
| | |
| | |
| I hereby certify that the above noted equipment is ready for safe and efficient operation. | |
| Witnessed by:<br><br>_____<br>Contractor's Representative Signature<br>Date: _____ | Certified by:<br><br>_____<br>Manufacturer's Representative Signature<br>Date: _____ |

**SECTION 01046**

**CONTROL OF WORK**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, equipment, tools, and materials necessary for the implementation of the Control of Work during the construction of the facilities.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 – SUBMITTALS – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - REFERENCED STANDARDS – Not Used**

**PART 2 - PRODUCTS AND SERVICES – Not Used**

**PART 3 - EXECUTION**

**3.01 - FACILITY AND HOURS OF CONSTRUCTION**

A. Furnish facility and equipment which will be efficient, appropriate, and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the Contract Time. If at any time such facility appears to the Engineer to be inefficient, inappropriate, or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character, or increase the facility equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

B. Normal construction activity shall take place in accordance with SECTION 01030, SPECIAL REQUIREMENTS. only between the hours of 7:00 a.m. to 5:00 p.m., excluding Saturdays, Sundays, and legal holidays. Work outside the above time periods will be permitted only on an emergency basis and only with the approval of the Owner.

**3.02 - OCCUPYING PRIVATE LAND**

A. The Contractor shall not (except after written consent from the proper parties) enter or occupy with men, tools, materials, or equipment any land outside the rights of way or property of the Owner.

B. A copy of the written consent shall be given to the Engineer.

**3.03 - PIPE LOCATIONS**

A. Exterior pipelines will be located substantially as indicated on the Drawings, but the right is reserved to the Owner, acting through the Engineer, to make such modifications in location as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings, etc., are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

B. Small interior piping is indicated diagrammatically on the Drawings, and the exact location is to be determined in the field. Piping shall be arranged in a neat, compact, and workmanlike manner, with a minimum of crossing and interlacing, so as not to interfere with equipment or access ways, and, in general, without diagonal runs.

**3.04 - DIMENSION OF EXISTING STRUCTURES**

A. Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

**3.05 - OPEN EXCAVATIONS**

A. Excavation shall be made and mantained in accrodance wth all federal, state and locateal rules and regualtinos includign OSHA.

B. All open excavations shall be adequately safeguarded by providing temporary barricades, fencing, caution signs, lights, and other means to prevent accidents to persons and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public shall be well lighted at night.

**3.06 - TEST PITS**

A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

**3.07 - INTERFERENCE WITH AND PROTECTION OF STREETS**

A. The Contractor shall not close or obstruct any portion of a street, road, or private way without obtaining permits therefor from the proper authorities. If any street, road or private way shall be rendered unsafe by the Contractor's operations, he shall make such repairs or provide such temporary ways or guards as shall be acceptable to the proper authorities.

B. Streets, roads, private ways, and walks not closed shall be maintained passable and safe by the Contractor, who shall assume and have full responsibility for the adequacy and safety of provisions made therefor.

C. The Contractor shall, at least 24 hours in advance, notify the Police and Fire Departments in writing, with a copy to the Engineer, if the closure of a street or road is necessary. The Contracotr shall cooperate with the Police Department in the establishment of alternate routes and shall provide adequate detour signs, plainly marked and well lighted, in order to minimize confusion.

**3.08 - CARE AND PROTECTION OF PROPERTY**

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

**3.09 - PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES**

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired by him at his expense.

B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the Total Price Bid in the Bid Form.

D. If, in the opinion of the Engineer, permanent relocation of a Owner’s utility is required, he may direct the Contractor, in writing, to perform the work. Work so ordered will be paid at the Contract unit prices, if applicable, or as extra work. If relocation of a privately owned utility is required, the Owner will notify the Utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the Owner and Utility, and shall have no claim for delay due to such relocation. The Contractor shall notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays, and Legal holidays) before excavating in any public way. The Contractor shall coordinate the removal and replacement of traffic loops and signals, if required for the performance of the work, at no additional cost to the Owner.

**3.10 - INSPECTION OF WORK AWAY FROM THE SITE**

A. If work to be done away from the construction site is to be inspected on behalf of the Owner during its fabrication, manufacture, or testing, or before shipment, the Contractor shall give notice to the Engineer of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Engineer in ample time so that the necessary arrangements for the inspection can be made.

**3.11- COOPERATION WITHIN THIS CONTRACT**

A. All firms or persons authorized to perform any work under this Contract shall cooperate with General Contractor and his Subcontractors or trades, and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

**3.12 - CLEANUP AND DISPOSAL OF EXCESS MATERIAL**

A. During the course of the work, the Contractor shall keep the site of his operations in as clean and as neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, the Contractor and his subcontractors shall comply with all applicable Federal, State, and local laws, and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and elsewhere in the Specifications.

C. The Contractor is advised that the disposal of excess excavated material in wetlands, stream corridors, and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by him, will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. Therefore, the Contractor will be required to remove the fill at his own expense and restore the area impacted.

**3.13 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 01050**

**FIELD ENGINEERING**

PART 1 – GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 – MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMTTALS ..... 2
1.05 – PROJECT/SITE CONDITIONS ..... 2
PART 2 – PRODUCTS – Not Used ..... 3
PART 3 – EXECUTION ..... 3
3.01 - EXAMINATION ..... 3
3.02 - APPLICATION ..... 3
3.03 – CONTRACT CLOSEOUT ..... 3

## PART 1 – GENERAL

### 1.01 - SCOPE

A. This work of this Section includes all labor, materials, tools, and equipment required for the providing Field Engineering as specified herein and/or as shown on the Contract Drawings including the following:

1. Examination of site and conditions of construction;
2. Establishment of lines, grades, and easements;
3. Connections to existing facilities; and
4. Restoration and protection of public and private property.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 – MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMTTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. As-Built Drawings: The Contractor shall be responsible for maintaining two sets of redline "as-built locations and dimensions of work". The As-Built Drawings shall be submitted to the Owner at substantial completion of the project.

2. The Contractor shall submit copies of field records and record drawings each month with project invoices. Field data shall be updated each month as applicable.

**1.05 – PROJECT/SITE CONDITIONS**

A. Environmental Requirements

1. Unfavorable Construction Conditions

a. During unfavorable weather, wet ground, or other unsuitable construction conditions, confine operations to work which will not be affected adversely by such conditions.

b. No portion of Work shall be constructed under conditions which adversely affect quality or efficiency thereof, unless special means or precautions are taken to perform Work in manner acceptable to the Engineer.

B. Field Measurements

1. Lines and Grades

a. All Work shall be done to lines, grades, and elevations indicated on drawings or specified herein.

b. Basic vertical control points have been established or designated by the Engineer. Contractor shall be responsible for maintaining or subsequently replacing these controls to the satisfaction of the Engineer if these controls are disturbed. The Contractor shall be responsible for verifying all vertical control information that is used.

(1) Points shall be used as datum for work.

(2) Contractor shall be responsible for transferring all lines and grades from basic survey control points.

c. Contractor to perform all additional survey, layout, and measurement work.

(1) The Contractor shall provide survey work by a firm having successfully completed at least two projects of similar size and complexity within the last five years, and who shall employ experienced personnel and provide adequate supervision to satisfaction of the Engineer at all times when operations are in progress.

(2) Surveyor shall be a registered land surveyor in the location of the project.

d. Keep the Engineer informed, in writing, two weeks in advance, of times and places at which work is to be performed, so that horizontal and vertical control points may be established, and any checking deemed necessary by the Engineer may be performed.

e. Remove and reconstruct Work which is improperly located as determined by the Engineer and at no additional cost to the Owner.

2. Easements and Rights-of-Way

a. Easements and rights-of-way for utilities, if required, will be provided by the Owner.

b. Confine construction operations within limits indicated on drawings and/or within limits of easements or public ways.

c. Place construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause least possible damage to property and interference with traffic.

**PART 2 – PRODUCTS – Not Used**

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Examination of Site and Verification of Conditions

1. Before starting operations, examine site to become acquainted with conditions to be encountered.

2. Verify exact locations of sewers, water mains, gas mains, above or below ground electrical wires, other utilities, conduits and structures which may interfere with work.

**3.02 - APPLICATION**

A. Connections to Existing Facilities

1. Make connections to existing facilities as indicated on drawings or as specified.

2. Plan in advance all connections to existing facilities which are in service.

a. All equipment, materials, and labor shall be on hand at time of undertaking connections to existing facilities in service.

b. Work shall proceed continuously if necessary, to complete connections within the time designated by the Engineer.

3. Operation of valves or other appurtenances on existing utilities, when required, shall be performed by respective utility personnel unless otherwise noted. a. A tight shutdown of existing Owner's or Community valves is not guaranteed; Contractor shall control leakage past valves to satisfaction of the Owner and Engineer and at no additional cost to the Owner.

B. Restoration and Protection of Public and Private Property

1. Protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by construction operations.

2. Restore all public and private property including pavement, surfacing, curbs, walks, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod and landscaping to their original condition or better, whether within or outside easements.

**3.03 – CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

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**SECTION 01065**

**STRUCTURAL TESTS AND INSPECTIONS**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 2
1.06 - DESIGN CRITERIA – Not Used ..... 2
1.07 - CONTRACTOR'S RESPONSIBILITIES ..... 2
1.08 - CONTRACTOR FURNISHED TESTING LABORATORY SERVICES ..... 3
1.09 - OWNER FURNISHED TESTING AND INSPECTION SERVICES ..... 3
PART 2 – PRODUCTS – Not Used ..... 3
PART 3 – EXECUTION – Not Used ..... 3

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Structural Engineer of Record (SER) is required to prepare a program describing the structural tests and inspections that will be performed for this project. The SER is the structural engineer (an individual) who is in responsible charge of the preparation of the structural drawings and structural specifications for this project and whose professional engineering seal appears on said structural drawings. The parties responsible for the performance of the structural tests and inspections are noted on the Program of Structural Tests and Inspections prepared by the SER.

B. The SER has prepared a Program of Structural Tests and Inspections (the "Program"), which has been or will be submitted to the building official who has jurisdiction over this project. A copy of this program is included in this specification as Attachment No 1 for reference.

C. The Program shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the Work, their other obligations for supervising the work, for any design work, which is included in their scope of services, and for full compliance with the requirements of the Contract Documents. The detection of, or failure to detect, deficiencies or defects in the Work during the testing and inspection conducted pursuant to the Program shall not relieve the Contractor or its subcontractors of their responsibility to correct all deficiencies or defects, whether detected or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents. Further, while the SER, and the Resident Engineer shall perform certain tasks in the Program requiring the review of certain construction activities, the SER and Resident Engineer shall only perform such tasks to ensure compliance with the SER approved submittals and the specifications. Neither the SER nor the Resident Engineer shall assume any responsibility or liability for the means, methods, procedures or techniques used by any construction contractor.

D. The program of structural tests and inspection does not apply to the Contractor's equipment, temporary structures used by the Contractor to construct the project, the Contractor's means, methods, and procedures, and job site safety.

E. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Testing Laboratory Qualifications
2. Testing and Inspection Schedule
3. Test Reports.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - CONTRACTOR’S RESPONSIBILITIES**

A. Where the Program of Structural Tests and Inspections indicates that a structural component or system is subject to structural tests and inspections and that the SER for the project has not been retained to design said component or system or to prepare a performance specification for said component of system, the Contractor shall retain, or require others under his aegis to retain, a professional engineer registered in the jurisdiction where the project is located to design said component or system and to provide the required program of structural tests and inspections for said component or system.

B. The Contractor shall provide free and safe access to the Work for the SER and all other individuals who are observing the Work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.

**1.08 - CONTRACTOR FURNISHED TESTING LABORATORY SERVICES**

A. An independent commercial testing laboratory acceptable to the Engineer shall perform all tests that require the services of a laboratory to determine compliance with the Contract Documents. The laboratory shall be staffed with experienced technicians, properly equipped, and fully qualified to perform the tests in accordance with the specified standards.

B. Preliminary Testing Services: The Contractor shall be responsible for all testing laboratory services in connection with concrete materials and mix designs, the design of asphalt mixtures, gradation tests for structural and embankment fills, backfill materials, and all other tests and engineering data required for the Engineer's review of materials and equipment proposed to be used in the Work. The Contractor shall obtain the Engineer's acceptance of the testing laboratory before having services performed, and shall pay all costs for services.

C. The Contractor shall not retain any testing laboratory against which the Owner or the Engineer have reasonable objection, and if at any time during the construction process the services become unacceptable to the Owner, or the Engineer, either the Owner or the Engineer may direct in writing that such services be terminated. The request must be supported with evidence of improper testing or unreasonable delay. If the Engineer determines that sufficient cause exists, the Contractor shall terminate the services and engage a different testing laboratory.

D. Transmittal of Test Reports: Written reports of testing and engineering data furnished by the Contractor for the Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

E. The Contractor’s testing laboratory shall furnish four copies of a written report of each test performed by laboratory personnel within three days after each test is completed. Distribution shall be two copies of each test report to the Engineer's Representative, one copy to the Owner, and one copy for the Contractor.

**1.09 - OWNER FURNISHED TESTING AND INSPECTION SERVICES**

A. The Owner will employ the services of an independent testing agency to conduct the Program of Structural Tests and Inspections as described herein and perform all quality control tests of materials of construction in the field or in the laboratory during and after their incorporation in the Work. Field sampling and testing shall be performed in the general manner indicated in the specifications, with minimum interference with construction operations.

B. The Contractor shall furnish a construction schedule and a minimum of 48 hour notice of readiness for testing and inspection of the work. The Engineer shall determine the exact time and location of field sampling and testing, and may require such additional sampling and testing as necessary to determine that materials and equipment conform with data previously furnished by Contractor and to the Contract Documents.

C. The Contractor shall schedule the work to permit adequate time for testing and re-testing should test results not conform to the contract documents. Lack of testing or inspection which is attributable to insufficient notice by the Contractor or failure of the Contractor to cooperate, will be cause for rejection of the work.

D. The Contractor shall deliver materials in sufficient quantities to the Owner’s testing agency as may be required. Laboratory testing shall be performed within a reasonable time, consistent with the specified standards.

E. The Contractor shall furnish material samples and cooperate in the field sampling and testing activities, interrupting the work when necessary. The Contractor shall furnish personnel, facilities and access to assist in the sampling and testing activities.

**PART 2 – PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF TEXT**

SEE ATTACHMENT 1

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**ATTACHMENT NO. 1**

**PROGRAM OF STRUCTURAL TESTS AND INSPECTIONS**

Project: Downton Area Collection System and Pumping Stations

Location: Orleans, Massachusetts

Owner: Town of Orleans, Massachusetts

Owner's Address: 40 Giddiah Hill Road, Orleans, MA 02653

Engineer of Record: AECOM Technical Services, Inc.

Structural Engineer of Record (SER): Michael E. Malenfant, PE

This program of structural tests and inspections is submitted as a condition for issuance of the building permit in accordance with the International Building Code.

The following firms, agencies, or individuals (hereinafter referred to collectively as agents) will perform the tests and inspections under the direction of the SER:

| Abbreviation | Agent |
|---|---|
| SER | Structural Engineer Of Record Listed Above |
| RES | The Resident Representative |
| ITA(C) | Independent Testing Agency Employed By Contractor |
| ITA | Independent Testing Agency Employed By Owner |
| RPE(C) | Registered Professional Engineer Employed By Contractor |
| GEO | The Project Geotechnical Engineer |
| IWI | Independent Welding Inspector |

The above abbreviations will be used on the attached pages to identify which agent is performing the particular tests or inspections.

The following categories of structural tests and inspections, if checked, are included in the program for structural tests and inspections for this project. The specific tests and inspections required for each checked category are listed on the page noted opposite the category and further described in the various technical specification sections.

| | Category | Page | | Category | Page |
|---|---|---|---|---|---|
| ☐ | Steel Construction | 7 | ☒ | Controlled Structural Fill | 10 |
| ☒ | Cast-in-Place Concrete | 7 | ☐ | Pile Foundations | 11 |
| ☒ | Precast Concrete Construction | 8 | ☐ | Pier Foundations | 11 |
| ☒ | Masonry Construction | 9 | ☐ | Aluminum Construction | 12 |
| ☐ | In-situ Bearing Strata | 10 | ☒ | Special Cases | 12 |

The following items of construction, if checked, are specified in the structural plans or specifications on a performance basis. The structural design of these items will be performed by the RPEC and reviewed by the SER. The construction of these items is included in the program for tests and inspections on the attached sheets.

| | Category | | Category |
|---|---|---|---|
| ☐ | Curtain Walls | ☐ | Metal Buildings |
| ☒ | Precast Concrete Components | ☒ | Metal Stairs |
| ☐ | Post-Tensioning Steel | ☒ | Metal Railings |
| ☐ | Structural Steel Connections | ☐ | Metal and Composite Gratings |
| ☐ | Structural Aluminum Connections | ☐ | Metal Plate Covers |

The following items are excluded from this program of structural tests and inspections, since other structural engineers not under the aegis of the SER designed them and the SER has no duties or responsibilities with respect to such performance specifications or designs. The Owner shall assign other architects, or construction contractors, as applicable; to be special SER's for their respective designs and such architects and/or contractors shall be responsible for all such structural tests and inspections for their respective designs.

- Seismic design of mechanical or electrical components, systems and their anchorage to the structure.
- Excavation support systems.
- Temporary bracing, temporary platforms, scaffolding, temporary guards and railings.
- Anything related to jobsite safety or construction means and methods.

Structural Engineer of Record:

Name: Michael E. Malenfant, PE

Signature:_____

Firm: AECOM Technical Services, Inc.

Date: _____ Registration Seal

**STEEL CONSTRUCTION**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Fabricator Certification/ Quality Control Procedures. | SER | Review to ensure that quality control procedures have been adopted for each Fabricator. | Start of project |
| 2. Fabricator Inspection | SER | Review to ensure that an Independent Inspection Agency has approved each Fabricator. | Start of project |
| 3. Material Certification | SER | Review for conformance to the specifications. | Each product |
| 4. Bolting | ITA | Test and inspect bolted connections in accordance with specifications. Verify bolt size and grade in accordance with AISC specifications A325/A490. | Periodic |
| 5. Welding | IWI | Check welder qualifications. Verify filler material in accordance with AWS D1.1. Visually inspect fillet welds. Test complete and partial penetration groove welds full length by dye penetrant, ultrasonic, or radiographic testing in accordance with the contract documents. | Periodic |
| 6. Shear Connectors | IWI | Inspect for size and placement. Test for proper weld attachment. | Periodic |
| 7. Structural Framing, Details and Assemblies | RES | Review for conformance with specifications and shop drawings. | Continuous |
| 8. Open Web Steel Joists | RES | Inspect for size, placement, bridging, bearing and connection to structure. | Continuous |
| 9. Open Web Steel Joists | IWI | Visually inspect all welds of a minimum of 5 percent of the joists, randomly selected. | Periodic |
| 10. Steel Decking | RES<br>IWI | Verify gage, width, and type. Inspect placement, laps, welds, side lap attachment and screws or other mechanical fasteners (IWI). Check welder qualifications (RES). | Periodic |

**CAST-IN-PLACE CONCRETE CONSTRUCTION**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Mix Design | ITA(C)<br>SER | Design Concrete Mixes<br>Review mix designs. | Each mix<br>Each mix |
| 2. Materials Certification | SER | Review for conformance to specifications. | Each product |

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 3. Batching Plant | ITA<br>SER | Review to ensure that Plant quality control procedures have been adopted. | Start of project |
| 4. Reinforcement Installation | RES | Inspect reinforcing for size, quantity, condition and placement. | Prior to each placement |
| 5. Formwork Geometry | RES | Inspect form sizes for compliance with specifications. | Prior to each placement |
| 6. Concrete Placement | RES | Review for conformance with specifications. | Each placement |
| | ITA | Perform slump, density and air content tests at point of discharge. | Each truck |
| 7. Curing and Protection | ITA<br>RES | Observe procedures for conformance to the specifications. | Each placement |
| 8. Evaluation of Concrete Strength | ITA | Test and evaluate in accordance with the specifications. | Every 50 cubic yards or part thereof |
| Note: The Contractor may elect to have the Contractor's independent testing agency (ITA(C)) perform additional tests in addition to the testing by the Owner's Independent Testing Agency (ITA) at no cost to the Owner. | | | |

**PRECAST CONCRETE CONSTRUCTION**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Plant Certification/Quality Control Procedures | SER<br>ITA | Review to ensure that Plant quality control procedures have been adopted (SER). Inspect plant storage and handling procedures (ITA). Confirm that approved submittals are being used for fabrication; review welder's certifications (SER). Monitor finished product for structural defects (cracks) (ITA). | Start of project |
| 2. Material Certification | SER | Review for conformance to ACI 318. | Each product |
| 3. Formwork Geometry | ITA | Inspect form sizes. | Selected placements |
| 4. Reinforcement Installation | ITA | Inspect reinforcing and prestressing strands for size, quantity, condition and placement for conformance with Contract Documents, SER approved submittals, and ACI 318. Inspect welding. | Selected placements |
| 5. Mix Design | ITA(C) | Design Concrete Mixes | Each mix |
| | SER | Review for conformance with specifications (SER). | Each mix |

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 6. Concrete Placement | RES/ ITA | Inspect concrete placement procedures for conformance to ACI 318, Sections 5.9 and 5.10 (ITA), and for conformance with specifications (RES). | Selected placements |
| 7. Curing and Protection | RES/ ITA | Inspect for maintenance of specified curing temperatures and techniques per ACI 318 (ITA), and for conformance with specifications (RES). | Each placement |
| 8. Evaluation of Concrete Strength | ITA | Test for conformance to specifications in accordance with ACI 318. | Every 50 cubic yards or part thereof |
| 9. Prestress Operation | ITA | Inspect application of prestressing forces per ACI 318. Inspect grouting of bonded, post-tensioned, prestressing tendons. | Selected placements |
| 10. Assembled/Erected Precast Elements. | RES | Inspect for compliance with SER approved submittals and specifications. Review site storage and handling procedures for consistency with design of precast elements. Verify that SER approved erection drawings are on site and are being used for erection. Verify that SER approved erection procedures are being followed. Review welder's certifications. | Each unit |
| 11. Connections/ Embedded Items | ITA | Inspect interface connections including end and edge doweling. Inspect embedment for proper location. Inspect shimming, bearing, bolting and welding of connections. | Each unit |

**MASONRY CONSTRUCTION**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Material Certification | SER | Review for conformance to specifications. | Each product |
| 2. Evaluation of Masonry Strength | ITA | Verify strength in accordance with the specifications. | Periodic |
| 3. Proportioning, Mixing and Consistency of Mortar and Grout | ITA | Inspect field-mixing procedures for conformance to the specifications. | Continuous |
| 4. Installation of Masonry | RES | Inspect placement for conformance to the specifications. | Continuous |

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 5. Reinforcement Installation | RES<br>IWI | Inspect reinforcing steel for conformance to SER approved submittals and specifications (RES) Inspect welding of reinforcement and review welder's certifications (IWI). | Periodic |
| 6. Grouting Operations | RES | Review grouting procedures for conformance with the specifications. | Periodic |
| 7. Weather Protection | RES | Review procedures for protection for cold and hot weather for conformance with the specifications. | Periodic |
| 8. Anchorage | RES | Inspect anchorage of masonry to other construction for conformance with specifications. | Periodic |

**IN-SITU BEARING STRATA FOR FOUNDATIONS**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Bearing strata for foundations | GEO<br>RES | Review strata for conformance to the structural drawings, specifications, and/or geotechnical report. | Prior to foundation placement |
| 2. Bearing surfaces of foundations | GEO<br>RES | Review for conformance to the requirements of the structural drawings, specifications, and/or geotechnical report. | Prior to foundation placement |

**CONTROLLED STRUCTURAL FILL (PREPARED FILL)**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Fill Material | ITA | Test material for conformance to specifications or geotechnical report. Perform laboratory compaction tests in accordance with the specifications to determine optimum water content and maximum dry density. | Each Material |
| 2. Installation of Controlled Structural Fill | RES<br>ITA(C) | Provide review of the installation, in accordance with the specifications. Verify maximum lift placement thickness ITA (C). | Each lift |
| 3. Density of Fill | ITA | Perform field density tests of the in-place fill in accordance with the specifications. | Each lift |
| | | | |

**PILE FOUNDATIONS**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Pile Material | SER<br>RES | Review for conformance with the specifications, and that the identification is maintained from the point of manufacture to the point of delivery to the site. | Each pile shipment |
| 2. Pile Material Tests | ITA | If Item 1 is unsatisfactory, test material for conformance to the Contract Documents. | As required |
| 3. Precast Concrete Piles. | --- | Perform structural tests and inspections as listed under Precast Concrete Construction. | See precast concrete requirements |
| 4. Steel Piles | --- | Perform structural test and inspections as listed under Steel Construction. | See steel construction requirements |
| 5. Pile Installation | RES<br>GEO | Provide review for conformance with specifications. Maintain accurate records for each pile. Record final location of each pile in plan. | Continuous |
| 6. Cast-in-Place Concrete Piles | --- | Perform structural tests and inspections as listed under Cast-in-Place Concrete Construction. | See cast-in-place concrete construction |
| Note: Additional confirmatory observations and/or testing by the Owner's independent testing agency (ITA) in addition to the observations and testing required by the Contractor's independent testing agency (ITA(C)) and the Contractor's registered professional engineer (RPE(C)) may be performed at the Owner's discretion. | | | |

**PIER FOUNDATIONS**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Load-bearing Steel Components | SER | Review documents identifying material and certifying grade of material for conformance to the specifications | Each component |
| 2. Concrete and Reinforcing Steel Components | --- | Perform structural tests and inspections as listed under Cast-in-Place Concrete Construction. | See concrete requirements |
| 3. Pier installation | RES | Provide review of installation for conformance with specifications. Maintain accurate records for each pier, documenting observations. | Continuous |

**ALUMINUM CONSTRUCTION**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Fabricator Certification/ Quality Control Procedures. | SER | Review to ensure that quality control procedures have been adopted for each Fabricator. | Start of project |
| 2. Fabricator Inspection | SER | Review to ensure that an Independent Inspection Agency has approved each Fabricator. | Start of project |
| 3. Material Certification | SER | Review for conformance to the specifications. | Each product |
| 4. Bolting | ITA | Test and inspect bolted connections in accordance with specifications. Verify bolt size and grade in accordance with AISC specifications A325/A490. | Periodic |
| 5. Welding | IWI | Check welder qualifications. Verify filler material in accordance with AWS D1.1. Visually inspect fillet welds. Test complete and partial penetration groove welds full length by dye penetrant, ultrasonic, or radiographic testing in accordance with the contract documents. | Periodic |
| 6. Structural Framing, Details and Assemblies | RES | Review for conformance with specifications and shop drawings. | Periodic |

**SPECIAL CASES**

| Item | Agent | Scope | Frequency |
|---|---|---|---|
| 1. Tank Leakage Testing | RES | Witness testing in accordance with contract documents. | Each tank |
| 2. Concrete Anchor Installation | RES | Verify diameters, depth and cleaning of holes conforms to manufacturer's instructions. | Each anchor |

**END OF SECTION**

**SECTION 01090**

**REFERENCE STANDARDS**

PART 1 - GENERAL ..... 1
1.01 - QUALITY ASSURANCE ..... 1
1.02 - SCHEDULE OF REFERENCES ..... 1
PART 2 - PRODUCTS - Not Used ..... 4
PART 3 - EXECUTION - Not Used ..... 4

## PART 1 - GENERAL

### 1.01 - QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids unless otherwise specified in Product Sections.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

D. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

### 1.02 - SCHEDULE OF REFERENCES

| Abbreviation | Name and Address | Abbreviation | Name and Address |
|---|---|---|---|
| AA | Aluminum Association<br>818 Connecticut Avenue, N.W.<br>Washington, DC 20006 | AABC | Associated Air Balance Council<br>1000 Vermont Avenue, N.W.<br>Washington, DC 20005 |
| AASHTO | American Association of State Highway<br>and Transportation Officials<br>444 North Capitol Street, N.W.<br>Washington, DC 20001 | ACI | American Concrete Institute<br>Box 19150<br>Reford Station<br>Detroit, MI 48219 |
| ADC | Air Diffusion Council<br>230 North Michigan Avenue<br>Chicago, IL 60601 | AI | Asphalt Institute<br>Asphalt Institute Building<br>College Park, MD 20740 |
| AISC | American Institute of Steel Construction<br>400 North Michigan Avenue<br>Eighth Floor<br>Chicago, IL 60611 | AISI | American Iron and Steel Institute<br>1000 16th Street, N.W.<br>Washington, DC 20036 |
| AITC | American Institute of Timber Construction<br>333 W. Hampden Avenue<br>Englewood, CO 80110 | AMCA | Air Movement and Control Association<br>30 West University Drive<br>Arlington Heights, IL 60004 |
| ANSI | American National Standards | APA | American Plywood Association |

| Abbreviation | Name and Address | Abbreviation | Name and Address |
|---|---|---|---|
| | Institute<br>1430 Broadway<br>New York, NY 10018 | | Box 11700<br>Tacoma, WA 98411 |
| ARI | Air-Conditioning and Refrigeration Institute<br>1501 Wilson Boulevard<br>Arlington, VA 22209 | ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers<br>1791 Tullie Circle, N.E.<br>Atlanta, GA 30329 |
| ASME | American Society of Mechanical Engineers<br>345 East 47th Street<br>New York, NY 10017 | ASPA | American Sod Producers Association<br>4415 West Harrison Street<br>Hillside, IL 60162 |
| ASTM | American Society for Testing and Materials<br>1916 Race Street<br>Philadelphia, PA 19103 | AWI | Architectural Woodwork Institute<br>2310 South Walter Reed Drive<br>Arlington, VA 22206 |
| AWPA | American Wood-Preservers' Association<br>7735 Old Georgetown Road<br>Bethesda, MD 20014 | AWS | American Welding Society<br>550 LeJeune Road, N.W.<br>Miami, FL 33135 |
| AWWA | American Water Works Association<br>6666 West Quincy Avenue<br>Denver, CO 80235 | BIA | Brick Institute of America<br>11490 Commerce Park Drive<br>Reston, VA 22091 |
| CDA | Copper Development Association<br>57th Floor, Chrysler Building<br>405 Lexington Avenue<br>New York, NY 10174 | CLFMI | Chain Link Fence Manufacturers Institute<br>1101 Connecticut Avenue, N.W.<br>Washington, DC 20036 |
| CRSI | Concrete Reinforcing Steel Institute<br>933 Plum Grove Road<br>Schaumburg, IL 60195 | DHI | Door and Hardware Institute<br>7711 Old Springhouse Road<br>McLean, VA 22102 |
| EJCDC | Engineers' Joint Contract Documents Committee<br>American Consulting Engineers Council<br>1015 15th Street, N.W.<br>Washington, DC 20005 | EJMA | Expansion Joint Manufacturers Association<br>25 North Broadway<br>Tarrytown, NY 10591 |
| FGMA | Flat Glass Marketing Association<br>3310 Harrison<br>White Lakes Professional Building<br>Topeka, KS 66611 | FM | Factory Mutual System<br>1151 Boston-Providence Turnpike<br>P.O. Box 688<br>Norwood, MA 02062 |
| FS | Federal Specification | GA | Gypsum Association |

| Abbreviation | Name and Address | Abbreviation | Name and Address |
|---|---|---|---|
| | General Services Administration<br>Specifications and Consumer Information<br>Distribution Section (WFSIS)<br>Washington Navy Yard, Bldg. 197<br>Washington, DC 20407 | | 1603 Orrington Avenue<br>Evanston, IL 60201 |
| ICBO | International Conference of Building Officials<br>5360 S. Workman Mill Road<br>Whittier, CA 90601 | IEEE | Institute of Electrical and Electronics Engineers<br>345 East 47th Street<br>New York, NY 10017 |
| IMIAC | International Masonry Industry All-Weather Council<br>International Masonry Institute<br>815 15th Street, N.W.<br>Washington, DC 20005 | MBMA | Metal Building Manufacturer's Association<br>1230 Keith Building<br>Cleveland, OH 44115 |
| MFMA | Maple Flooring Manufacturers Association<br>60 Rivere Drive<br>Northbrook, IL 60062 | MIL | Military Specification<br>Naval Publications and Forms Center<br>5801 Tabor Avenue<br>Philadelphia, PA 19120 |
| ML/SFA | Metal Lath/Steel Framing Association<br>221 North LaSalle Street<br>Chicago, IL 60601 | NAAMM | National Association of Architectural Metal Manufacturers<br>221 North LaSalle Street<br>Chicago, IL 60601 |
| NCMA | National Concrete Masonry Association<br>P.O. Box 781<br>Herndon, VA 22070 | NEBB | National Environmental Balancing Bureau<br>8224 Old Courthouse Road<br>Vienna, VA 22180 |
| NEMA | National Electrical Manufacturers' Association<br>2101 'L' Street, N.W.<br>Washington, DC 20037 | NFPA | National Fire Protection Association<br>Battery March Park<br>Quincy, MA 02269 |
| NFPA | National Forest Products Association<br>1619 Massachusetts Avenue, N.W.<br>Washington, DC 20036 | NSWMA | National Solid Wastes Management Association<br>1730 Rhode Island Ave., N.W.<br>Washington, DC 20036 |
| NTMA | National Terrazzo and Mosaic Association<br>3166 Des Plaines Avenue<br>Des Plaines, IL 60018 | NWMA | National Woodwork Manufacturers Association<br>205 W. Touhy Avenue<br>Park Ridge, IL 60068 |
| OSHA | Occupational Safety and Health Administration | PCA | Portland Cement Association<br>5420 Old Orchard Road |

| Abbreviation | Name and Address | Abbreviation | Name and Address |
|---|---|---|---|
| | | | Skokie, IL 60077 |
| PCI | Prestressed Concrete Institute<br>201 North Wells Street<br>Chicago, IL 60606 | PS | Product Standard<br>U. S. Department of Commerce<br>Washington, DC 20203 |
| SDI | Steel Door Institute<br>712 Lakewood Center North<br>14600 Detroit Avenue<br>Cleveland, OH 44107 | SDI | Steel Deck Institute<br>P.O. Box 9506<br>Canton, OH 44711 |
| SIGMA | Sealed Insulating Glass<br>Manufacturers Association<br>111 East Wacker Drive<br>Chicago, IL 60601 | SJI | Steel Joist Institute<br>1205 48th Avenue North<br>Suite A<br>Myrtle Beach, SC 29577 |
| SMACNA | Sheet Metal and Air Conditioning<br>Contractors'<br>National Association<br>8224 Old Court House Road<br>Vienna, VA 22180 | SSPC | Steel Structures Painting Council<br>4400 Fifth Avenue<br>Pittsburgh, PA 15213 |
| TCA | Tile Council of America, Inc.<br>Box 326<br>Princeton, NJ 08540 | UL | Underwriters' Laboratories, Inc.<br>333 Pfingston Road<br>Northbrook, IL 60062 |
| WWPA | Western Wood Products Association<br>1500 Yeon Building<br>Portland, OR 97204 | | |

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION - Not Used**

**END OF SECTION**

**SECTION 01110**

**ENVIRONMENTAL PROTECTION PROCEDURES**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 – SUBMITTALS – Not Used ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 2
1.06 - DESIGN CRITERIA ..... 2
PART 2 - PRODUCTS – Not Used ..... 3
PART 3 - EXECUTION ..... 3
3.01 - IMPLEMENTATION ..... 3
3.02 - EROSION CONTROL ..... 3
3.03 - PROTECTION OF STREAMS, WETLANDS, AND SURFACE WATER ..... 3
3.04 - PROTECTION OF LAND RESOURCES ..... 3
3.05 - PROTECTION OF AIR QUALITY ..... 4
3.05 - MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION ..... 4
3.06 - NOISE CONTROL ..... 4
3.07 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide and compact bank-run gravel as indicated and specified.

B. The work covered by this Section consists of furnishing all labor materials and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

C. The control of environmental pollution requires consideration of air, water, and land, and involves management of noise and solid waste, as well as other pollutants.

D. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching, or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in SECTION 01568, EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS.

E. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

F. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Massachusetts Department of Environmental Protection and local Conservation Commission.

G. Schedule and conduct all work in a manner that will minimize the level of noise escaping the site, especially at night and on weekends.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 – SUBMITTALS – Not Used**

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

B. The Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectional acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. The Contractor shall, after receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - IMPLEMENTATION**

A. Prior to commencement of the work, meet with the Engineer to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program.

B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the project at the earliest practicable time.

**3.02 - EROSION CONTROL**

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures such as siltation basins, hay check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Offsite surface water shall be diverted around the site to a downstream channel ahead of siltation barriers. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

**3.03 - PROTECTION OF STREAMS, WETLANDS, AND SURFACE WATER**

A. Care shall be taken to prevent or reduce to a minimum any damage to any stream, drainage ditch, storm drain of sewer from pollution by debris, sediment, or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Such water will be diverted through a settling basin or filter before being directed into the streams.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action drawing or plan approved by the Massachusetts Department of Environmental Protection. Contractor shall submit to copies of approved contingency drawings or plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a Cl2 residue of 2 mg/l or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

**3.04 - PROTECTION OF LAND RESOURCES**

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly before beginning operations near them.

D. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition. The Engineer will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.

E. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in. in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

F. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.

G. The locations of the Contractor's storage, and other construction building, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and shall require written approval of the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

H. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling, and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in SECTION 01568, EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS or as approved by the Engineer.

I. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

**3.05 - PROTECTION OF AIR QUALITY**

A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control. The Contractor will be required to maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

**3.05 - MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION**

A. During the life of this Contract, maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

**3.06 - NOISE CONTROL**

A. The Contractor shall make every effort to minimize noises caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal (OSHA) regulations.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 01171**

**ELECTRIC MOTORS**

PART 1 - GENERAL ..... 1
1.00 - SUBBID REQUIREMENTS ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 3
1.06 - DESIGN CRITERIA ..... 3
1.07 - QUALITY ASSURANCE ..... 4
1.08 - REFERENCES ..... 4
PART 2 - PRODUCTS ..... 4
2.01 - ACCEPTABLE MOTOR MANUFACTURERS ..... 4
2.02 - ELECTRIC MOTOR RATINGS ..... 5
2.03 - MOTOR REQUIREMENTS ..... 5
PART 3 - EXECUTION ..... 8
3.01 - INSTALLATION ..... 8
3.02 - TESTING ..... 8
3.03 - CONTRACT CLOSEOUT ..... 9

## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. This section is part of the filed sub-bid for DIVISION 16, ELECTRICAL. See SECTION 16050, ELECTRICAL WORK - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Low Voltage Electric Motors and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Unless otherwise specified, all electric motors furnished and installed by the Contractor shall conform to the requirements specified herein.

1. Motors rated at 460 V which are powered from Variable Frequency Drives shall be inverter duty rated as per NEMA-MG-1.

2. Motors shall be NEMA Premium Efficient as per NEMA-MG-1.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Descriptive literature and motor characteristics, including thermal limit curves and speed vs. torque curves. Provide thermal limit curves for motors 75 Hp and greater and all motor data.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.
3. Submit motor data with the associated driven equipment submittals.
4. Shop drawings and descriptive data to include:
    a. Complete list of all motors to be furnished.
    b. Outlines, dimensions, weights, and wiring diagrams.
    c. Location of main and accessories boxes with size of conduit entrance.
    d. Efficiency and power factor at 1/2, 3/4 and full load.
    e. Bearing life data and grease requirements.
    f. Nameplate data.
    g. Prototype test data.

h. Ground pad locations.

i. Strip heaters KW and voltage ratings.

j. Statement certifying that motor insulation system is compatible with output of VFD system provided under SECTION 16260, VARIABLE FREQUENCY DRIVES.

k. Full load current

l. Locked rotor current

m. Full load torque in lb.-ft.

n. Starting and breakdown torque in percent of full-load torque

o. Number and frequency of permissible starts under specified conditions

p. Horsepower versus current curves

q. Moment of inertia of rotor

r. The zero load, rated speed (with no load connected) kW and kvar input

s. The locked rotor KVA and power factor at rated voltage

t. Service factor

u. Descriptive bulletins or catalog cuts with full description of the insulation system

v. Manufacturer, type, size and rating of bearings

w. Motor thermal limit or damage curves

5. Submit certified copies of all factory shop test results.

6. Submit list of recommended spare parts and maintenance tools for each type of motor.

7. Provide manufacturer’s printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.

8. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Motors shall comply with the latest reference standards specified.

B. Routine tests shall be performed on representative motors less than 100 Hp in size and shall include the information described on NEMA MG1-12.54 Report of Test Form for Routine Tests on Induction Motors. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

C. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. Where motors are driven by variable frequency drives (VFDs) the Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

2. Variable frequency drives shall be provided in accordance with Specification SECTION 16260, VARIABLE FREQUENCY DRIVES.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract Electrical drawing 00 E-601.

**1.08 - REFERENCES**

A. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriters Laboratories, Inc. (UL)

D. National Electrical Manufacturers Assoc. (NEMA)

1. NEMA Standard MG-1 – Motors and Generators

2. NEMA WP-1 – Enclosed Electric Motor

E. American Bearing Manufacturers Association (ABMA)

F. American National Standard Institute (ANSI)

G. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Standard 112 – Test Procedures for Polyphase Induction Motor and Generators

2. IEEE Standard 85 – Airborne Sound Measurements on Rotating Electric Machinery, Test Procedure for

3. IEEE Standard 429 – Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form – Wound Stator Coils

4. IEEE Standard 841 – Service Duty Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MOTOR MANUFACTURERS**

A. Reliance Electric

B. Toshiba

C. U.S. Electric Motors

D. Or equal

**2.02 - ELECTRIC MOTOR RATINGS**

A. Voltage Ratings:

1. Unless otherwise specified, motors with ratings of 1/2 to 500 Hp shall be rated 460-volt (nameplate rating), three-phase, 60-Hertz; motors of 1/3 Hp or less to be rated 115-volt, single-phase, 60 Hertz.

B. The following specific motor requirements shall be identified in each equipment specification:

1. RPM.

2. Motor enclosure type.

**2.03 - MOTOR REQUIREMENTS**

A. Motor heaters shall be supplied on all motors located outdoors. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 volt, single phase with wattage. The heater wattage and voltage shall be embossed on the motor nameplate.

B. Every motor shall be of capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop the necessary torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop the necessary torque under the conditions imposed by the reduced voltage starting method.

C. The motor shall have capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

D. Type of Motors

1. All motors shall be NEMA Design B or of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be for full-voltage starting.

E. Insulation

1. All motors shall have Class B (fractional horse power only) and Class F insulation for all other size motors.

2. Insulation systems shall be manufacturer’s premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock for 480 Volt motors. Provide a Class F insulation system for an ambient temperature motor operation of 0 to 40 degrees C at no more than 3300 feet above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

3. Motors shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H insulation shall be used.

F. Enclosures

1. Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in. diameter, shall be provided inside the conduit box for motor frame grounding.

    a. Totally enclosed fan cooled: TEFC motors shall have a steel or cast-iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

    b. Totally enclosed non-ventilated: TENV motors shall include the same rating and accessories as specified for TEFC motors.

    c. Explosion proof motors shall comply with all requirements of Class I, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto.

    d. Motors in NEMA 4, NEMA 4X and classified areas shall be provided with severe duty rating. Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as “Corro-Duty”, “Mill and Chemical”, “Custom Severe Duty”, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40 degrees C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

G. Special Purpose Motors

1. Hermetically sealed air conditioning units, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Service factor 1.15 above 3 hp.

2. Submersible motors shall be equipped with three thermal switches (one in each phase winding) connected to stop motor operation if the temperature exceeds 125 deg. C (255 deg. F). Also a leakage sensor for sensing water intrusion into the stator housing shall be provided.

3. Inverter duty rated: Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31.

    a. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated.

    b. Motors nameplate service factor shall be 1.0. Internal service factor shall be 1.15 that of the nameplate.

    c. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

    d. Provide each variable frequency drive motor with an internal normally closed motor thermostat per phase wired in series

    e. Provide VFD driven motor shafts with grounding rings.

H. Auxiliary Devices

1. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

I. General Design of Motors

1. Motors shall comply with the latest NEMA Standards Publication No. MG1 for Motors and Generators, unless otherwise specified.
2. All polyphase non-explosion proof motors shall be provided with energy efficient operation and meet the requirements of MG1-12.53 a and b.
3. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with an insulating compound that protects against moisture and slightly acid or alkaline conditions.
4. Bearings shall be of the self-lubricating type, provided so that there is proper alignment of rotor and shaft and to prevent leakage of lubricant.
    a. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.
    b. Bearings for totally enclosed and explosion proof motors shall be of the ball type.
    c. Bearing L-10 fatigue life in hours at 100 percent load shall be 50,000.
    d. Bearing grease shall be of the 120 deg. C thermal capability type.
    e. Bearings for 50 HP and larger VFD driven motors shall be isolated type bearings.
5. Vertical motors shall be provided with thrust bearings for all thrusts to which they can be subjected in operation.
6. All three phase two speed motors shall be of the two-winding design.
7. All non-VFD driven three phase motors shall be provided with a 1.15 service factor.
8. Three phase motors shall be of cast iron construction including frame and end brackets.
9. Motor nameplates shall be Type 316 stainless steel.
10. Motor Terminal Boxes and Leads:
    a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 4 in. beyond the face of the box. Solderless lugs shall be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.
    b. Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 1" threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.
    c. A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.
    d. For inverter rated motors, provide oversized terminal boxes with oversize conduit opening and oversized cable lugs for cables as indicated.

J. Motor Efficiencies

1. Three phase motors rated 1 Hp and larger shall be of the premium efficiency, "Design E", type per Table 12.1 of NEMA MG1 Part 12. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or rpms not listed shall conform to comparable standards of construction and materials as those for listed motors.

K. Shop Painting

1. Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

L. Motor Data

1. The Contractor shall furnish five certified copies of characteristic curves of each motor furnished, except 115-volt motors. Curves shall be supplied as a part of the driven equipment submittal.

M. Motor Shop Tests

1. Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG1 Standards for Motors and Generators. NEMA report-of-test forms to be used in submitting test data.

2. Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MGI-12.53 a and b.

3. For motors rated 100 hp and larger, complete tests of each motor furnished to be made and certified test data sheets to be submitted. Each motor shall be tested at rated voltage for: efficiency and power factor at 25, 50, 75, and 100 percent of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

4. For induction motors 5 hp, up to 100 hp, copies of routine test reports of electrically duplicate motors shall be furnished.

5. For motors 3 hp or less, no test data need be furnished.

6. Where required by the load equipment specifications, provide testing support for shop testing at the equipment manufacturer's facility.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Verify heaters are energized when supplied on motors.

B. After motor installation but before connection to power wiring, test motor winding insulation.

C. After connection to power wiring, check for operating temperature, correct rotation, vibration, alignment and operating current drawn under load.

D. Submit all motor test results for review and record.

**3.02 - TESTING**

A. Inspect physical and mechanical condition.

B. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.

C. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturers published data.

D. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

E. Megger test motor winding insulation.

F. Provide testing in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 01300**

**SUBMITTALS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section specifies the general methods and requirements of submissions applicable to the following Work-related submittals:

1. Shop Drawings, Product Data and Samples.
2. Mock Ups.
3. Construction Photographs.
4. Contractor's Responsibilities.
5. Submission Requirements.
6. Review of Shop Drawings, Product Data, Working Drawings and Samples.
7. Distribution.
8. General Procedures for Submittals.
9. Certificate of Design.
10. Certificates of Compliance.
11. Schedules.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
11. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
12. Submittals: written and graphic information and physical samples that require Engineer’s responsive action. Action submittals are those submittals indicated in individual Specification sections as "action submittals."
13. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
14. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
15. Shop drawings, as defined in the General Conditions, and as specified in individual Work Sections include, but are not necessarily limited to: custom-prepared data such as fabrication and erection/installation (working) drawings of concrete reinforcement, structural details and piping layout, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications as applicable to the Work

**1.04 - SUBMITTALS**

A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with the provisions of DOCUMENT 00700, GENERAL CONDITIONS and this Section.

B. Detailed submittal requirements are specified in the Technical Specifications sections.

C. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of Subcontractors, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.

b. Specification section number and title.

c. Submittal category: Action; informational.

d. Name of Subcontractor.

e. Description of the Work covered.

f. Scheduled date for Engineer's final release or acceptance.

g. Scheduled date of fabrication.

**1.05 - SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

A. Engineer's Digital Data Files: Electronic digital data files of the Drawings will be provided by Engineer for Contractor's use in preparing Project Record Drawings.

1. Engineer will furnish Contractor one set of digital data drawing files of the Drawings for use in preparing Project record drawings.

2. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

3. Digital Drawing Software Program: The Contract Drawings are available in AutoCad Civil 3D 2017 format.

4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to the Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification section concurrently unless partial submittals for portions of the Work are indicated on accepted submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. All shop drawings shall be submitted using the transmittal form furnished by the Engineer.

D. All shop drawings submitted by Subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

E. Processing Time. Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review. Allow 15 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review. If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review. Allow 15 working days for review of each resubmittal.
4. Sequential Review. Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 20 working days for initial review of each submittal.

F. Paper Submittals. Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6-inches by 8-inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
3. Number of submittals required:
    a. Shop Drawings: Unless otherwise stated in the respective Specifications sections, submit six (6) copies.
    b. Product Data: Unless otherwise stated in the respective Specifications submit six (6) copies.
    c. Samples: Submit the number stated in the respective Specification Sections.
4. Include the following information for processing and recording action taken:
    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Name of Subcontractor.
    f. Name of supplier.
    g. Name of manufacturer.

h. Submittal number or other unique identifier, including revision identifier. Engineer's Shop Drawing Transmittal Form includes spaces for the submittal number (e.g. 12) and the Specification section number (e.g., SECTION 09940, SHOP PAINTING). Submittal numbering shall be sequential. Resubmittals shall include an alphabetic suffix after the original submittal number (e.g. 12A).

i. Number and title of appropriate Specification section.

j. Drawing number and detail references, as appropriate.

5. Additional Paper Copies. Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

6. Transmittal for Paper Submittals. Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form to be supplied by the Engineer. Engineer will discard submittals received from sources other than Contractor.

G. Options. Identify options requiring selection by Engineer.

H. Deviations and Additional Information. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

I. Resubmittals. Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with acceptance notation from Engineer's action stamp.

J. Distribution. Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

K. Use for Construction. Retain complete copies of submittals on the Project Site. Use only final action submittals that are marked with acceptance notation from Engineer's action stamp.

**1.06 - CONSTRUCTION PHOTOGRAPHS**

A. The Contractor shall provide construction photographs in accordance with requirements specified in SECTION 01030, SPECIAL REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - SUBMITTAL PROCEDURES**

A. General Submittal Procedure Requirements. Prepare and submit submittals required by individual Specification sections. Types of submittals are indicated in individual Specification sections.

B. Product Data. Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.

b. Manufacturer's product specifications.

c. Standard color charts.

d. Statement of compliance with specified referenced standards.

e. Testing by recognized testing agency.

f. Application of testing agency labels and seals.

g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.

c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

6. Submit Product Data in the following format. Six (6) paper copies of Product Data unless otherwise indicated. Engineer will return three (3) copies.

C. Shop Drawings. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Contractor shall submit certified shop and erection drawings of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

a. Drawings shall include plan views, sectional views, title block, Tag Numbers, serial numbers, Parts List (identifying each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

b. Drawings shall be in conformance with all other requirements as specified in this Specification.

2. Preparation. Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

3. Sheet Size. Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8 ½ inches by 11 inches, but no larger than 24 inches by 36 inches.

4. Submit Shop Drawings in the following format. Submit Product Data in the following format. Six (6)paper copies of Product Data unless otherwise indicated. Engineer will return three (3) copies.

D. Samples. Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one (1) submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:

   a. Generic description of Sample.

   b. Product name and name of manufacturer.

   c. Sample source.

   d. Number and title of applicable Specification Section.

   e. Specification paragraph number and generic name of each item.

3. Disposition: Maintain sets of accepted Samples at Project Site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit two (2) sets of Samples. Engineer will retain one (1) sample set; remainder will be returned.

   b. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

   c. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

E. Test and Inspection Report Submittal. Comply with requirements specified in SECTION 01400, QUALITY ASSURANCE.

F. Welding Certificates. Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

G. Installer Certificates. Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

H. Manufacturer Certificates. Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

I. Product Certificates. Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

J. Material Certificates. Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

K. Field Test Reports. Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

**2.02 - DELEGATED-DESIGN SERVICES**

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

**PART 3 - EXECUTION**

**3.01 - CONTRACTOR'S REVIEW**

A. Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Mark with approval stamp before submitting to Engineer.

B. Contractor review shall verify the following:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with the Specifications

C. If a shop drawing shows any deviation from the requirements of the Contract Documents, the Contractor shall make specific mention of the deviations in the Transmittal Form furnished by the Engineer and provide a description of the deviations in a letter attached to the submittal.

D. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will not have responsibility therefor.

E. No portion of the Work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to accepted shop drawings and data shall be at the Contractor's risk. The Owner and Engineer will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

F. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

**3.02 - ENGINEER’S ACTION**

A. The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Drawings and Specifications or from departures therefrom. The Contractor remains responsible for details and accuracy, for coordinating the Work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

B. The review of shop drawings, data, and samples will be general. They shall not be construed:

1. As permitting any departure from the Contract requirements;

2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials; or

3. As approving departures from details furnished by the Engineer, except as otherwise provided herein.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

D. Three (3) (maximum) copies of shop drawings or product data will be returned to the Contractor via First Class United States Postal Service. Samples will not be returned.

E. Submittals will be returned to the Contractor under one of the action codes indicated below and defined on the transmittal form furnished by the Engineer.

1. Marking: No Exception Taken.

a. When submittals are marked as “No Exception Taken,” Work covered by submittal may proceed provided it complies with Contract Documents. Acceptance of Work depends on that compliance.

2. Marking: Make Corrections Noted.

a. When submittals are marked as “Make Corrections Noted,” Work covered by submittal may proceed provided it complies with Engineer’s notations or corrections on submittal and with Contract Documents. Acceptance of Work depends on that compliance. Resubmittal not required.

3. Marking: Amend and Resubmit.

a. When submittals are marked as “Amend and Resubmit,” do not proceed with Work covered by submittal. Do not permit Work covered by submittals to be used at Project Site or elsewhere where Work is in progress.

b. Revise submittal or prepare new submittal in accordance with Engineer's notations in accordance with resubmittal requirements of this section. Resubmit without delay. Repeat if required to obtain different action marking.

4. Marking: Rejected; See Remarks.

a. When submittals are marked as “Rejected; See Remarks,” do not proceed with Work covered by submittal. Work covered by submittal does not comply with Contract Documents.

b. Prepare new submittal for different material or equipment supplier or different product line or material of same supplier complying with Contract Documents.

5. Marking: For Information Only.

a. When submittals are marked as “For Information Only,” the Engineer will review the submittal but take no action.

b. It will be recorded as “For Information Only”. Work covered by this submittal may proceed provided it complies with the Contract Documents.

6. Marking: Not Required for Review.

a. When submittals are marked as “Not Required for Review,” the Engineer has not reviewed the submittal and it is being returned.

b. Work covered by this submittal may proceed provided it complies with the Contract Documents.

F. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing, on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any Work done because of this type revision that is not in accordance to the Contract Documents as may be required by the Engineer.

G. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer within five working days after the date of the Engineer's review of the shop drawing and prior to the release for manufacture.

I. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

**3.03 - DISTRIBUTION**

A. Distribute reproductions of accepted shop drawings and copies of accepted product data and samples, where required, to the Project Site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six (6).

**3.04 - CERTIFICATE OF DESIGN**

A. If specifically specified in other sections of these Specifications, the Contractor shall submit the applicable Certificate of Design for each item required, and in the form attached to this Section, completely filled in and signed and sealed by a registered professional engineer.

**3.05 - CERTIFICATES OF COMPLIANCE**

A. Certificates of Compliance as specified in the specifications shall include and mean certificates, manufacturer's certificates, certifications, certified copies, letters of certification and certificate of materials.

B. The Contractor shall be responsible for providing Certificates of Compliance as specified in the technical specifications. Certificates are required for demonstrating proof of compliance with specification requirements and shall be executed in six (6) copies unless otherwise specified. Each certificate shall be signed by an official authorized to certify on behalf of the manufacturing company and shall contain the name and address of the Supplier, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Supplier from furnishing satisfactory material, if after tests are performed on selected samples, the material is found not to meet the specific requirements.

**3.06 - SCHEDULES**

A. Provide all schedules as specified.

B. Progress Payments shall be subject to meeting the Schedule Requirements of this section (Refer to Table 01300-1). No progress payment identified in Table 01300-1 over the limits identified will be made until the milestones set in this table are satisfied.

**Table 01300-1**

| Section Number | Section Name | Submittal | Schedule Requirement/ Payment Milestone |
|---|---|---|---|
| 01311 | Construction Progress Schedule | Project schedule is submitted and reaches no exceptions taken status. | Prior to Mobilization to the Project Site |
| 01300 | Submittals | Shop drawings are submitted and reach no exceptions taken status. | Prior to 75% payment of Mobilization/Demobilization. |
| 01030 | Special Requirements | Record documentation is submitted and reaches no exceptions taken status. | Prior to 95% payment. |
| 01311 | Construction Progress Schedule | Punch list is completed and corrected. | Prior to 95% payment. |

**END OF SECTION**

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**SECTION 01310**

**MISCELLANEOUS TESTING AND SOIL DATA**

PART - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 2
1.06 - DESIGN CRITERIA ..... 2
PART 2 - PRODUCTS - Not Used ..... 2
PART 3 - EXECUTION - Not Used ..... 2

## PART - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, materials, tools and equipment required to perform miscellaneous testing as required in the Contract Documents and/or as directed by the Engineer.

B. Existing testing and subsurface soil data, if available, is included in this section.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. In addition to the above, measurement and payment shall be in accordance to the following:

1. Payment for testing shall be as specified under the applicable Payment Items included under SECTION 01025, MEASUREMENT AND PAYMENT.

2. Pay all up front costs associated with additional testing. If the testing proves the Work is defective or materials are unsatisfactory then correct all defective Work at no cost to the Owner. If the testing proves the Work and/or materials are satisfactory, then the Owner will pay for costs associated with additional testing.

3. Where the technical section of the Specifications required that a piece of equipment be tested at the manufacturer's facility or at the site, the cost of such tests shall be included in the price of the equipment.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings including at least the following:

1. Additional Testing.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. Subsurface soil data, if included in the Contract Documents, is for general information only. The information pertains to the subsoil conditions in the vicinity of the Work and is given to assist in properly evaluating the amount and character of the Work required hereunder. Such data is represented as being the best factual information available.

1. The Owner and Engineer assume no responsibility for the accuracy thereof or for any conclusions that might draw therefrom.
2. It is understood and agreed that, by careful examination, you have satisfied yourself as to the nature and location of the Work, have examined such logs of test borings and/or records made of underground exploration as may be available, understand the character of equipment and facilities needed for the prosecution of the Work, the general and local conditions, and all other matters which could in any way affect the Work under this Contract.
3. Jar samples, if available, may be examined during normal business hours, at the Owner’s office.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION - Not Used**

**END OF TEXT**

SEE ATTACHED GEOTECHNICAL DATA REPORT

AECOM

# GEOTECHNICAL DATA REPORT

Downtown Area Wastewater Treatment Facility
Orleans, Massachusetts

August 2019

AECOM Project: Final Design of Downtown Area Sewer Collection System, Treatment Facility and Effluent Disposal Site in Orleans, Massachusetts

AECOM Project No.: 60587515

## 1.1 PROJECT DESCRIPTION

AECOM is providing engineering services to integrate relevant components of the Comprehensive Wastewater Management Plan (CWMP) developed by the Town in 2011 and all work since, including the 25 percent Downtown Area Collection System design, 25 percent Downtown Area Wastewater Treatment Facility design (29 Oak Ridge Lane) and studies for effluent disposal at 32 Lots Hollow Road in order to permit, final design and bid complete a fully functioning and permitted Downtown Area Sewer System.

## 1.2 PURPOSE OF REPORT

The purpose of this Geotechnical Data Report (GDR) is to provide supporting data for the design and ultimate construction of the proposed Downtown Area Wastewater Treatment Facility (WWTF) in Orleans, Massachusetts. The data was collected during a subsurface investigation that involved the drilling of test borings and the laboratory testing of selected soil samples. The subsurface investigation conducted at the WWTF is one component of the design.

## 1.3 SUBSURFACE INVESTIGATION

The subsurface investigation at the WWTF was performed from March 26, 2019 to April 1, 2019 and consisted of the drilling of eight (8) test borings. The test borings ranged in depth from 25 to 55 feet and were drilled by Desmond Well Drilling, Inc. of Orleans, Massachusetts.

### 1.3.1 Drilling and Sampling

Utility locating efforts were implemented prior to the start of borehole drilling. These efforts included a *DigSafe* mark-out and borehole vacuum excavation to 5-feet.

Test borings were drilled using 3.25-inch ID hollow stem augers. Standard penetration test (SPT) split-spoon soil sampling was conducted at 5-foot intervals. The SPT soil samples were logged by an AECOM geologist in accordance with ASTM D2488.

The boring locations are shown on Figure 1. The test boring logs from the subsurface investigation are provided in Attachment 1.

### 1.3.2 Groundwater Levels

Groundwater levels at each boring location were estimated at the time of drilling and were recorded on the boring logs. It should be noted that groundwater levels will fluctuate with changes in precipitation, season, construction activities, run-off controls, and other hydraulic factors.

### 1.3.3 Laboratory Testing

A laboratory testing program was performed to determine the engineering properties of encountered site soils. Representative soil samples were selected and tested for physical characteristics (*i.e. gradation, moisture content and density)*. The soil samples were tested by GeoTesting Express in Acton, Massachusetts.

A summary of the soil laboratory testing is provided in Table 1. The laboratory test results are provided in Attachment 2.

**TABLE 1: Summary of Geotechnical Laboratory Testing**

| Boring ID | Sample ID | Depth | Sieve (ASTM D6913) | Hydrometer (ASTM D7928) | Moisture Content (ASTM D2216) | Density (ASTM D7263) |
|---|---|---|---|---|---|---|
| B19-1 | SS-1 | 5.5 – 7.5 | X | | | |
| B19-2 | SS-1 | 5 - 7 | X | | | |
| B19-3 | SS-1 | 6 – 7.5 | X | | | |
| B19-3 | SS-6 | 28 – 30 | X | | | |
| B19-4 | SS-2 | 8 – 10 | X | X | | |
| B19-5 | SS-2 | 8 – 10 | X | X | X | |
| B19-5 | SS-4 | 18 - 20 | X | | | |
| B19-5 | SS-6 | 28 – 30 | X | X | | |
| B19-6 | SS-2 | 8 – 10 | X | X | X | |
| B19-6 | SS-4 | 18 – 20 | X | | | |
| B19-6 | SS-7 | 33 – 35 | X | X | | |
| B19-7 | SS-1 | 5 – 7 | X | X | | X |
| B19-7 | SS-3 | 13 - 15 | X | | | |
| B19-8 | SS-1 | 5 – 7 | X | X | | X |
| B19-8 | SS-4 | 18 - 20 | X | X | | |
| B19-8 | SS-6 | 28 - 30 | X | | | |

## 1.4 PREVIOUS GEOTECHNICAL INVESTIGATIONS

### 1.4.1 GZA Geotechnical Study (1982)

A 1982 geotechnical study by Goldberg-Zoino & Associates (GZA) was performed for the Oak Ridge WWTF site in 1982 (*Septage and Wastewater Treatment Facilities Geotechnical Studies – Orleans, Massachusetts;* Goldberg-Zoino & Associates, December 1982). The purpose of the GZA study was to provide earthwork and foundation recommendations for the design and construction of the since demolished Tri-Town Septage Treatment Facility (STF).

The GZA study included the drilling of fifteen (15) test borings. The GZA test borings that were drilled proximate to the currently proposed WWTF structures are shown on Figure 1. The proximate boring logs from the GZA study are provided in Attachment 3.

### 1.4.2 USGS and CCC Investigations (Mid to Late 1980s)

The US Geological Survey (USGS) also conducted numerous investigations at the WWTF site. The USGS investigations focused primarily near and downgradient of the former STF discharge lagoons. The USGS investigations began prior to the startup of the STF.

The USGS investigations included the installation of numerous groundwater monitoring wells at various locations and depths, borehole geophysics to evaluate the locations of a subsurface clay layer, and groundwater quality monitoring.

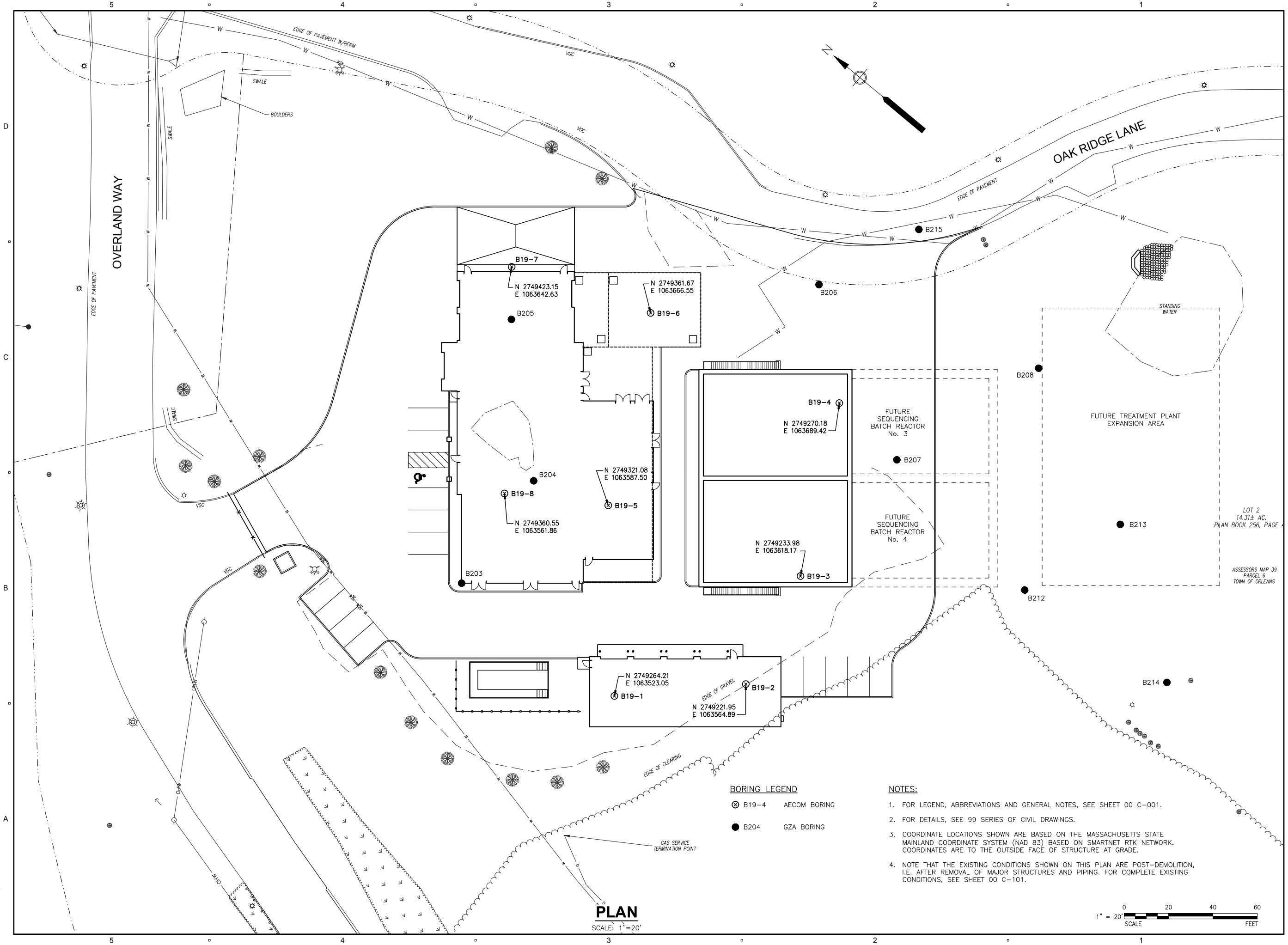
The Cape Cod Commission (CCC) also investigated the soils, water levels and water quality across the Town of Orleans in the early 1990s. The CCC investigation included the gathering of existing soil boring and water level data, the drilling of additional soil borings, and the installation of supplementary monitoring wells. The data collected by the CCC was summarized in a report titled (*Orleans Water Table Mapping Project, Orleans Massachusetts*; CCC, May 1995). The CCC report includes soil boring logs, water level and groundwater elevation data, well location maps, geologic cross-sections and groundwater contour maps.

Reports, technical papers and data from the USGS and CCC investigations are not provided in this report.

### 1.4.3 AECOM Hydrogeologic Evaluation (2017)

A hydrogeologic evaluation of the Downtown Area WWTF site was performed by AECOM in 2017 (*Hydrogeologic Evaluation: Overland Way Site, Town of Orleans, Massachusetts;* AECOM, October 2017*)*. The purpose of the hydrogeologic evaluation was to assess the potential for WWTF effluent discharge at the site. The hydrogeologic evaluation by AECOM used data from the USGS and CCC investigations and supplemented it with additional soil borings and laboratory testing.

The new borings taken during the AECOM hydrogeologic evaluation fall outside of the proposed WWTF and effluent disposal area and are therefore not provided in this document.




**PLAN**
SCALE: 1"=20'

BORING LEGEND

| | | |
|---|---|---|
| ⊗ B19-4 | AECOM BORING |
| ● B204 | GZA BORING |

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE 99 SERIES OF CIVIL DRAWINGS.
3. COORDINATE LOCATIONS SHOWN ARE BASED ON THE MASSACHUSETTS STATE MAINLAND COORDINATE SYSTEM (NAD 83) BASED ON SMARTNET RTK NETWORK. COORDINATES ARE TO THE OUTSIDE FACE OF STRUCTURE AT GRADE.
4. NOTE THAT THE EXISTING CONDITIONS SHOWN ON THIS PLAN ARE POST-DEMOLITION, I.E. AFTER REMOVAL OF MAJOR STRUCTURES AND PIPING. FOR COMPLETE EXISTING CONDITIONS, SEE SHEET 00 C-101.

1" = 20' SCALE: 0 20 40 60 FEET

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\CIFIGURE 1 - BORING LOCATION PLAN.DWG
LAST UPDATE: Wednesday, June 19, 2019 6:46:15 AM
PLOT DATE: Thursday, June 27, 2019 8:38:45 AM

AECOM

**PROJECT**

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

**OWNER**

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

**ENGINEER**

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

**REGISTRATION**

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

**ISSUE/REVISION**

| I/R | DATE | DESCRIPTION |
|---|---|---|

**PROJECT NUMBER**

60587515

| | |
|---|---|
| Designed By: | K. HARTEN |
| Drawn By: | S. NAPOLITANO |
| Dept Check: | C. BENZIGER |
| Proj Check: | T. PARECE |
| Date: | JUNE 2019 |
| Scale: | AS NOTED |

**DISCIPLINE**
SKETCHES
**SHEET TITLE**

**BORING LOCATION PLAN**

**SHEET NUMBER**

**FIGURE 1**

# ATTACHMENT 1

# Test Boring Logs (AECOM, 2019)

## Exploration Location

**NORTHING:** 2,749,264.21 **EASTING:** 1,063,523.05 **STATION:** _____ **OFFSET:** _____
**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree
**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.5
**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-1



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/26/2019 **TOTAL DEPTH (FT):** 30.0
**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten
**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers
**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A
**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30
**WATER LEVEL DEPTHS (ft):** Not Encountered
**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength
NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Recently placed TOPSOIL (~5") | | Utility Clear w/ Vactor to 5.5 ft. |
| | | | Grab 1 | | 0.5 to 5.5 | 60 | | | | Poorly graded SAND with Silt (SP/SM) - brown, fine to coarse sand, few to little fines, few fine to coarse gravel; dry, possible FILL | | |
| | 55 | | | | | | | | | | | |
| 5 | | | SS-1 | | 5.5 to 7.5 | 24/17 | 4-5-3-4 | Gradation | | Poorly graded SAND (SP) - tan. clean, fine to medium grained, trace coarse sand, trace fine gravel, trace silt; dry | | |
| | 50 | | SS-2 | | 8 to 10 | 24/14 | 2-3-2-4 | | | Top 10: Poorly graded SAND (SP) - tan, fine to medium grained, trace to few coarse sand, trace fines; dry | | |
| 10 | | | | | | | | | | Bottom 4": Silty SAND with Gravel (SM) - brown, fine to medium grained, some fines, little fine gravel, few coarse sand; moist | | |
| | 45 | | SS-3 | | 13 to 15 | 24/7 | 7-9-11-9 | | | Poorly graded SAND with Gravel and Silt (SP/SM) - light brown, fine to medium grained, some to little fine to coarse gravel, few coarse sand, few fines; dry, non-homogenous matrix | | |
| 15 | | | | | | | | | | | | |
| | 40 | | SS-4 | | 18 to 20 | 24/17 | 7-10-7-8 | | | No Recovery<br>(Redrove interval - recovered piece of coarse gravel in spoon tip and small amount of tan fine to medium sand within) | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,264.21 **EASTING:** 1,063,523.05 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.5

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-1



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 35 | | SS-5 | | 23 to 25 | 24/14 | 2-4-6-6 | | | Poorly graded SAND (SP) - tan, fine to medium grained, trace fines; dry | | |
| 30 | 30 | | SS-6 | | 28 to 30 | 24/16 | 3-8-11-11 | | | Poorly graded SAND (SP) - tan, fine to medium grained, trace fines, trace coarse sand, occasional silt seams (to 3/8") | | |
| 30 | 25 | | | | | | | | | End of Boring at 30 feet | | |
| 35 | 20 | | | | | | | | | | | |
| 40 | 15 | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,221.95 **EASTING:** 1,063,564.89 **STATION:** _____ **OFFSET:** _____
**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree
**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.8
**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-2



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/26/2019 **TOTAL DEPTH (FT):** 25.0
**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten
**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers
**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A
**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30
**WATER LEVEL DEPTHS (ft):** Not Encountered
**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength
NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Grab 1 | | 0.5 to 5 | 54 | | | | Recently placed TOPSOIL (~5") | | Utility Clear w/ Vactor to 5.0 ft. |
| | | | | | | | | | | Poorly graded SAND w/ Gravel and Silt (SP/SM) - light brown, fine to coarse grained, little fine gravel, few fines; dry, possible fill | | |
| | 55 | | | | | | | | | | | |
| 5 | | | SS-1 | | 5 to 7 | 24/13 | 4-4-4-5 | Gradation | | Poorly graded SAND (SP) - tan, clean, fine to medium grained, trace fines; dry | | |
| | 50 | | SS-2 | | 8 to 10 | 24/15 | 3-4-5-6 | | | Poorly graded SAND (SP) - tan, clean, fine to medium grained, trace coarse sand, trace fines; dry | | |
| 10 | | | | | | | | | | | | |
| | 45 | | SS-3 | | 13 to 15 | 24/13 | 2-3-6-8 | | | SILT with poorly graded Sand (ML-SP) - gray, some layers of tan to rust brown fine to medium sand with trace fines; dry | | |
| 15 | | | | | | | | | | | | |
| | 40 | | SS-4 | | 18 to 20 | 24/17 | 2-6-8-9 | | | Poorly graded SAND (SP) - tan, clean, fine to medium grained, trace fines; dry, finer in top half | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,221.95 **EASTING:** 1,063,564.89 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.8

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-2



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 35 | | SS-5 | X | 23 to 25 | 24/16 | 4-7-7-11 | | | Poorly graded SAND with Silt (SP/SM) - tan, stratified, fine to medium grained, few to trace fines, trace coarse sand, occasional silt seams (to 1/8") | | |
| | | | | | | | | | | End of Boring at 25 feet | | |
| 30 | 30 | | | | | | | | | | | |
| 35 | 25 | | | | | | | | | | | |
| 40 | 20 | | | | | | | | | | | |
| 45 | 15 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,233.98 **EASTING:** 1,063,618.17 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.3

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-3



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/27/2019 **TOTAL DEPTH (FT):** 50.0

**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten

**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers

**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A

**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30

**WATER LEVEL DEPTHS (ft):** Measured 45.5 ft. inside HSA at time of drilling

**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Grab 1 | | 0.5 to 6 | 66 | | | | Recently placed TOPSOIL (~5")<br>Poorly graded SAND with Silt (SP-SM) - brown, fine to coarse grained, few fines, trace fine gravel; dry, possible FILL | | Utility Clear w/ Vactor to 6.0 ft. |
| | 55 | | | | | | | | | | | |
| 5 | | | SS-1 | | 6 to 7.5 | 18/14 | 5-7-9 | Gradation | | Poorly graded SAND (SP) - light brown, fine to medium grained, trace coarse sand, trace fines; dry | | |
| | 50 | | SS-2 | | 8 to 10 | 24/15 | 1-9-7-5 | | | Poorly graded SAND (SP) - light brown, fine to coarse grained (predominantly fine to medium), few fine to coarse gravel (mostly @ top), trace to few fines; dry, top portion is possible fill | | |
| 10 | | | | | | | | | | | | |
| | 45 | | SS-3 | | 13 to 15 | 24/14 | 3-5-6-6 | | | Top 11": Poorly to well graded SAND (SP-SW) - brown to rust brown, fine to coarse grained, trace to few fine gravel, trace fines, sample a contains single ~1/4" silt seam at bottom; dry<br>Bottom 3": Poorly graded SAND (SP) - tan, clean, fine to medium grained, trace fines; dry | | |
| 15 | | | | | | | | | | | | |
| | 40 | | SS-4 | | 18 to 20 | 24/18 | 2-6-7-7 | | | Poorly graded SAND (SP) - light brown, clean, fine to coarse grained (predominantly fine to medium), trace fines; dry<br>Bottom 12": SANDY SILT (ML) - gray to rust brown, non-plastic, fine grained sand; dry | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

**Exploration Location**

**NORTHING:** 2,749,233.98 **EASTING:** 1,063,618.17 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.3

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-3



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 35 | | SS-5 | | 23 to 25 | 24/16 | 5-7-9-10 | | | SILT with SAND (ML) - gray, non to low plasticity silt, some rust brown fine grained sand interbeds; dry, | | |
| 30 | 30 | | SS-6 | | 28 to 30 | 24/15 | 3-5-6-11 | Gradation | | Poorly graded SAND (SP) - rust brown and tan, clean, medium grained, little fine sand, trace coarse sand, few to trace gray fine sandy silt seams; dry | | |
| 35 | 25 | | SS-7 | | 33 to 35 | 24/17 | 7-9-12-12 | | | Poorly graded SAND (SP) - light tan, fine grained, trace medium sand, trace fines, occasional silt seams (to 1/2"); dry | | |
| 40 | 20 | | SS-8 | | 38 to 40 | 24/17 | 7-12-14-14 | | | Silty SAND (SM) - gray and rust brown, interbedded, fine grained, some fines; dry, non-plastic | | |
| 45 | 15 | | SS-9 | | 43 to 45 | 24/16 | 3-8-12-11 | | | Sandy SILT (ML-SM) - gray and rust brown, non-plastic, fine grained sand, trace medium to coarse sand; moist | ▽ | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,233.98 **EASTING:** 1,063,618.17 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 57.3

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-3



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | SS-10 | X | 48 to 50 | 24/16 | 7-9-12-13 | | | Sandy SILT and SAND (ML-SM) - interlayers of fine sandy silt and light brown, fine to medium sand with trace fines, trace coarse sand and trace fine gravel; wet | | |
| 50 | | | | | | | | | | End of Boring at 50 feet | | |
| | 5 | | | | | | | | | | | |
| 55 | | | | | | | | | | | | |
| | 0 | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |
| | -5 | | | | | | | | | | | |
| 65 | | | | | | | | | | | | |
| | -10 | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,270.18 **EASTING:** 1,063,689.42 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 52.0

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-4



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/27/2019 **TOTAL DEPTH (FT):** 55.0

**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten

**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers

**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A

**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30

**WATER LEVEL DEPTHS (ft):** Measured 38 ft. inside HSA at time of drilling

**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Grab 1 | | 0.5 to 6 | 66 | | | | Recently placed TOPSOIL (~5")<br>Poorly graded SAND (SP) - light brown, fine to coarse grained, few fine to coarse gravel, few to several cobbles and concrete chunks, trace fines; dry, FILL | | Utility Clear w/ Vactor to 5.0 ft.<br><br>Many attempts and offsets made to clear hole; final location offset was ~16' SSE from staked borehole location. |
| 5 | 50 | | SS-1 | | 5 to 7 | 24/18 | 5-6-5-10 | | | Top 14": Poorly graded SAND (SP) - rust brown, fine to medium grained, trace fines, occasional silt seams (to 1/2"); dry<br>Bottom 4": Sandy SILT (ML) - brown, fine grained sand, trace medium to coarse sand, trace fine gravel; moist | | |
| 10 | 45 | | SS-2 | | 8 to 10 | 24/11 | 8-14-4-4 | Gradation | | Top: Silty SAND (SM) - rust brown, fine grained, some fines; dry<br>Bottom: SAND with Silt (SP/SM) - tan, fine grained, few to trace fines; dry | | |
| 15 | 40 | | SS-3 | | 13 to 15 | 24/12 | 4-4-4-4 | | | Poorly graded SAND (SP) - rust brown (@ top) and tan, stratified, fine grained, few medium to coarse sand, trace fines, occasional silt seams; dry | | |
| | 35 | | SS-4 | | 18 to 20 | 24/0 | 8-9-9-10 | | | No Recovery - brown, silty fine to coarse sand in spoon tip | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,270.18 **EASTING:** 1,063,689.42 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 52.0

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-4



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 30 | | SS-5 | | 23 to 25 | 24/12 | 3-6-7-10 | | | Poorly graded SAND (SP) - tan, fine grained, trace to few fines, trace medium to coarse sand; dry | | |
| 30 | 25 | | SS-6 | | 28 to 30 | 24/17 | 4-8-11-13 | | | Top 7": Poorly graded SAND (SP) - tan and rust brown, stratified, fine to medium grained (predominantly fine), trace fines; dry<br>Bottom 10": Sandy SILT (ML) - gray and rust brown, stratified, some fine to medium sand, trace coarse sand; dry | | |
| 35 | 20 | | SS-7 | | 33 to 35 | 24/16 | 5-9-12-12 | | | Silty SAND (SM) - gray and rust brown, stratified, fine to medium grained, some to little fines, trace coarse sand, trace fine gravel; dry, less silty with depth | | |
| 40 | 15 | | SS-8 | | 38 to 40 | 24/16 | 5-6-8-9 | | | Poorly graded SAND (SP) and Sandy SILT (ML) - interlayered rust brown, fine to coarse grained sand with trace fines and gray brown, fine sandy silt; wet | ▽ | |
| 45 | 10 | | SS-9 | | 43 to 45 | 24/13 | 2-4-9-12 | | | Top 11": Poorly graded SAND (SP) - rust brown, fine to coarse grained, trace fines; wet<br>Bottom 2": Sandy SILT (ML) - gray, fine grained sand; wet | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,270.18 **EASTING:** 1,063,689.42 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 52.0

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-4



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 5 | | SS-10 | | 48 to 50 | 24/17 | 3-6-14-17 | | | Top: Silty SAND (SM) and Sandy SILT (ML) - gray brown interbeds of silty fine to medium grained sand with trace coarse sand and fine sandy silt; wet | | |
| | | | | | | | | | | Bottom: Silty SAND with Gravel (SM) - rust brown, fine to coarse sand, little fine to coarse gravel, little fines; wet | | |
| 55 | 0 | | SS-11 | | 53 to 55 | 24/11 | 12-13-11-11 | | | Top 6": SAND with Silt (SP/SM) - gray brown, fine to medium grained (predominantly fine), few fines; wet | | |
| | | | | | | | | | | Bottom 5": Sandy SILT (ML) - gray and rust brown, interbedded, fine grained sand; wet, low plasticity | | |
| | | | | | | | | | | End of Boring at 55 feet | | |
| 60 | -5 | | | | | | | | | | | |
| 65 | -10 | | | | | | | | | | | |
| 70 | -15 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,321.08 **EASTING:** 1,063,587.5 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 49.4

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-5



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/28/2019 **TOTAL DEPTH (FT):** 50.0

**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten

**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers

**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A

**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30

**WATER LEVEL DEPTHS (ft):** Measured 37 ft. inside HSA at time of drilling

**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength
NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Recently placed TOPSOIL (~5") | | Utility Clear w/ Vactor to 5.0 ft. |
| | | | Grab 1 | | 0.5 to 5 | 54 | | | | Silty SAND (SM) - brown, fine to medium grained, little fines, trace to few fine gravel, trace coarse sand; dry, probable FILL, similar to SS-1 | | Offset borehole ~12' NNE to a more gentle slope. |
| 5 | 45 | | SS-1 | | 5 to 7 | 24/12 | 2-8-8-7 | | | Silty SAND (SM) - brown, fine to medium grained, little fines, trace to few fine gravel, trace coarse sand; dry, probable FILL | | |
| | | | SS-2 | | 8 to 10 | 24/15 | 1-2-2-2 | Gradation Moist. % | | Silty SAND (SM) - brown, fine to medium grained w/ trace coarse sand, little fines, trace fine gravel; dry, probable FILL | | |
| 10 | 40 | | | | | | | | | | | |
| | | | SS-3 | | 13 to 15 | 24/16 | 2-1-1-1 | | | Silty SAND (SM) - brown, fine to medium grained w/ trace coarse sand, little fines, trace fine gravel; moist, probable FILL | | |
| 15 | 35 | | | | | | | | | | | |
| | | | SS-4 | | 18 to 20 | 24/16 | 1-7-9-9 | Gradation | | Poorly graded SAND w/ Silt (SP/SM) - tan, fine to medium grained, few fines; dry | | |
| | 30 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

**Exploration Location**

**NORTHING:** 2,749,321.08 **EASTING:** 1,063,587.5 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 49.4

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-5



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 25 | | SS-5 | | 23 to 25 | 24/18 | 2-3-3-4 | | | SILT (MH) - olive brown, medium plasticity, trace fine sand, occasional fine to medium sand partings and seams; moist to wet | | |
| 30 | 20 | | SS-6 | | 28 to 30 | 24/17 | 2-2-2-4 | Gradation | | SILT (MH) - olive brown (@ top) and gray, few fine sand, occasional fine to medium sand partings; moist to wet, less plastic than SS-5 above | | |
| 35 | 15 | | SS-7 | | 33 to 35 | 24/14 | 5-12-18-20 | | | Top 4": SILT (MH), as SS-6 above; wet to moist<br>Bottom 10": Poorly graded SAND with Silt (SP/SM) - brown, fine to medium grained, trace to few fines | ▽ | |
| 40 | 10 | | SS-8 | | 38 to 40 | 24/16 | 6-14-20-22 | | | Poorly graded SAND (SP/SM) - brown, fine to coarse grained, few fines, few fine gravel; moist to wet | | |
| 45 | 5 | | SS-9 | | 43 to 45 | 24/17 | 5-7-11-15 | | | Poorly graded SAND and Sandy SILT (SP-ML) - brown, fine to coarse grained clean sand with trace fine gravel, trace fines and fine sandy silt interlayers; wet | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,321.08 **EASTING:** 1,063,587.5 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 49.4

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-5



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | | SS-10 | X | 48 to 50 | 24/18 | 4-6-8-12 | | | Poorly graded SAND and SILT (SP-ML) - brown, clean, interbedded, medium to coarse sand, few fine sand, trace fines, and silt with fine sand; wet | | |
| | | | | | | | | | | End of Boring at 50 feet | | |
| 55 | -5 | | | | | | | | | | | |
| 60 | -10 | | | | | | | | | | | |
| 65 | -15 | | | | | | | | | | | |
| 70 | -20 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,361.67 **EASTING:** 1,063,666.55 **STATION:** _____ **OFFSET:** _____
**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree
**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.8
**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-6



## Drilling Information

**DATE START / END:** 3/29/2019 - 3/29/2019 **TOTAL DEPTH (FT):** 55.0
**CONTRACTOR:** Desmond Well Drilling **DRILLER:** P. Desmond **LOGGED BY:** K. Harten
**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers
**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A
**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30
**WATER LEVEL DEPTHS (ft):** Measured 33 ft. inside HSA at time of drilling
**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Recently placed TOPSOIL (~5") | | |
| | 45 | | Grab 1 | | 0.5 to 5 | 54 | | | | Poorly graded SAND with Gravel and Silt (SP/SM) - brown, fine to coarse sand, little fine to coarse gravel, few fines; dry, FILL | | Utility Clear w/ Vactor to 5.0 ft. |
| 5 | | | SS-1 | | 5 to 7 | 24/2 | 8-8-9-5 | | | Silty SAND (SM) - brown, fine to coarse sand, little fines, few fine gravel; dry, FILL | | |
| | 40 | | SS-2 | | 8 to 10 | 24/17 | 4-2-3-2 | Gradation Moist. % | | Silty SAND (SM) - brown, fine to coarse sand (predominantly fine to medium), little fines, trace fine gravel; moist, FILL | | |
| 10 | | | | | | | | | | | | |
| | 35 | | SS-3 | | 13 to 15 | 24/2 | 4-4-4-10 | | | Silty SAND and Concrete Pieces (SM) - brown, fine to coarse sand, broken concrete pieces, little fines; dry, poor recovery, FILL | | |
| 15 | | | | | | | | | | Tip of SS-3 contains poorly graded SAND (SP) - rust brown, clean, fine to coarse grained, trace fines; dry | | |
| | 30 | | SS-4 | | 18 to 20 | 24/15 | 4-10-14-18 | Gradation | | Poorly graded SAND (SP/SM) - tan, clean, fine to medium grained, few to trace fines; dry | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,361.67 **EASTING:** 1,063,666.55 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.8

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-6



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 25 | | SS-5 | X | 23 to 25 | 24/16 | 2-7-9-15 | | | Poorly graded SAND (SP) - tan and rust orange, stratified, fine to coarse grained, trace fines; ~2" layer of Gray SILT with fine sand in top half of spoon; dry | | |
| 30 | 20 | | SS-6 | X | 28 to 30 | 24/13 | 9-8-8-11 | | | Poorly graded SAND (SP) - rust orange and tan, fine to medium grained, trace fines, occasional silt laminae; dry | | |
| 35 | 15 | | SS-7 | X | 33 to 35 | 24/17 | 2-5-7-10 | Gradation | | Silty SAND (SM) - light brown to rust brown, fine to medium grained, little to some fines, few gray silt laminae and seams; wet | ▽ | |
| 40 | 10 | | SS-8 | X | 38 to 40 | 24/16 | 4-11-12-14 | | | Silty SAND (SM) - medium brown and rust brown, stratified, fine grained, little to some fines, trace medium to coarse sand; wet | | |
| 45 | 5 | | SS-9 | X | 43 to 45 | 24/20 | 3-5-7-7 | | | Silty SAND (SM) - medium brown and rust brown, stratified, fine to medium grained, some fines, trace coarse sand, occasional silt seams (to 1/8"); wet | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,361.67 **EASTING:** 1,063,666.55 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.8

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-6



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | | SS-10 | | 48 to 50 | 24/20 | 4-4-7-8 | | | Silty SAND (SM) - medium brown and rust brown, stratified, fine to medium grained, some fines, trace coarse sand, occasional to few seams and laminae of elastic silt (to 1/2"); wet | | |
| | -5 | | SS-11 | | 53 to 55 | 24/13 | 4-9-14-18 | | | Top 4": Brown Silty SAND (SM), as described in sample SS-10 above<br>Bottom 9": Poorly graded SAND (SP) - light brown, fine to medium grained, trace fines; wet | | |
| 55 | | | | | | | | | | End of Boring at 55 feet | | |
| | -10 | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |
| | -15 | | | | | | | | | | | |
| 65 | | | | | | | | | | | | |
| | -20 | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,423.15 **EASTING:** 1,063,642.63 **STATION:** _____ **OFFSET:** _____
**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree
**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.5
**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-7


## Drilling Information

**DATE START / END:** 3/29/2019 - 4/1/2019 **TOTAL DEPTH (FT):** 50.0
**CONTRACTOR:** Desmond Well Drilling **DRILLER:** T. Desmond **LOGGED BY:** K. Harten
**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers
**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A
**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30
**WATER LEVEL DEPTHS (ft):** Measured 33 ft. inside HSA at end of drilling
**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Recently placed TOPSOIL (~5") | | |
| | 45 | | Grab 1 | | 0.5 to 5 | 54 | | | | Silty SAND (SM) - brown, fine to coarse grained (predominantly fine), little fines, few fine gravel, few cobbles; dry, probable FILL | | Utility Clear w/ Vactor to 5.0 ft.; offset borehole ~15' E due to standing water |
| 5 | | | SS-1 | | 5 to 7 | 24/16 | 4-4-3-4 | Gradation Density | | Silty SAND (SM) - brown, fine to medium grained w/ trace coarse sand, little fines, trace fine gravel; dry, probable FILL | | |
| | 40 | | SS-2 | | 8 to 10 | 24/0 | 3-2-3-3 | | | No Recovery | | |
| 10 | | | | | | | | | | | | |
| | 35 | | SS-3 | | 13 to 15 | 24/18 | 5-8-8-9 | Gradation | | Poorly graded SAND (SP/SM) - tan, clean, fine to medium grained (predominantly fine), few fines; dry | | |
| 15 | | | | | | | | | | | | |
| | 30 | | SS-4 | | 18 to 20 | 24/19 | 4-10-9-12 | | | Poorly graded SAND (SP/SM) - tan, fine to medium grained, few fines; dry, similar to above | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

**Exploration Location**

**NORTHING:** 2,749,423.15 **EASTING:** 1,063,642.63 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.5

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-7



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 25 | | SS-5 | | 23 to 25 | 24/16 | 5-8-11-16 | | | Poorly graded SAND (SP/SM) - tan and rust orange, fine to medium grained, few fines, occasional seams of gray, slightly elastic silt (to ~1/2') | | |
| 30 | 20 | | SS-6 | | 28 to 30 | 24/15 | 7-11-11-11 | | | Poorly graded SAND (SP-ML) - tan, fine to medium grained sand with trace to few fines, some interbeds of gray fine sandy silt; dry | | |
| 35 | 15 | | SS-7 | | 33 to 35 | 24/20 | 3-11-9-11 | | | Sandy SILT (ML) - gray brown and rust brown, interbedded, fine sandy silt with little interbeds of rust brown fine to medium sand with few fines; wet, non to low plasticity | ▽ | |
| 40 | 10 | | SS-8 | | 38 to 40 | 24/18 | 5-7-8-11 | | | Silty SAND (SM) - gray and rust brown, stratified, fine to medium grained, some fines, few fine to coarse gravel, trace coarse sand; wet, non-plastic | | |
| 45 | 5 | | SS-9 | | 43 to 45 | 24/11 | 6-12-12-14 | | | Top 4": Well graded SAND with Gravel (SW) - brown, fine to coarse grained, some to little fine to coarse gravel, trace fines; wet<br>Bottom 7": Silty SAND (SM) - gray and rust brown, fine to medium grained, little to few fines; wet | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,423.15 **EASTING:** 1,063,642.63 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 46.5

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-7



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | | SS-10 | | 48 to 50 | 24/15 | 6-11-18-18 | | | Top 6": Sandy SILT (ML) - gray and rust brown, non-plastic, some fine grained sand; wet<br>Bottom 9": Well graded SAND with Gravel (SW-SM) - brown, fine to coarse grained sand, some fine to coarse grained gravel, few fines; wet<br>End of Boring at 50 feet | | |
| 55 | -5 | | | | | | | | | | | |
| 60 | -10 | | | | | | | | | | | |
| 65 | -15 | | | | | | | | | | | |
| 70 | -20 | | | | | | | | | | | |
| | -25 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

## Exploration Location

**NORTHING:** 2,749,360.55 **EASTING:** 1,063,561.86 **STATION:** _____ **OFFSET:** _____
**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree
**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 48.6
**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-8



## Drilling Information

**DATE START / END:** 3/26/2019 - 3/28/2019 **TOTAL DEPTH (FT):** 55.0
**CONTRACTOR:** Desmond Well Drilling **DRILLER:** T. Desmond **LOGGED BY:** K. Harten
**EQUIPMENT:** CME 45C **EXPLORATION TYPE/METHOD:** Hollow Stem Augers
**AUGER ID/OD:** 3.25 in. **CASING ID/OD:** N/A **CORE INFORMATION:** N/A
**HAMMER TYPE:** Automatic **HAMMER WEIGHT (lbs):** 140 **HAMMER DROP (inch):** 30
**WATER LEVEL DEPTHS (ft):** Estimated @ 35 ft. at time of drilling
**GENERAL NOTES:** Boring backfilled with cuttings upon completion

**ABBREVIATIONS:**
ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length
bpf = Blows per Foot; mpf = Minute per Foot; SS = Sample
ST = Undisturbed Tube Sample; RC = Rock Core; FVS = Field Vane Shear; CBR = California Bearing Ratio
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
$Q_p$ = Pocket Penetrometer Strength; $S_v$ = Pocket Torvane Shear Strength; $F_v$ = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Recently placed TOPSOIL (~5") | | |
| | | | Grab 1 | | 0.5 to 5 | 54 | | | | Poorly graded SAND with Silt (SP/SM) - brown, fine to coarse grained, few fines; dry, probable FILL | | Utility Clear w/ Vactor to 5.0 ft. |
| 5 | 45 | | SS-1 | | 5 to 7 | 24/15 | 2-3-3-5 | Gradation Density | | Silty SAND (SM) - brown, fine to medium grained with trace coarse sand, few to little fine gravel, few to little fines; dry, probable FILL | | |
| | 40 | | SS-2 | | 8 to 10 | 24/12 | 4-7-10-9 | | | Poorly graded SAND (SP) - rust brown, fine to coarse grained, few fine gravel, trace to few fines; dry | | |
| 10 | | | | | | | | | | | | |
| | 35 | | SS-3 | | 13 to 15 | 24/13 | 2-3-4-4 | | | Poorly graded SAND (SP) - rust brown, clean, fine to coarse grained sand, little to few fine gravel, trace fines; dry, appears native | | |
| 15 | | | | | | | | | | | | |
| | 30 | | SS-4 | | 18 to 20 | 24/17 | 7-6-5-5 | Gradation | | Poorly graded SAND with Silt (SP/SM) - light brown, fine to medium grained, few to little fines, trace coarse sand, trace coarse gravel, occasional gray silt seams (to 1"); dry | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM
**PROJECT NAME:** Orleans DACSD
**CITY/STATE:** Orleans, MA
**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,360.55 **EASTING:** 1,063,561.86 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 48.6

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG
# B19-8



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 25 | | SS-5 | | 23 to 25 | 24/14 | 3-6-6-9 | | | Poorly graded SAND (SP) - tan, fine to medium grained, trace coarse sand, trace fines with some gray and rust brown fine sandy SILT (ML) layers in top half of sample; dry | | |
| 30 | 20 | | SS-6 | | 28 to 30 | 24/12 | 5-6-6-7 | Gradation | | Poorly graded SAND (SP) - tan, clean, fine to coarse grained (predominantly medium sand), trace fine gravel, trace fines; dry, some FeOx staining | | |
| 35 | 15 | | SS-7 | | 33 to 35 | 24/17 | 6-7-10-10 | | | Poorly graded SAND (SP) - tan, fine to medium grained, trace fines, trace coarse sand; moist to wet @ tip | ▽ | |
| 40 | 10 | | SS-8 | | 38 to 40 | 24/20 | 2-3-6-6 | | | Poorly graded SAND (SP) - brown, fine to medium grained, trace fines; wet<br>Sandy SILT (ML) - gray and rust stained, low plasticity, some fine grained sand, trace medium to coarse sand; wet | | |
| 45 | 5 | | SS-9 | | 43 to 45 | 24/16 | 8-5-7-9 | | | Sandy elastic SILT (MH) & poorly graded SAND (SP) - interlayers of gray and rust brown, low plasticity, fine sandy silt, and light brown fine to medium grained sand with trace coarse sand and trace silt; wet | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

**Exploration Location**

**NORTHING:** 2,749,360.55 **EASTING:** 1,063,561.86 **STATION:** _____ **OFFSET:** _____

**HORIZONTAL DATUM:** NAD 83 **INCLINATION FROM VERTICAL:** 0 degree

**VERTICAL DATUM:** NAVD88 **GROUND SURFACE ELEV. (FT):** 48.6

**LOCATION:** WWTF **ESTIMATED/SURVEYED?:** _____

# GEOLOGIC LOG

# B19-8



| Depth (ft) | Elev. (ft) | Casing Pen. (bpf) or Core Rate (mpf) | SAMPLE INFORMATION: Sample No. | Type | Depth (ft) | Pen./ Rec. (in) | Blows Count or RQD | Field/ Laboratory Test Data | GRAPHIC LOG | Sample Description & Classification | $H_20$ Depth | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | | SS-10 | | 48 to 50 | 24/20 | 15-17-16-15 | | | Poorly graded SAND (SP) - light brown, fine to medium grained, trace to few coarse sand, trace fines; wet | | Sand ran up inside augers during the collection of SS-10; sample contents don't appear affected; but blow counts might be inflated. Drill an additional 5-ft. |
| | | | | | | | | | | (Some auger grinding @ ~51 ft.) | | |
| 55 | -5 | | SS-11 | | 53 to 55 | 24/10 | 27-19-19-22 | | | Well graded SAND with Gravel (SW) - light brown, fine to coarse grained sand, some to little fine gravel, trace fines; wet | | |
| | | | | | | | | | | End of Boring at 55 feet | | |
| 60 | -10 | | | | | | | | | | | |
| 65 | -15 | | | | | | | | | | | |
| 70 | -20 | | | | | | | | | | | |

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

**LOGGED BY (Consultant):** AECOM

**PROJECT NAME:** Orleans DACSD

**CITY/STATE:** Orleans, MA

**AECOM PROJECT NUMBER:** 60476644

AECOM

MASSDOT I-90 REV. 2 ORLEANS DATABASE_2019.04.03.GPJ 6/19/19

# ATTACHMENT 2

## Geotechnical Laboratory Testing Results
## (AECOM, 2019)

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | --- | Sample Type: | --- | Tested By: | ckg |
| Sample ID: | --- | Test Date: | 04/16/19 | Checked By: | jdt |
| Depth : | --- | Test Id: | 499781 | | |

# Moisture Content of Soil and Rock - ASTM D2216

| Boring ID | Sample ID | Depth | Description | Moisture Content,% |
|---|---|---|---|---|
| B19-5 | SS- 2 | 8-10 | Moist, olive yellow silty sand | 9.2 |
| B19-6 | SS- 2 | 8-10 | Moist, yellowish brown silty sand | 11.0 |
| B-134 | SS- 2 | 8-10 | Moist, brownish yellow sand with silt | 20.8 |

Notes: Temperature of Drying : 110° Celsius

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | --- | Sample Type: | --- | Tested By: | ckg |
| Sample ID: | --- | Test Date: | 04/16/19 | Checked By: | jdt |
| Depth : | --- | Test Id: | 499787 | | |

# Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

| Boring ID | Sample ID | Depth | Visual Description | Bulk Density pcf | Moisture Content % | Dry Density pcf | * |
|---|---|---|---|---|---|---|---|
| B19-7 | SS- 1 | 5-7 | Moist, dark grayish brown silty sand | 107.0 | 10.44 | 96.91 | (1) |
| B19-8 | SS- 1 | 5-7 | Moist, dark brown silty sand | 105.2 | 9.767 | 95.83 | (2) |
| PS2-1 | SS- 2 | 8-10 | Moist, yellowish brown sand with silt | 93.54 | 5.172 | 88.94 | (3) |
| PS2-2 | SS- 1 | 5-7 | Moist, yellowish brown sand | 93.52 | 3.420 | 90.43 | (4) |

* Sample Comments

(1): Method B-Volumetric, Reconstituted (compacted)

(2): Method B-Volumetric, Reconstituted (compacted)

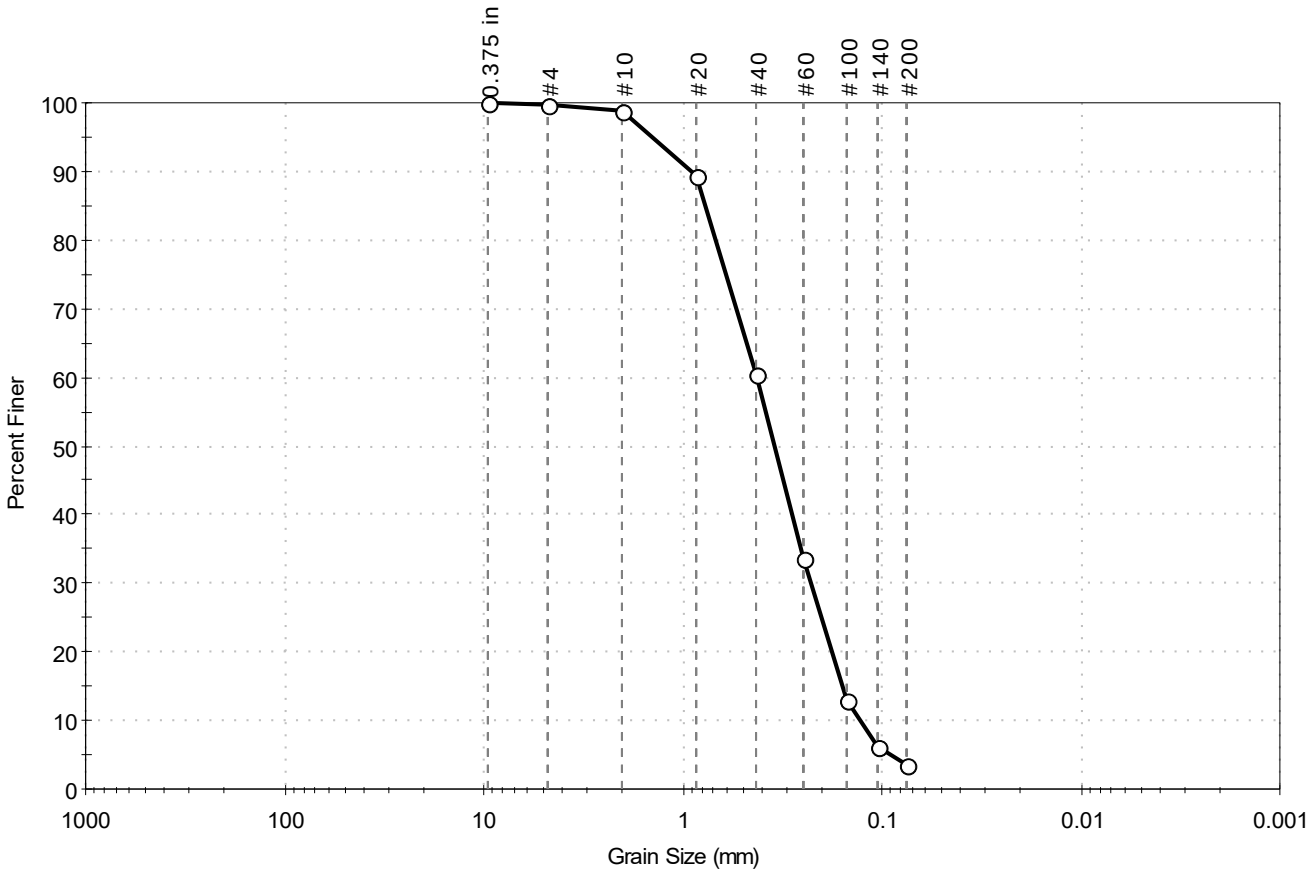
(3): Method B-Volumetric, Reconstituted (compacted)

(4): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-1 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-1 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 5.5-7.5 | Test Id: | 499761 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, yellow sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.2 | 96.2 | 3.6 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 99 | | |
| #20 | 0.85 | 89 | | |
| #40 | 0.42 | 60 | | |
| #60 | 0.25 | 34 | | |
| #100 | 0.15 | 13 | | |
| #140 | 0.11 | 6 | | |
| #200 | 0.075 | 3.6 | | |
| | | | | |
| | | | | |

**Coefficients**

$D_{85}$ = 0.7651 mm  $D_{30}$ = 0.2286 mm

$D_{60}$ = 0.4222 mm  $D_{15}$ = 0.1577 mm

$D_{50}$ = 0.3461 mm  $D_{10}$ = 0.1289 mm

$C_u$ = 3.275  $C_c$ = 0.960

**Classification**

ASTM  Poorly graded SAND (SP)

AASHTO  Fine Sand (A-3 (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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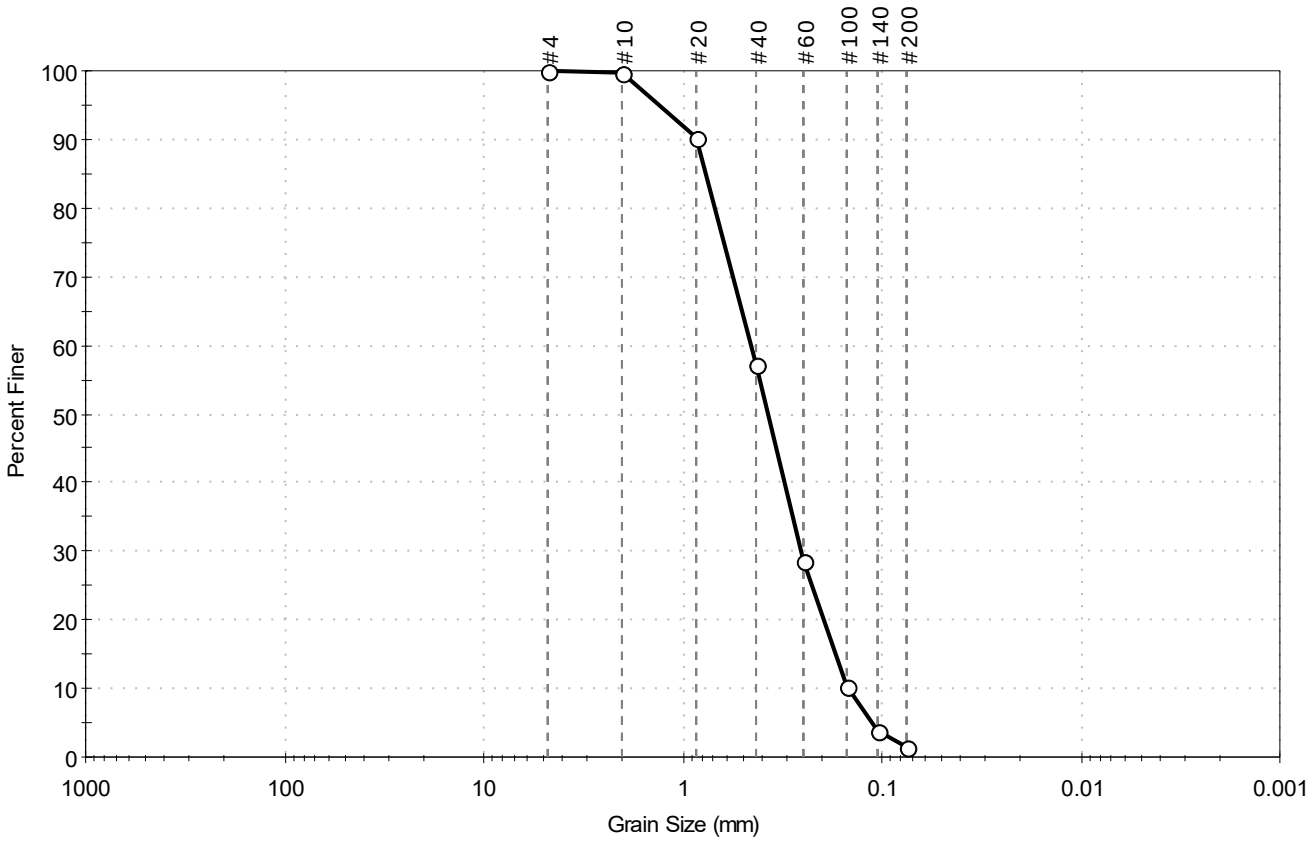
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-2 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-1 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 5-7 | Test Id: | 499762 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, yellow sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| – | 0.0 | 98.6 | 1.4 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 100 | | |
| #20 | 0.85 | 90 | | |
| #40 | 0.42 | 57 | | |
| #60 | 0.25 | 29 | | |
| #100 | 0.15 | 10 | | |
| #140 | 0.11 | 4 | | |
| #200 | 0.075 | 1.4 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.7602 mm | $D_{30}$ = 0.2567 mm |
| $D_{60}$ = 0.4504 mm | $D_{15}$ = 0.1715 mm |
| $D_{50}$ = 0.3717 mm | $D_{10}$ = 0.1485 mm |
| $C_u$ = 3.033 | $C_c$ = 0.985 |

**Classification**

ASTM Poorly graded SAND (SP)

AASHTO Fine Sand (A-3 (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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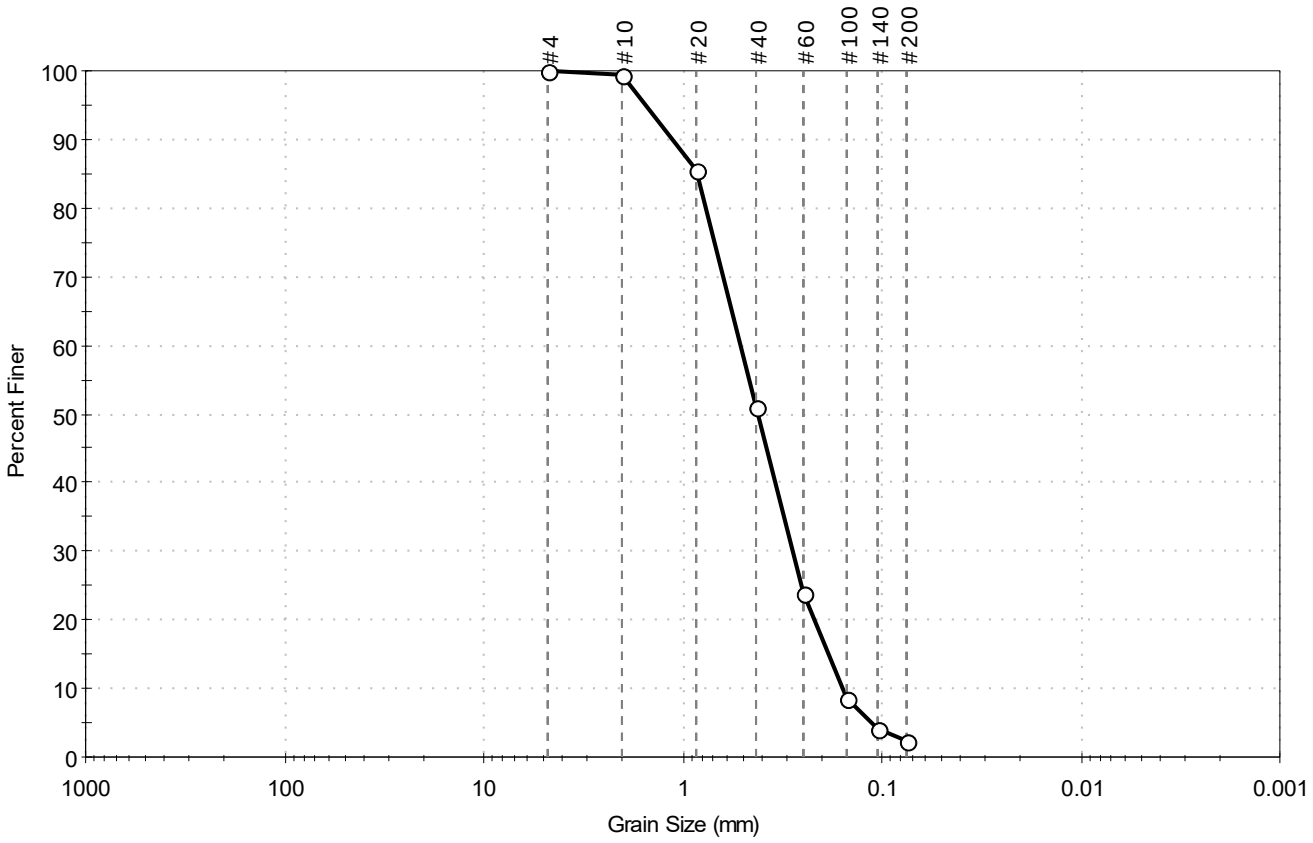
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-3 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-1 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 6-7.5 | Test Id: | 499763 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, yellow gravel with sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.0 | 97.8 | 2.2 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 99 | | |
| #20 | 0.85 | 86 | | |
| #40 | 0.42 | 51 | | |
| #60 | 0.25 | 24 | | |
| #100 | 0.15 | 8 | | |
| #140 | 0.11 | 4 | | |
| #200 | 0.075 | 2.2 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.8389 mm | $D_{30}$ = 0.2814 mm |
| $D_{60}$ = 0.5087 mm | $D_{15}$ = 0.1861 mm |
| $D_{50}$ = 0.4167 mm | $D_{10}$ = 0.1579 mm |
| $C_u$ = 3.222 | $C_c$ = 0.986 |

**Classification**

ASTM Poorly graded SAND (SP)

AASHTO Fine Sand (A-3 (1))

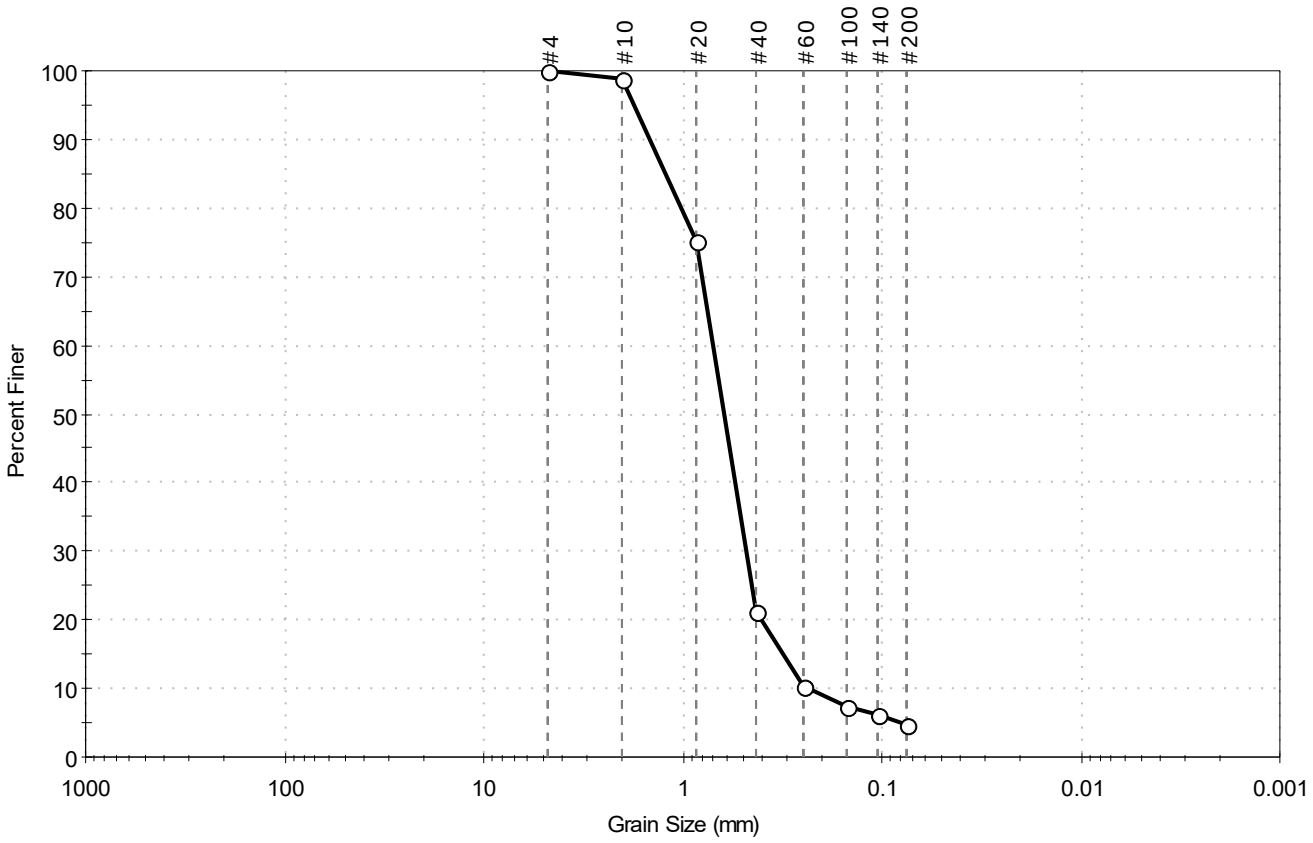
**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-3 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-6 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 28-30 | Test Id: | 499764 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, brownish yellow sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.0 | 95.1 | 4.9 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 99 | | |
| #20 | 0.85 | 75 | | |
| #40 | 0.42 | 21 | | |
| #60 | 0.25 | 10 | | |
| #100 | 0.15 | 7 | | |
| #140 | 0.11 | 6 | | |
| #200 | 0.075 | 4.9 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 1.2075 mm | $D_{30}$ = 0.4752 mm |
| $D_{60}$ = 0.6983 mm | $D_{15}$ = 0.3123 mm |
| $D_{50}$ = 0.6142 mm | $D_{10}$ = 0.2327 mm |
| $C_u$ = 3.001 | $C_c$ = 1.390 |

**Classification**

ASTM — Poorly graded SAND (SP)

AASHTO — Stone Fragments, Gravel and Sand (A-1-b (1))

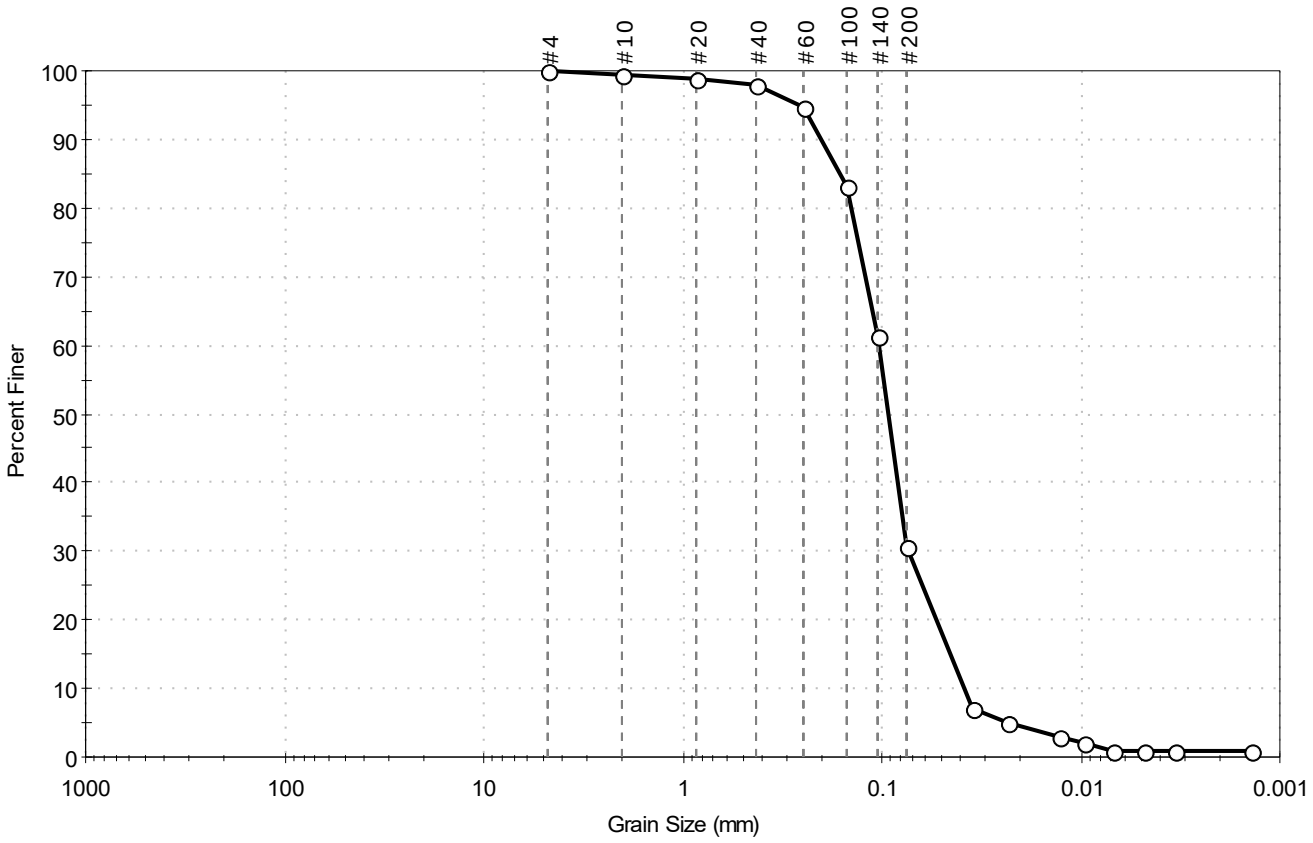
**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-4 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-2 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 8-10 | Test Id: | 499765 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, olive yellow silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.0 | 69.3 | 30.7 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 99 | | |
| #20 | 0.85 | 99 | | |
| #40 | 0.42 | 98 | | |
| #60 | 0.25 | 95 | | |
| #100 | 0.15 | 83 | | |
| #140 | 0.11 | 61 | | |
| #200 | 0.075 | 31 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0354 | 7 | | |
| --- | 0.0232 | 5 | | |
| --- | 0.0129 | 3 | | |
| --- | 0.0095 | 2 | | |
| --- | 0.0068 | 1 | | |
| --- | 0.0048 | 1 | | |
| --- | 0.0034 | 1 | | |
| --- | 0.0014 | 1 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.1623 mm | $D_{30}$ = 0.0734 mm |
| $D_{60}$ = 0.1045 mm | $D_{15}$ = 0.0456 mm |
| $D_{50}$ = 0.0933 mm | $D_{10}$ = 0.0389 mm |
| $C_u$ = 2.686 | $C_c$ = 1.325 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

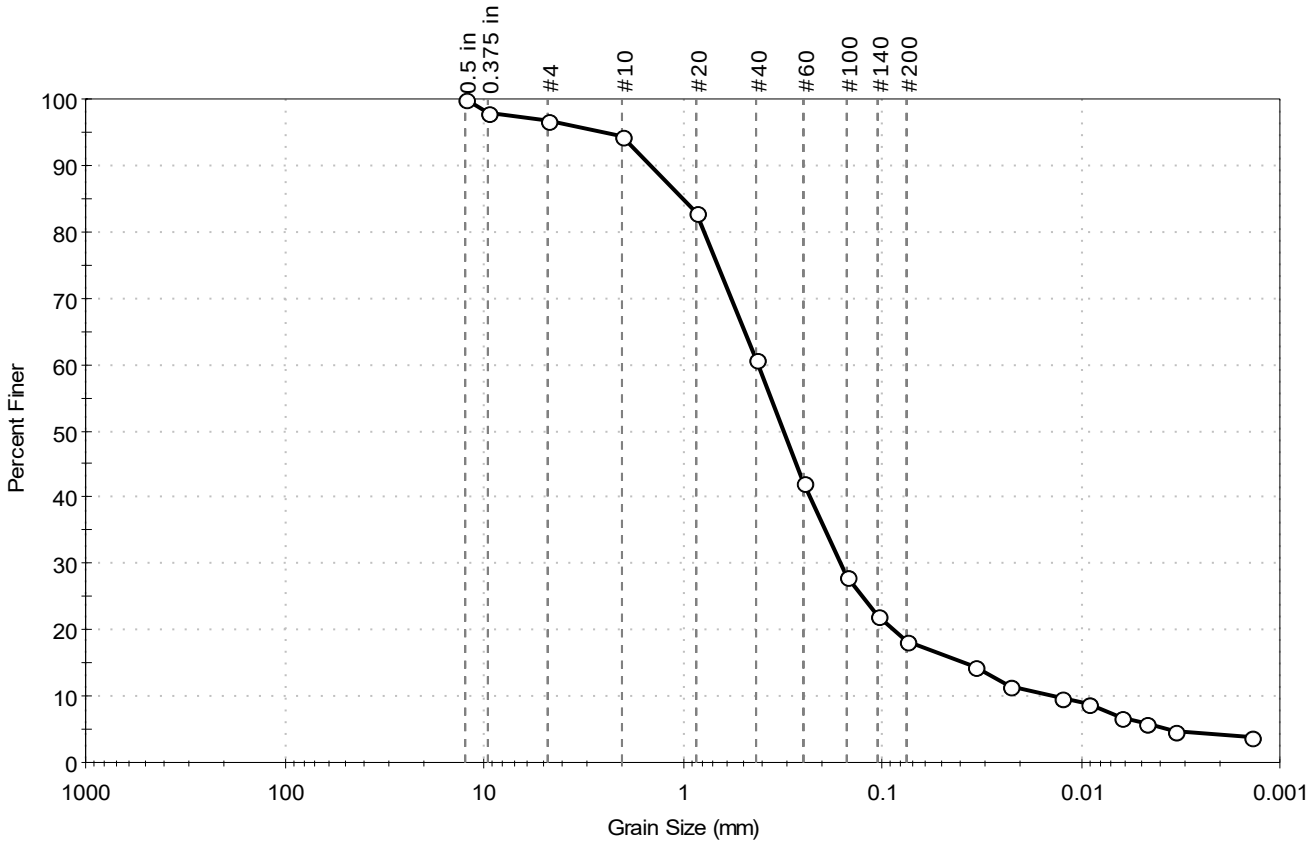
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-5 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-2 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 8-10 | Test Id: | 499766 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, olive yellow silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 3.1 | 78.5 | 18.4 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.5 in | 12.50 | 100 | | |
| 0.375 in | 9.50 | 98 | | |
| #4 | 4.75 | 97 | | |
| #10 | 2.00 | 94 | | |
| #20 | 0.85 | 83 | | |
| #40 | 0.42 | 61 | | |
| #60 | 0.25 | 42 | | |
| #100 | 0.15 | 28 | | |
| #140 | 0.11 | 22 | | |
| #200 | 0.075 | 18 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0340 | 15 | | |
| --- | 0.0227 | 12 | | |
| --- | 0.0127 | 10 | | |
| --- | 0.0092 | 9 | | |
| --- | 0.0064 | 7 | | |
| --- | 0.0047 | 6 | | |
| --- | 0.0034 | 5 | | |
| --- | 0.0014 | 4 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.9936 mm | $D_{30}$ = 0.1611 mm |
| $D_{60}$ = 0.4154 mm | $D_{15}$ = 0.0375 mm |
| $D_{50}$ = 0.3126 mm | $D_{10}$ = 0.0140 mm |
| $C_u$ = 29.671 | $C_c$ = 4.463 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

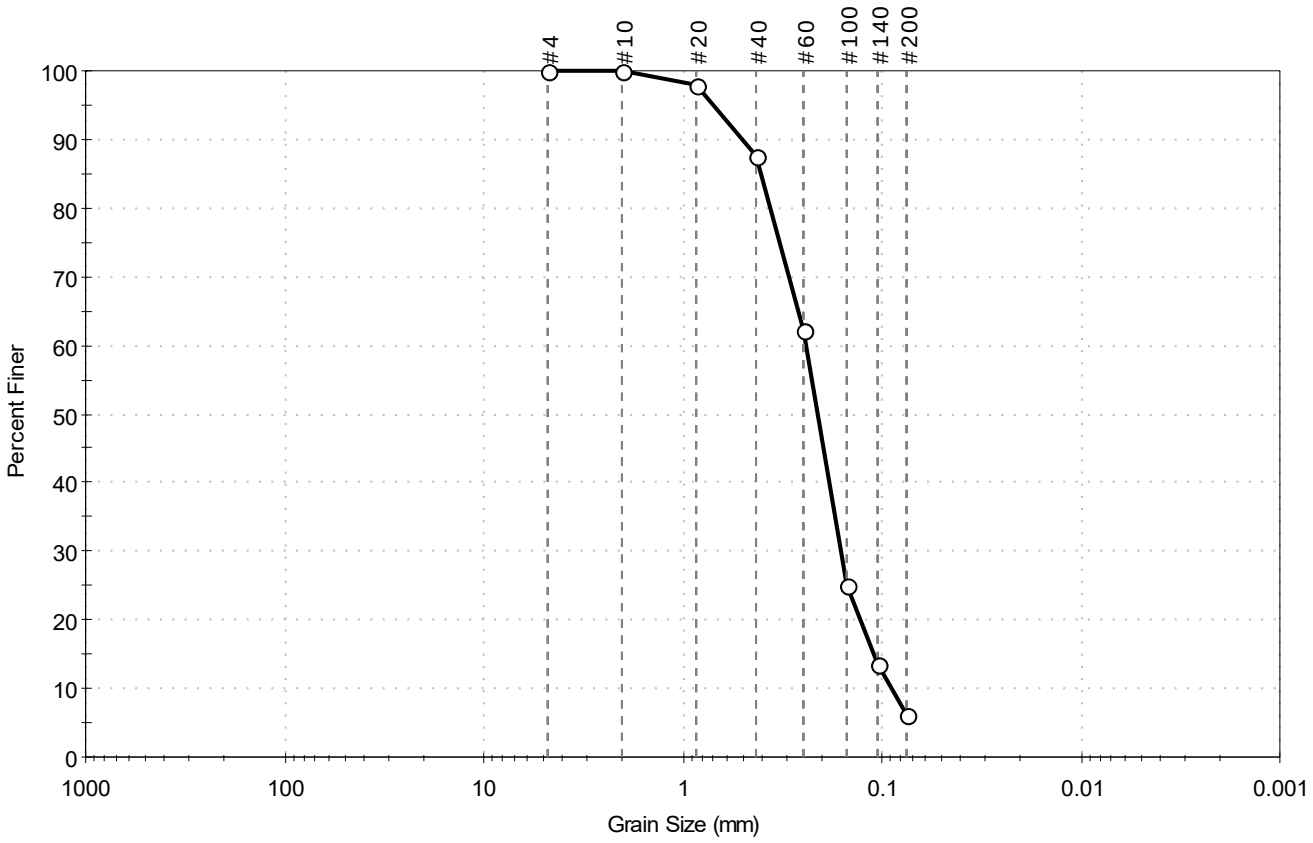
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-5 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-4 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 18-20 | Test Id: | 499767 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, brownish yellow sand with silt | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| – | 0.1 | 93.8 | 6.1 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 100 | | |
| #20 | 0.85 | 98 | | |
| #40 | 0.42 | 88 | | |
| #60 | 0.25 | 62 | | |
| #100 | 0.15 | 25 | | |
| #140 | 0.11 | 14 | | |
| #200 | 0.075 | 6.1 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.4026 mm | $D_{30}$ = 0.1603 mm |
| $D_{60}$ = 0.2420 mm | $D_{15}$ = 0.1106 mm |
| $D_{50}$ = 0.2110 mm | $D_{10}$ = 0.0897 mm |
| $C_u$ = 2.698 | $C_c$ = 1.184 |

**Classification**

ASTM N/A

AASHTO Fine Sand (A-3 (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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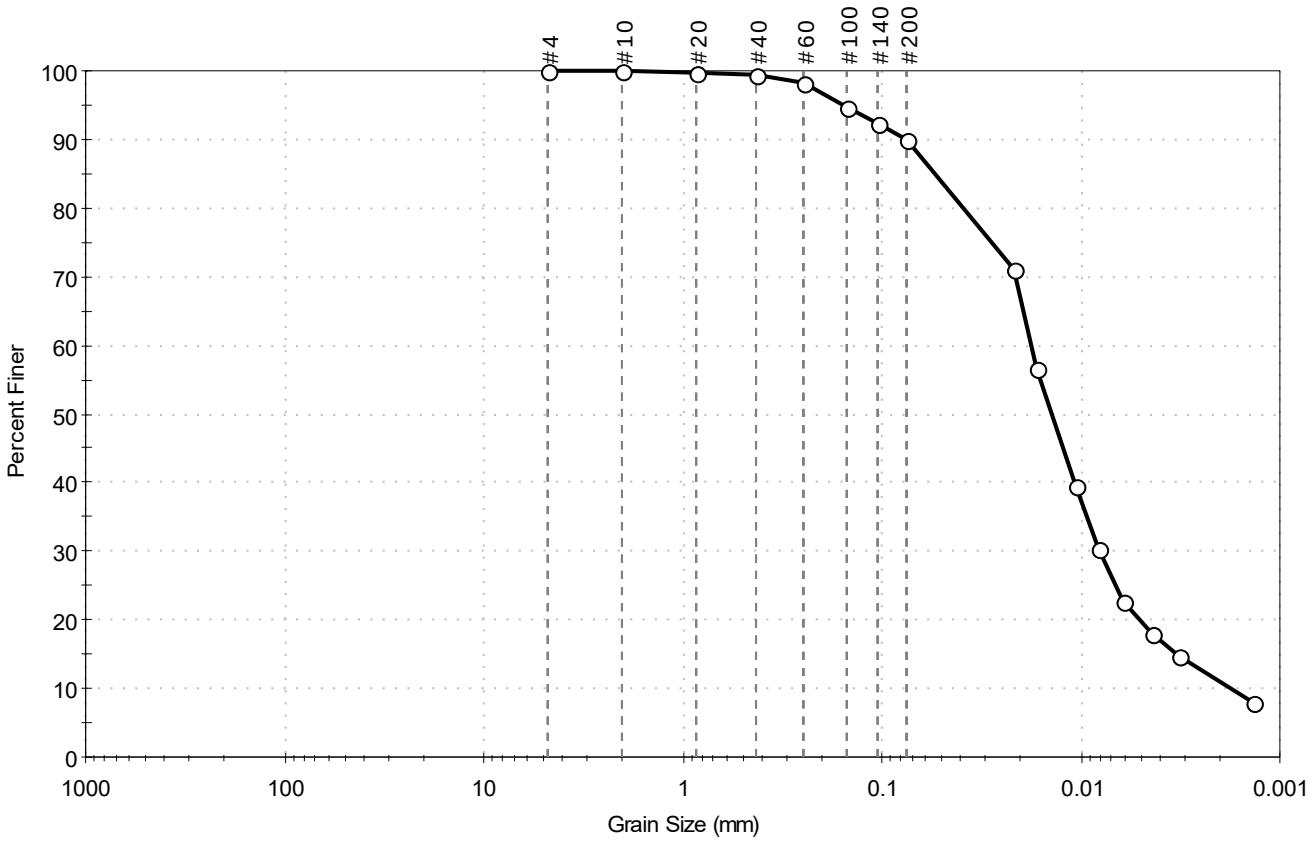
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-5 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-6 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 28-30 | Test Id: | 499768 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, olive yellow silt | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| -- | 0.0 | 10.0 | 90.0 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 100 | | |
| #20 | 0.85 | 100 | | |
| #40 | 0.42 | 99 | | |
| #60 | 0.25 | 98 | | |
| #100 | 0.15 | 95 | | |
| #140 | 0.11 | 92 | | |
| #200 | 0.075 | 90 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0219 | 71 | | |
| --- | 0.0166 | 57 | | |
| --- | 0.0105 | 40 | | |
| --- | 0.0082 | 31 | | |
| --- | 0.0061 | 23 | | |
| --- | 0.0044 | 18 | | |
| --- | 0.0032 | 15 | | |
| --- | 0.0014 | 8 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.0540 mm | $D_{30}$ = 0.0081 mm |
| $D_{60}$ = 0.0177 mm | $D_{15}$ = 0.0033 mm |
| $D_{50}$ = 0.0140 mm | $D_{10}$ = 0.0018 mm |
| $C_u$ = 9.833 | $C_c$ = 2.059 |

**Classification**

ASTM N/A

AASHTO Silty Soils (A-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

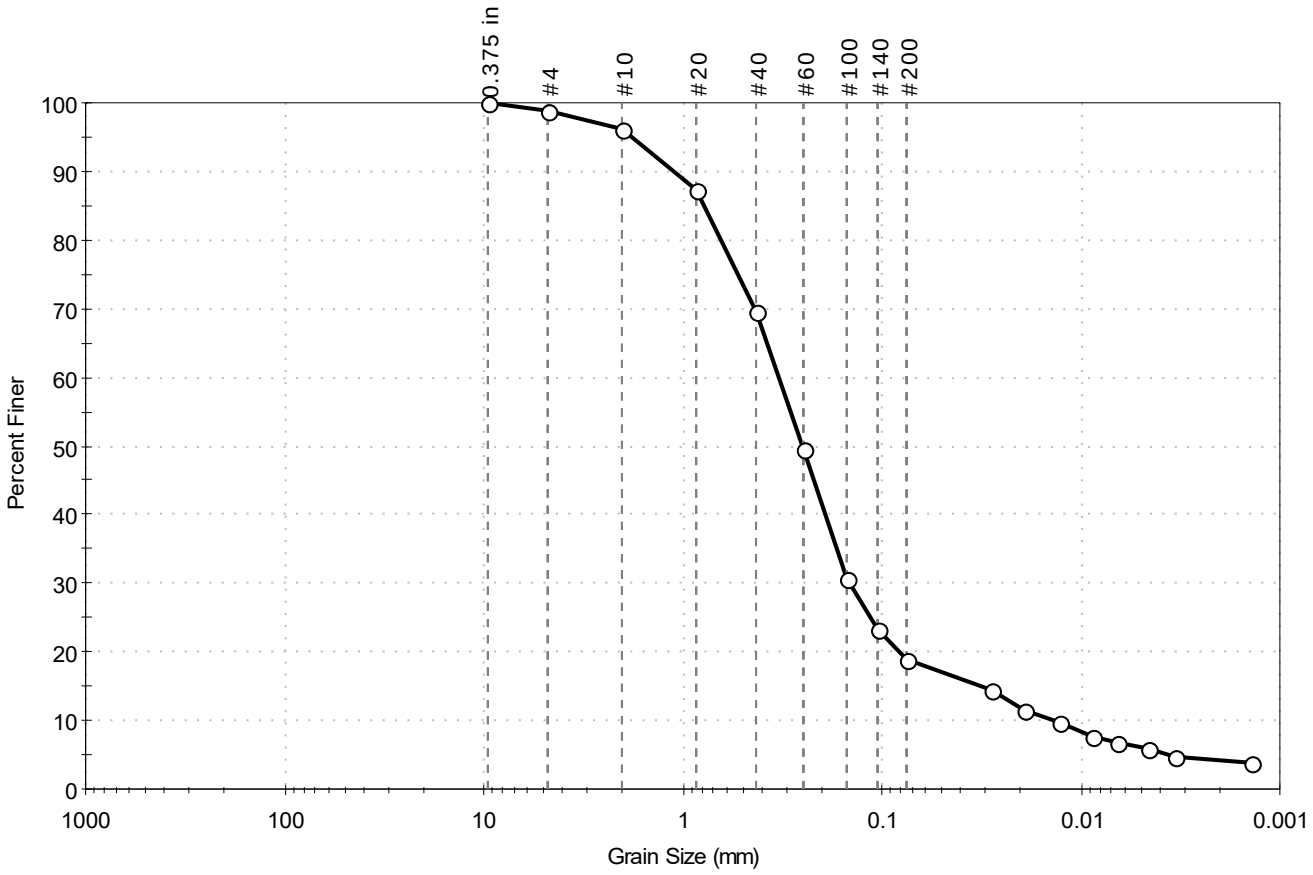
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-6 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-2 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 8-10 | Test Id: | 499769 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, yellowish brown silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 1.2 | 80.0 | 18.8 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 99 | | |
| #10 | 2.00 | 96 | | |
| #20 | 0.85 | 87 | | |
| #40 | 0.42 | 70 | | |
| #60 | 0.25 | 50 | | |
| #100 | 0.15 | 31 | | |
| #140 | 0.11 | 23 | | |
| #200 | 0.075 | 19 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0281 | 15 | | |
| --- | 0.0194 | 12 | | |
| --- | 0.0129 | 10 | | |
| --- | 0.0089 | 8 | | |
| --- | 0.0066 | 7 | | |
| --- | 0.0046 | 6 | | |
| --- | 0.0034 | 5 | | |
| --- | 0.0014 | 4 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.7743 mm | $D_{30}$ = 0.1445 mm |
| $D_{60}$ = 0.3293 mm | $D_{15}$ = 0.0313 mm |
| $D_{50}$ = 0.2528 mm | $D_{10}$ = 0.0138 mm |
| $C_u$ = 23.862 | $C_c$ = 4.595 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

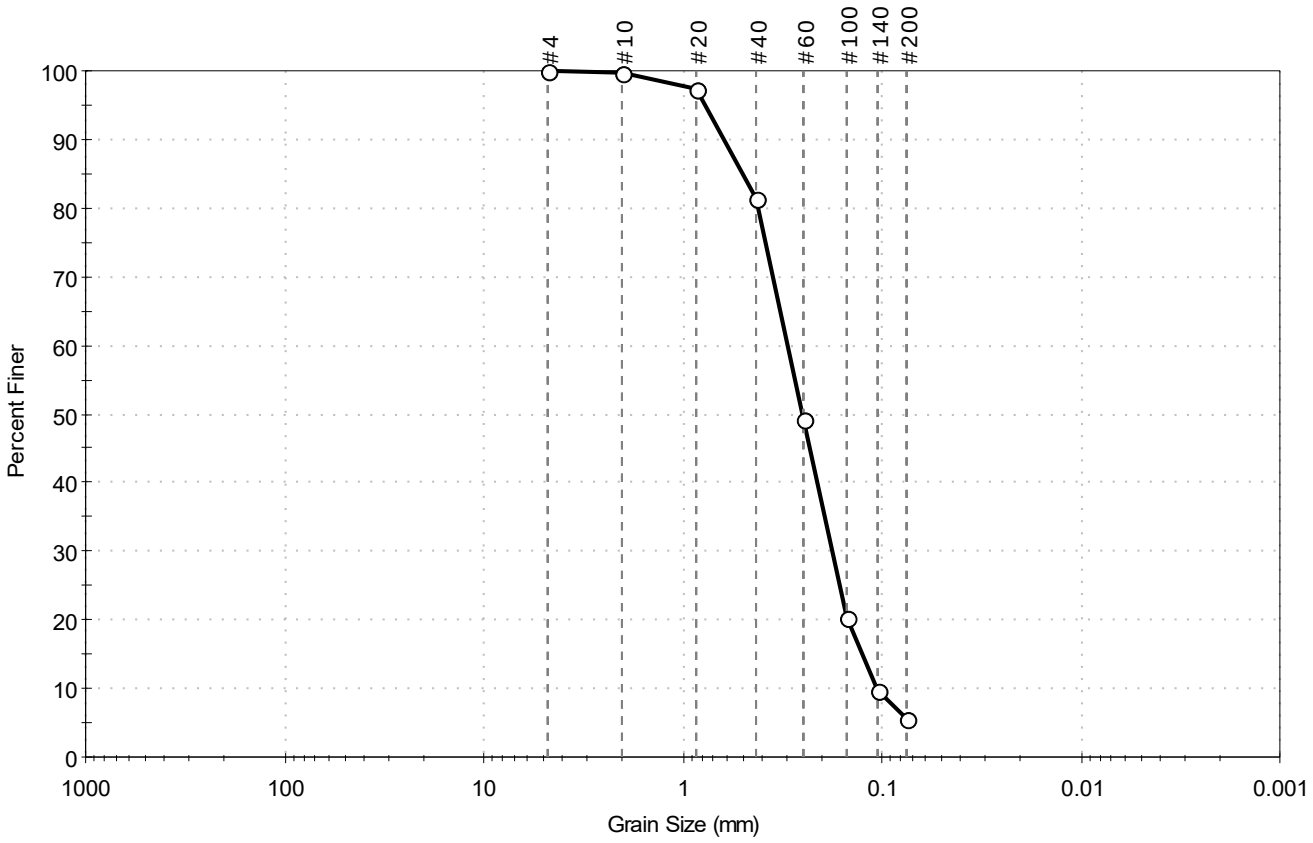
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-6 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-4 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 18-20 | Test Id: | 499770 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, brownish yellow sand with silt | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.0 | 94.4 | 5.6 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 100 | | |
| #20 | 0.85 | 97 | | |
| #40 | 0.42 | 81 | | |
| #60 | 0.25 | 49 | | |
| #100 | 0.15 | 20 | | |
| #140 | 0.11 | 10 | | |
| #200 | 0.075 | 5.6 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.4980 mm | $D_{30}$ = 0.1779 mm |
| $D_{60}$ = 0.2990 mm | $D_{15}$ = 0.1257 mm |
| $D_{50}$ = 0.2535 mm | $D_{10}$ = 0.1067 mm |
| $C_u$ = 2.802 | $C_c$ = 0.992 |

**Classification**

ASTM N/A

AASHTO Fine Sand (A-3 (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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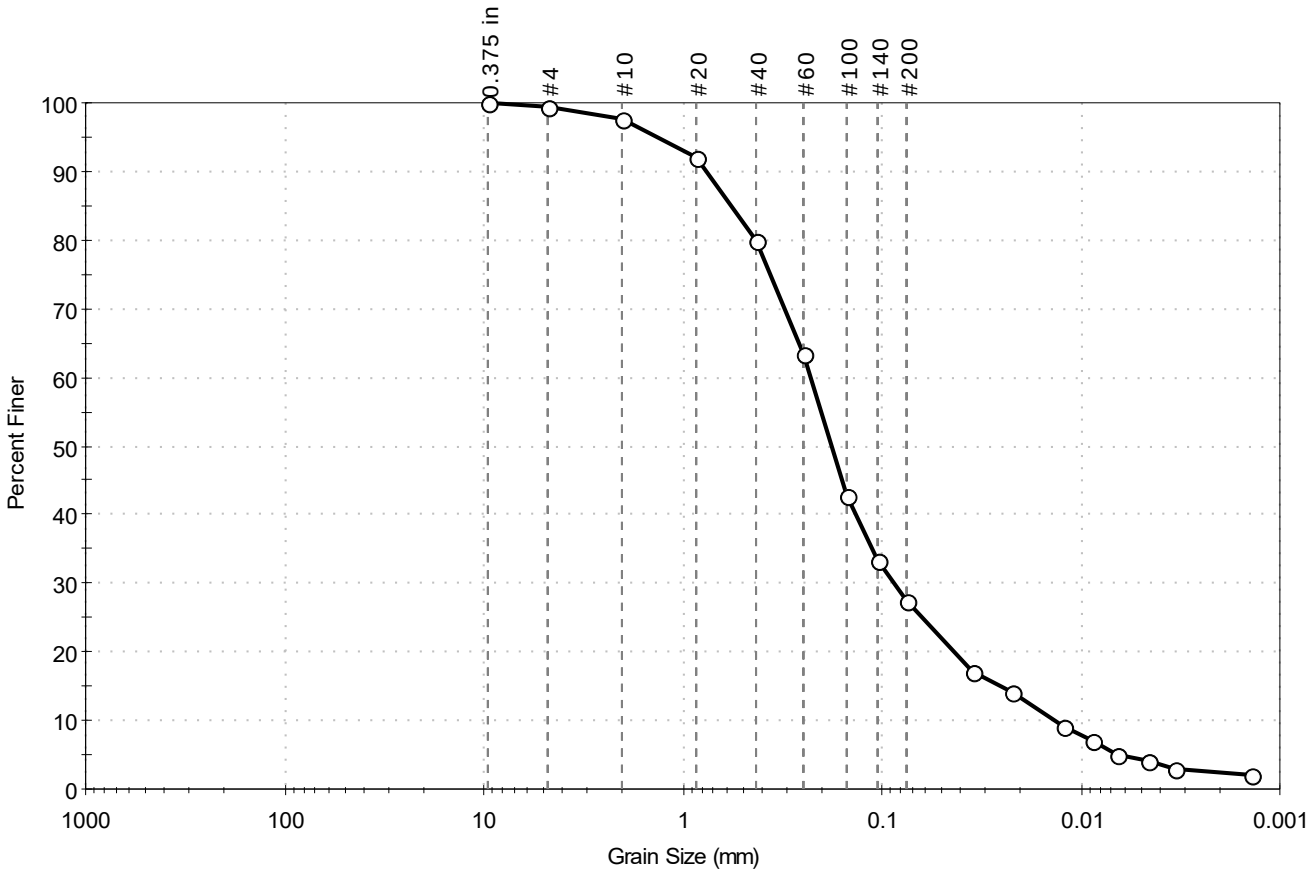
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-6 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-7 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 33-35 | Test Id: | 499771 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, brownish yellow silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.5 | 72.1 | 27.4 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 99 | | |
| #10 | 2.00 | 98 | | |
| #20 | 0.85 | 92 | | |
| #40 | 0.42 | 80 | | |
| #60 | 0.25 | 64 | | |
| #100 | 0.15 | 43 | | |
| #140 | 0.11 | 33 | | |
| #200 | 0.075 | 27 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0348 | 17 | | |
| --- | 0.0225 | 14 | | |
| --- | 0.0123 | 9 | | |
| --- | 0.0088 | 7 | | |
| --- | 0.0065 | 5 | | |
| --- | 0.0047 | 4 | | |
| --- | 0.0034 | 3 | | |
| --- | 0.0014 | 2 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.5700 mm | $D_{30}$ = 0.0873 mm |
| $D_{60}$ = 0.2292 mm | $D_{15}$ = 0.0257 mm |
| $D_{50}$ = 0.1788 mm | $D_{10}$ = 0.0138 mm |
| $C_u$ = 16.609 | $C_c$ = 2.410 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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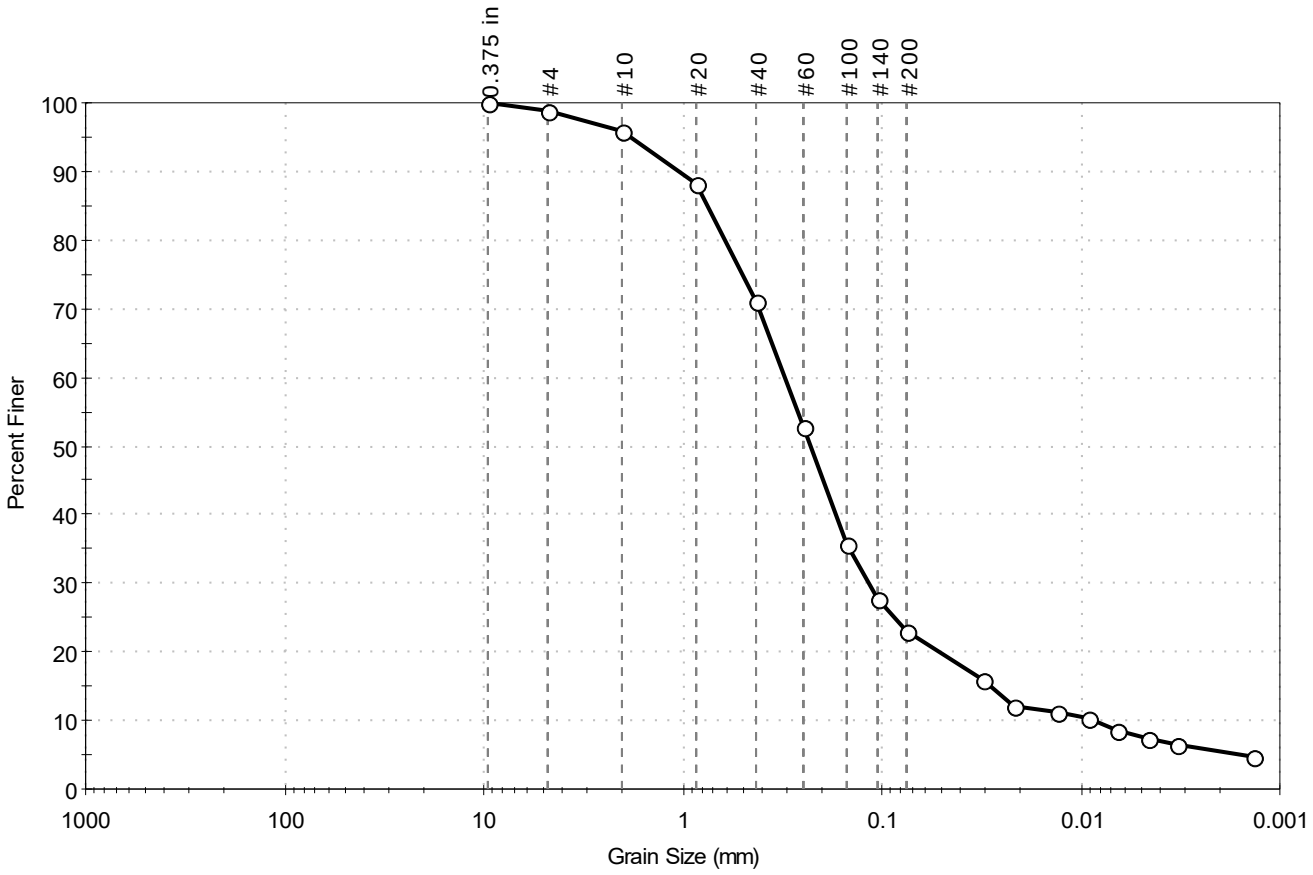
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-7 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-1 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 5-7 | Test Id: | 499772 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, dark grayish brown silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| -- | 1.2 | 75.9 | 22.9 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 99 | | |
| #10 | 2.00 | 96 | | |
| #20 | 0.85 | 88 | | |
| #40 | 0.42 | 71 | | |
| #60 | 0.25 | 53 | | |
| #100 | 0.15 | 36 | | |
| #140 | 0.11 | 28 | | |
| #200 | 0.075 | 23 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0314 | 16 | | |
| --- | 0.0215 | 12 | | |
| --- | 0.0130 | 11 | | |
| --- | 0.0092 | 10 | | |
| --- | 0.0066 | 8 | | |
| --- | 0.0046 | 8 | | |
| --- | 0.0033 | 7 | | |
| --- | 0.0014 | 5 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.7479 mm | $D_{30}$ = 0.1172 mm |
| $D_{60}$ = 0.3076 mm | $D_{15}$ = 0.0285 mm |
| $D_{50}$ = 0.2301 mm | $D_{10}$ = 0.0087 mm |
| $C_u$ = 35.356 | $C_c$ = 5.133 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

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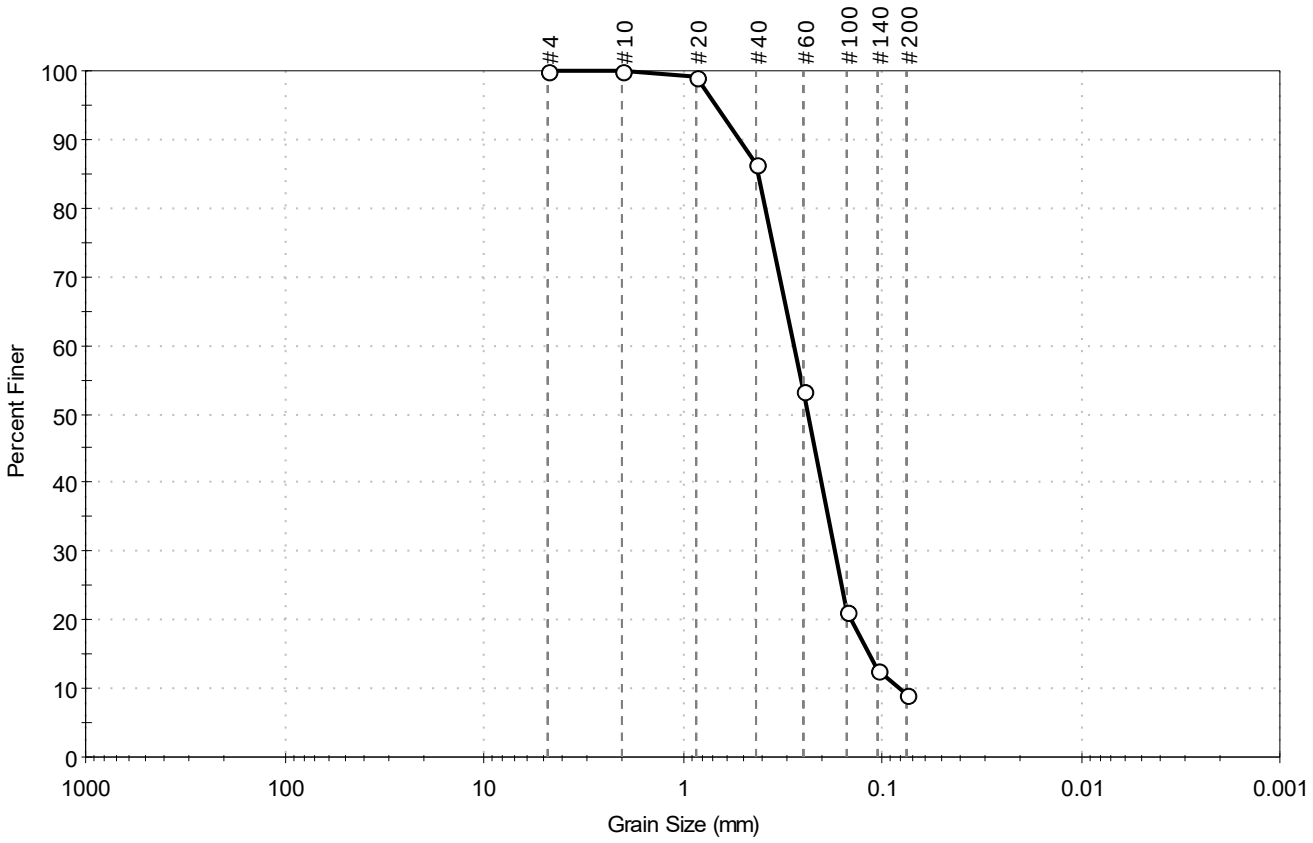
| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-7 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-3 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 13-15 | Test Id: | 499773 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, very pale brown sand with silt | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 0.0 | 90.8 | 9.2 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| #4 | 4.75 | 100 | | |
| #10 | 2.00 | 100 | | |
| #20 | 0.85 | 99 | | |
| #40 | 0.42 | 87 | | |
| #60 | 0.25 | 53 | | |
| #100 | 0.15 | 21 | | |
| #140 | 0.11 | 13 | | |
| #200 | 0.075 | 9.2 | | |
| | | | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.4148 mm | $D_{30}$ = 0.1725 mm |
| $D_{60}$ = 0.2783 mm | $D_{15}$ = 0.1165 mm |
| $D_{50}$ = 0.2372 mm | $D_{10}$ = 0.0815 mm |
| $C_u$ = 3.415 | $C_c$ = 1.312 |

**Classification**

ASTM N/A

AASHTO Fine Sand (A-3 (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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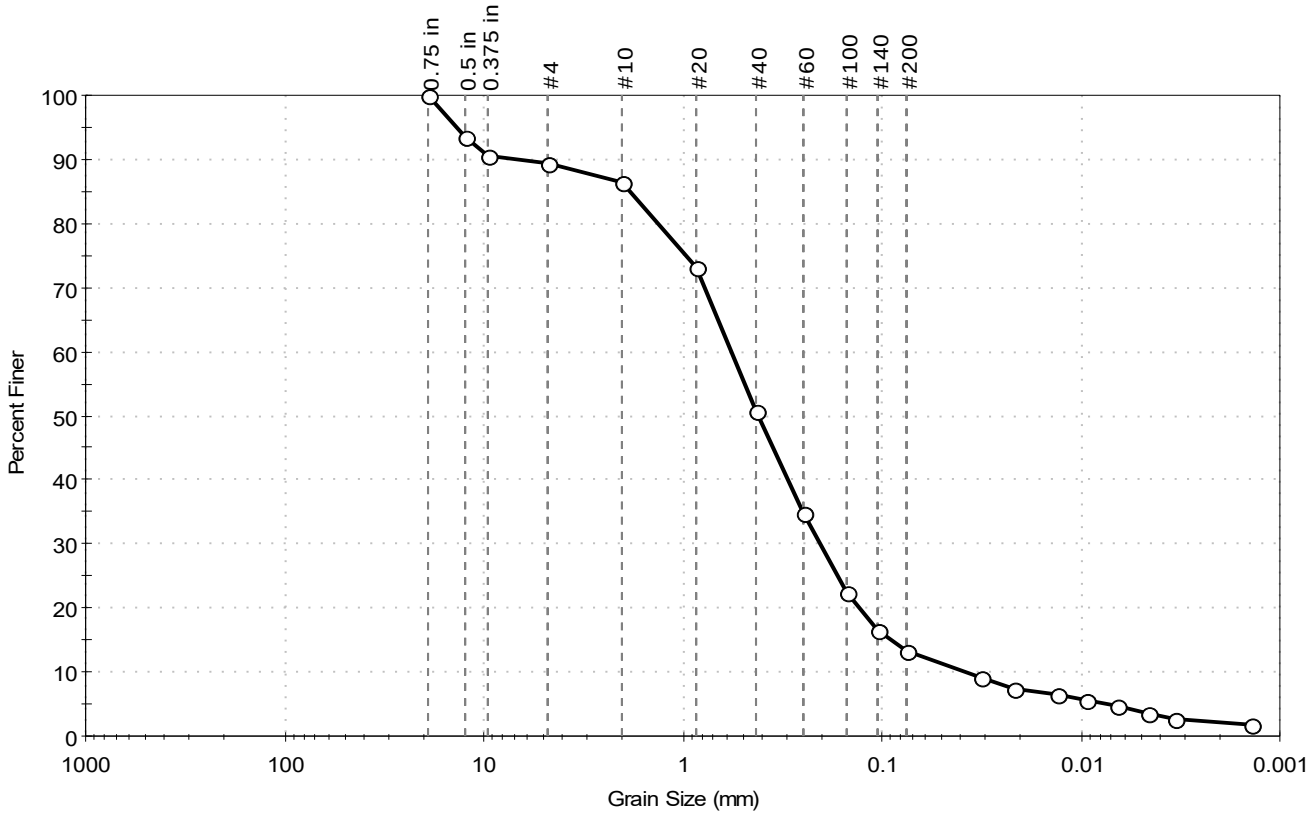
GeoTesting EXPRESS

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-8 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-1 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 5-7 | Test Id: | 499774 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, dark brown silty sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| – | 10.5 | 76.1 | 13.4 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.75 in | 19.00 | 100 | | |
| 0.5 in | 12.50 | 94 | | |
| 0.375 in | 9.50 | 91 | | |
| #4 | 4.75 | 89 | | |
| #10 | 2.00 | 87 | | |
| #20 | 0.85 | 73 | | |
| #40 | 0.42 | 51 | | |
| #60 | 0.25 | 35 | | |
| #100 | 0.15 | 23 | | |
| #140 | 0.11 | 17 | | |
| #200 | 0.075 | 13 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0317 | 9 | | |
| --- | 0.0218 | 7 | | |
| --- | 0.0132 | 6 | | |
| --- | 0.0095 | 6 | | |
| --- | 0.0065 | 5 | | |
| --- | 0.0047 | 4 | | |
| --- | 0.0033 | 3 | | |
| --- | 0.0014 | 2 | | |
| | | | | |

## Coefficients

$D_{85}$ = 1.8146 mm
$D_{30}$ = 0.2050 mm
$D_{60}$ = 0.5653 mm
$D_{15}$ = 0.0892 mm
$D_{50}$ = 0.4142 mm
$D_{10}$ = 0.0372 mm
$C_u$ = 15.196
$C_c$ = 1.998

## Classification

ASTM N/A

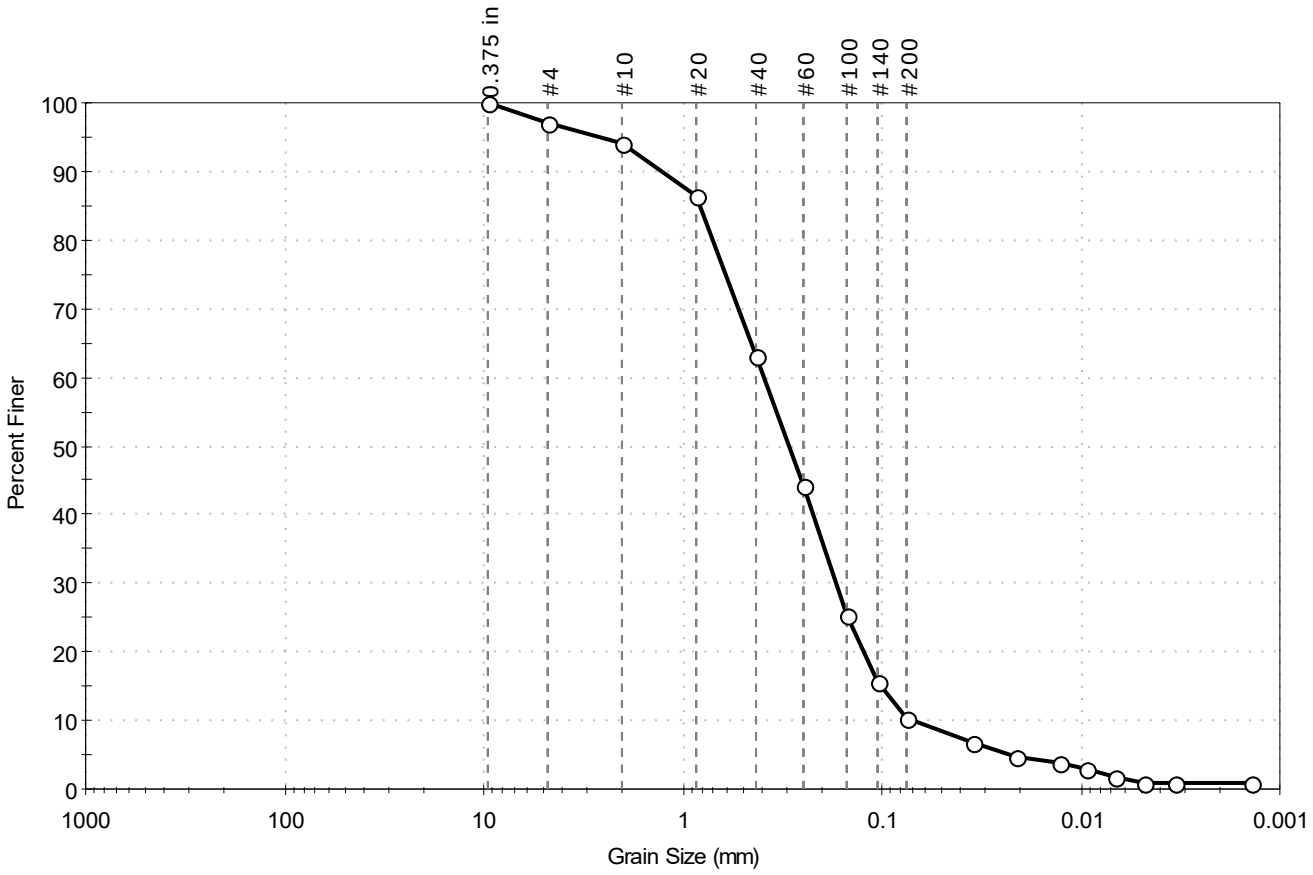
AASHTO Silty Gravel and Sand (A-2-4 (0))

## Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-8 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-4 | Test Date: | 04/22/19 | Checked By: | jdt |
| Depth : | 18-20 | Test Id: | 499775 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, olive yellow sand with silt | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913/D7928




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 3.0 | 86.7 | 10.3 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 97 | | |
| #10 | 2.00 | 94 | | |
| #20 | 0.85 | 86 | | |
| #40 | 0.42 | 63 | | |
| #60 | 0.25 | 44 | | |
| #100 | 0.15 | 25 | | |
| #140 | 0.11 | 16 | | |
| #200 | 0.075 | 10 | | |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| --- | 0.0354 | 7 | | |
| --- | 0.0212 | 5 | | |
| --- | 0.0127 | 4 | | |
| --- | 0.0093 | 3 | | |
| --- | 0.0068 | 2 | | |
| --- | 0.0048 | 1 | | |
| --- | 0.0034 | 1 | | |
| --- | 0.0014 | 1 | | |
| | | | | |

**Coefficients**

| | |
|---|---|
| $D_{85}$ = 0.8165 mm | $D_{30}$ = 0.1701 mm |
| $D_{60}$ = 0.3877 mm | $D_{15}$ = 0.1018 mm |
| $D_{50}$ = 0.2927 mm | $D_{10}$ = 0.0705 mm |
| $C_u$ = 5.499 | $C_c$ = 1.059 |

**Classification**

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

**Sample / Test Description**

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

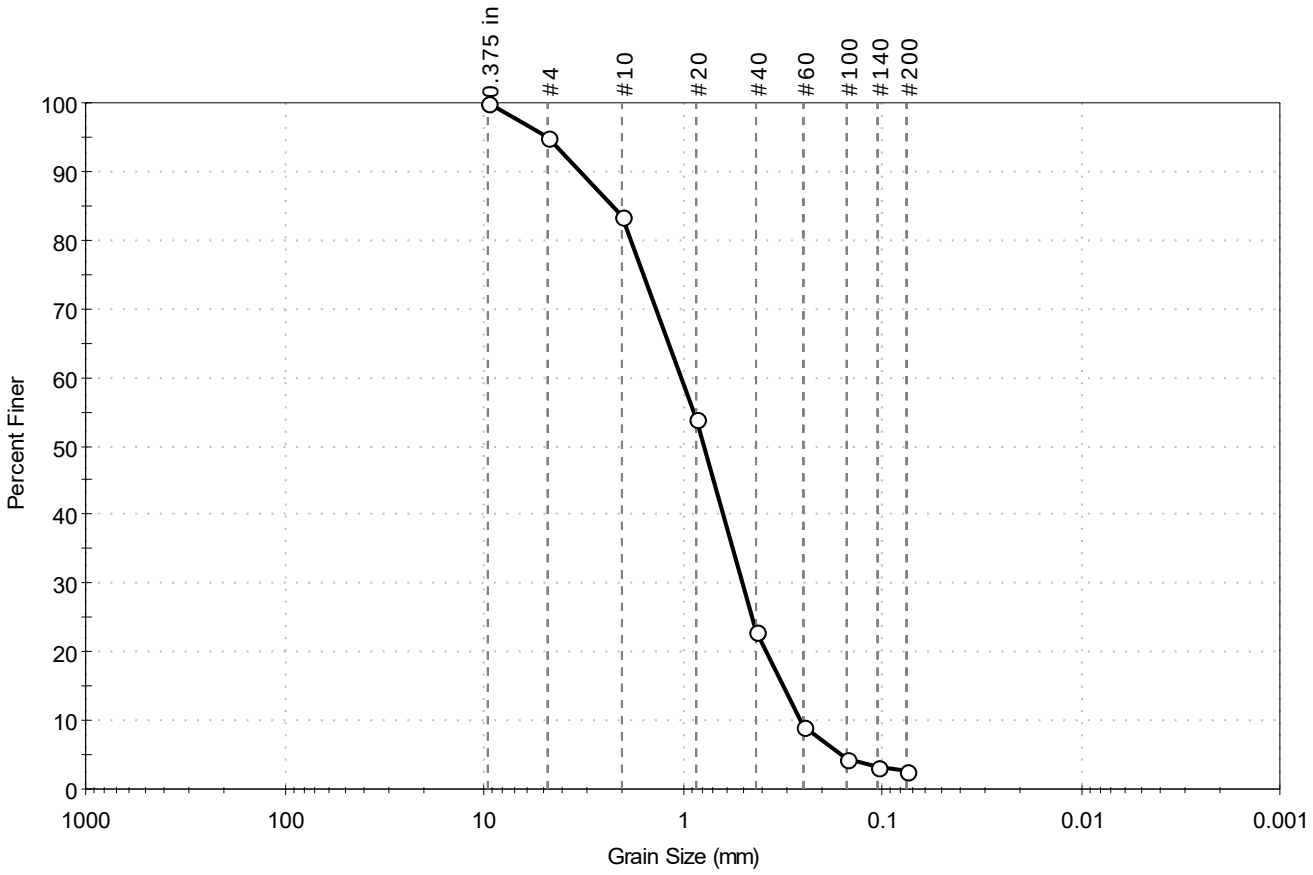
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

| | | | | | |
|---|---|---|---|---|---|
| Client: | AECOM | | | | |
| Project: | Sewer Collection System & Pump Station _WWTF | | | | |
| Location: | Orleans, MA | | | Project No: | GTX-309806 |
| Boring ID: | B19-8 | Sample Type: | jar | Tested By: | ckg |
| Sample ID: | SS-6 | Test Date: | 04/18/19 | Checked By: | jdt |
| Depth : | 28-30 | Test Id: | 499776 | | |
| Test Comment: | --- | | | | |
| Visual Description: | Moist, brownish yellow sand | | | | |
| Sample Comment: | --- | | | | |

# Particle Size Analysis - ASTM D6913




| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|---|---|---|---|
| — | 4.9 | 92.4 | 2.7 |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|---|---|---|---|---|
| 0.375 in | 9.50 | 100 | | |
| #4 | 4.75 | 95 | | |
| #10 | 2.00 | 83 | | |
| #20 | 0.85 | 54 | | |
| #40 | 0.42 | 23 | | |
| #60 | 0.25 | 9 | | |
| #100 | 0.15 | 4 | | |
| #140 | 0.11 | 3 | | |
| #200 | 0.075 | 2.7 | | |
| | | | | |
| | | | | |

**Coefficients**

$D_{85}$ = 2.2397 mm  $D_{30}$ = 0.4958 mm

$D_{60}$ = 1.0112 mm  $D_{15}$ = 0.3113 mm

$D_{50}$ = 0.7766 mm  $D_{10}$ = 0.2571 mm

$C_u$ = 3.933  $C_c$ = 0.946

**Classification**

ASTM  Poorly graded SAND (SP)

AASHTO  Stone Fragments, Gravel and Sand (A-1-b (1))

**Sample / Test Description**

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

# ATTACHMENT 3

# Test Boring Logs (GZA, 1982)

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-203
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN P. Wordell
GZA ENGINEER M. Sherrill

BORING LOCATION Process Building
GROUND SURFACE ELEVATION ____ DATUM ____
DATE START 11/3/82 DATE END 11/3/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER: Auger 3 1/2" I.D.

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | completion |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | PEN. (in)/REC | SAMPLE DEPTH (ft) | BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-1- | Black/brown f.SAND, some Silt; roots and organics; v.loose, dry. | | Topsoil: v.loose f.SAND, some silt; roots |
| 5 | | 2 | 18 | 5-6.5 | 8-11-11 | Brown f.SAND, some Silt; m.dense, moist. | | Silty fine SAND |
| 10 | | 3 | 18 | 10-11.5 | 6-7-9 | Rusty brown f. SAND, tr.Silt; m.dense, dry. | | Fine SAND |
| 15 | | 4 | 18 | 15-16.5 | 5-7-7 | Tan f.to v.f. SAND, tr.Silt; m.dense, dry. | | |
| 20 | | 5 | 18 | 20-21.5 | 12-13-13 | Tan f.to v.f.SAND, tr.Silt; m.dense, dry. | | |
| 25 | | 6 | 18 | 25-26.5 | 15-16-16 | Tan f. to v.f.SAND, tr.Silt; changing to grey v.f.SAND, tr.-Silt; m.dense, dry. | | 28 |
| | | 7 | 18 | 28.5-30 | 17-18-30 | Stratified grey and rusty brown f.SAND and Silt; dense, dry. | | Silty fine SAND |
| 30 | | | | | | Bottom of boring, required penetration 30' | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-204
SHEET 1 OF 2
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER M. Sherrill

BORING LOCATION Process Bldg.
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/4/82 DATE END 11/4/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER: Auger 3 1/2" I.D.

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| 11/4/82 | | 48' | | -- |
| | | | | |
| | | | | |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | SAMPLE PEN. (in)/REC. | SAMPLE DEPTH (ft) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION Burmister CLASSIFICATION | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-2 | Brown to black f. SAND, tr. Silt, tr. root fibers; v. loose, dry. | | Topsoil<br>Fine SAND<br>3' |
| 5 | | 2 | 18 | 5-6.5 | 4-6-6 | Brown f. SAND, l. Silt, tr. m. Sand; loose, dry. | | Silty fine SAND<br>7' |
| 10 | | 3 | 18 | 10-11.5 | 8-8-9 | Brown f. SAND, tr. m. Sand, tr.- Silt; m. dense, dry. | | Fine SAND |
| 15 | | 4 | 18 | 15-16.5 | 6-9-9 | Brown f. to v.f. SAND, tr- Silt; m. dense, dry. | | |
| 20 | | 5 | 18 | 20-21.5 | 8-10-13 | Brown to tan v. to v.f. SAND, tr-Silt; m. dense, dry. | | 25' |
| 25 | | 6 | 18 | 25-26.5 | 9-10-14 | Brown to tan f. to v.f. SAND, tr- Silt; stratified with laminae of Clayey Silt; m. dense, dry. | (1) | Fine SAND stratified with layers of Clayey Silt<br>27' |
| 30 | | 7 | 18 | 30-31.5 | 15-17-17 | Brown to rusty brown f. to v.f. SAND, tr. Silt; dense, dry. | | Fine SAND |
| 35 | | | | | | | | |

| GRANULAR SOILS | |
|---|---|
| BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE |
| 4-10 | LOOSE |
| 10-30 | M. DENSE |
| 30-50 | DENSE |
| >50 | V. DENSE |

| COHESIVE SOILS | |
|---|---|
| BLOWS/FT. | DENSITY |
| < 2 | V. SOFT |
| 2-4 | SOFT |
| 4-8 | M. STIFF |
| 8-15 | STIFF |
| 15-30 | V. STIFF |
| >30 | HARD |

REMARKS:
(1) Sample 6' Clayey Silt observed in jar sample, not in spoon return.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-204
SHEET 2 OF 2
FILE No. G-1485.7
CHKD. BY

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | PEN. (in) / REC. | DEPTH (ft) | BLOWS/6" | SAMPLE DESCRIPTION Burmister CLASSIFICATION | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| 35 | | 8 | 18 | 35-36.5 | 13-13-16 | Lt. brown m/f SAND, tr. c. Sand, tr.Gravel; stratified with a 1/4" thick layer of v.f. SAND, tr. Silt; dense, dry. | | Stratified medium to fine SAND |
| 40 | | 9 | 18 | 40-41.5 | 14-15-17 | Tan f. to v.f. SAND, tr. Silt; dense, dry. (Layer of oxidation staining) | | |
| 45 | | 10 | 24 | 45-47 | 18-18-20-19 | Grey f. to v.f. SAND, tr. Silt, stratified with rusty m/f SAND, tr. Silt; dense, wet. | | 48 |
| | | 11 | 24 | 48-50 | 16-20-21-24 | Brown/grey c/m SAND, tr. f. Sand, tr.Silt; dense, wet. | | Dense, wet, coarse to medium Sand |
| 50 | | | | | | Bottom of boring 50 ft. | | |

REMARKS:

GZA

BORING No. B-204

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-205
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER Mike Sherrill

BORING LOCATION Process Bldg.
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/4/82 DATE END 11/4/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | completion |
| | | | | |
| | | | | |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | SAMPLE PEN. (in) / REC. | SAMPLE DEPTH (ft) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-2 | Brown to black f.SAND,tr.Silt;organic mat; v.loose,dry. | | Organic topsoil |
| | | | | | | | | Fine SAND |
| 5 | | 2 | 18 | 5-6.5 | 3-5-6 | Brown f+/m SAND,tr.+ Silt;loose,dry, tr.roots | | 7.5 |
| 10 | | 3 | | 10-11.5 | 12-12-13 | Brown f.SAND,1+ Silt,tr. c/m Sand;m.dense, dry. | | Silty fine SAND |
| 15 | | 4 | | 15-16.5 | 8-8-9 | Brown f.SAND,1+ Silt,tr.+m.Sand; change to Brown f/m SAND,tr- Silt;m.dense, dry. | | 16' |
| 20 | | 5 | | 20-21.5 | 9-9-13 | Tan f.to v.f. SAND, tr.Silt;m.dense, dry. | | Fine SAND |
| 25 | | 6 | | 25-26.5 | 7-9-11 | Tan f. to v.f.SAND,tr.Silt;m.dense, dry. | | |
| | | 7 | | 28.5-30 | 9-10-10 | Tan f. to v.f. SAND, tr. Silt;m.dense,dry. | | |
| 30 | | | | | | Bottom of boring 30 ft. required penetration | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-206
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN P. Wordell
GZA ENGINEER M. Sherrill

BORING LOCATION Primary Settling Tank No. 1
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/3/82 DATE END 11/3/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |

| DEPTH (ft) | CASING (bl/ft) | SAMPLE No. | SAMPLE PEN./REC. (in) | SAMPLE DEPTH (ft) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-2 | Brown f+/m SAND, tr+ Silt; tr. roots; v.loose, dry. | | Loose to v. loose fine SAND, tr Silt, roots. |
| 5 | | 2 | 18 | 5-6.5 | 9-11-13 | Brown f/m SAND, l.Silt, tr.c.SAND; m.dense, dry. | | Silty fine SAND |
| 10 | | 3 | 18 | 10-11.5 | 9-15-15 | Brown f. to v.f. SAND, tr+ Silt; m. dense to dense, dry. | | |
| | | 4 | 18 | 15-16.5 | 13-17-18 | Grey to rust brown SILT, l. v.f. Sand, dense, dry. | | Sandy Silt. 17.5 |
| | | 5 | 18 | 18.5-20 | 12-15-17 | Grey to rust brown v.f.SAND, 1 Silt; m.dense, dry. | | Silty fine SAND |
| 20 | | | | | | Bottom of boring 20 ft. | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

**PROJECT**
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-207
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER M. Sherrrill

BORING LOCATION RBC Bldg.
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/1/82 DATE END 11/1/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.
CASING SIZE:
OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |
| | | | | |
| | | | | |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | SAMPLE PEN. (in) / REC. | SAMPLE DEPTH (ft) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-2 | Black/brown f.SAND, tr+ Silt and Organics; v.loose. | | V.loose organic topsoil |
| 5 | | 2 | 18 | 5-6.5 | 7-8-10 | Brown f+/m SAND, tr+ Silt, tr.Gravel; medium dense. | | |
| | | | | | | | | Brown fine SAND |
| 10 | | 3 | 18 | 10-11.5 | 5-5-5 | Lt.brown f/m SAND, tr.- Silt; loose to med. dense; dry. | | |
| 15 | | 4 | 18 | 15-16.5 | 5-5-6 | Lt.brown f.SAND, tr. Silt; loose to med. dense, dry. | | |
| 20 | | 5 | 18 | 20-21.5 | 5-6-7 | Lt. brown f. SAND, tr. Silt; med. dense; dry. | | |
| 25 | | 6 | 18 | 25-26.5 | 8-9-9 | Lt.brown f.SAND changing to lt.brown/grey v.f.SAND, l.Silt; med.dense, dry. | | 25.5 Silty fine SAND |
| | | 7 | 18 | 28.5-30 | 6-8-9 | Brown/rusty f/m SAND, tr.c. Sand, tr. Silt medium dense. | | 28 Fine to medium SAND |
| 30 | | | | | | | | BOH 30 ft. |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

**PROJECT**
Orleans Treatment Facilities
Orleans, Mass

REPORT OF BORING No. B-208
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Muralco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER M. Sherrrill

BORING LOCATION RBC Building
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/3/82 DATE END 11/3/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | PEN./REC. (in) | SAMPLE DEPTH (ft.) | BLOWS/6" | SAMPLE DESCRIPTION Burmister CLASSIFICATION | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-1-3 | Black/brn f/m SAND, tr+ silt, roots, organic mat. | | Organic topsoil |
| | | | | | | | | V. loose f/med. SAND, tr. silt, roots |
| 5 | | 2 | 18 | 5-6.5 | 12-16-22 | Lt.brn. f+ SAND, tr. Silt, tr. c/m SAND; med. dense to dense. | | Fine SAND |
| 10 | | 3 | 18 | 10-11.5 | 14-12-13 | Lt.brn/grey vf SAND, 1 Clayey Silt; slight plasticity; med. dense | | Fine SAND, little Clayey Silt |
| 15 | | 4 | 18 | 15-16.5 | 9-8-9 | Brown/grey f+/m SAND, 1 Silt; med. dense, dry | | Stratified silty fine SAND and fine to medium SAND |
| 20 | | 5 | 18 | 20-21.5 | 7-10-10 | Lt.brn. f. SAND, tr. Silt; dry, med.dense | | |
| 25 | | 6 | 18 | 25-26.5 | 15-18-18 | Brn/grey f. SAND, 1 Silt; change with brn/ f/m SAND, tr. c/m Sand, tr. Silt; dense, dry | (1) | |
| | | 7 | 18 | 28.5-30 | 16-15-18 | | | |
| 30 | | | | | | Grey f+/m SAND, 1 Silt, tr. c Sand; dense, dry (plasticity) | | Bottom of boring 30 ft. |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | <2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:
(1) Observ. of jar sample only - stratigraphy not observed in spoon sample.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-212
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER Mike Sherrrill
BORING LOCATION Secondary Setting Tank No. 1
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11/2/82 DATE END 11/2/82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |
| | | | | |
| | | | | |

| DEPTH (ft.) | CASING (lb/ft) | SAMPLE No. | SAMPLE PEN. (in)/REC. | SAMPLE DEPTH (ft.) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-2-2 | Blk/brown f/m. SAND, 1.Silt, organics; loose, moist | | Organic Topsoil |
| 5 | | 2 | 18 | 5-6.5 | 17-22-23 | Brn f+/m SAND, l. Gravel, tr.c.Sand, tr. Silt. (1 pc gravel 1" diam). Dense, dry. | | Gravelly fine SAND<br>8' |
| | | | | | | | | 10' |
| 10 | | 3 | 18 | 10-11.5 | 16-16-19 | Brown v.f. SAND and Silt, tr. organics; dry, dense. | (1) | Fine SAND and Silt<br>11.5' |
| 15 | | 4 | 18 | 15-16.5 | 6-10-15 | Brown f+/m SAND, l. Silt, tr.c.Sand, dry, med.dense. | | Silty fine SAND<br>18' |
| | | 5 | 18 | 18.5-20 | 8-9-9 | Brown/grey v.f. SAND, l. Silt; dry, med. dense. | | Fine SAND |
| 20 | | | | | | Bottom of boring, 20 ft. | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:
(1) Black/brown inclusions in ground mass. Probable organics.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-213
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER Mike Sherrrill

BORING LOCATION Secondary Settling Tank No. 2
GROUND SURFACE ELEVATION ____ DATUM ____
DATE START 11-2-82 DATE END 11-2-82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |
| | | | | |
| | | | | |

| DEPTH (ft) | CASING (bl/ft) | SAMPLE No. | PEN. (in) / REC. | SAMPLE DEPTH (ft) | BLOWS/6" | SAMPLE DESCRIPTION Burmister CLASSIFICATION | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-2-3 | Brown/black f+/m SAND, roots (organic mat.) | | Organic Topsoil |
| 5 | | 2 | 18 | 5-6.5 | 8-16-17 | Brown f/m SAND, l.- Silt, tr. c. Sand; med. dense to dense; dry. | | Fine to medium SAND |
| 10 | | 3 | 18 | 10-11.5 | 10-11-14 | Brown/grey v.f. SAND, l. Silt; rusty; med. dense, moist. | | Silty fine SAND |
| 15 | | 4 | 18 | 15-16.5 | 6-6-7 | Lt.brown f. SAND, tr. Silt; tr.c/m Sand; dry med. dense. | | Fine SAND |
| | | 5 | 18 | 18.5-20 | 7-8-10 | Tan v.f. SAND, tr. Silt. tr. m.Sand; dry, med.dense | | |
| 20 | | | | | | Bottom of boring 20 ft. | | |
| 25 | | | | | | | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST, PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-214
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Paul Wordell
GZA ENGINEER Mike Sherrrill

BORING LOCATION Disinfection/Pumping Bldg.
GROUND SURFACE ELEVATION 54.5 DATUM
DATE START 11-1-82 DATE END 11-1-82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER: Auger

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |
| | | | | |
| | | | | |

| DEPTH (ft.) | CASING (bl/ft) | SAMPLE No. | PEN. (in) / REC. | SAMPLE DEPTH (ft) | BLOWS/6" | SAMPLE DESCRIPTION Burmister CLASSIFICATION | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0-1.5 | 1-2-2 | Black/brown f+/m SAND, tr+ Silt, roots (Org.Mat.); v. loose | | Topsoil |
| 5 | | 2 | 18 | 5-6.5 | 4-6-6 | Brown and grey v.f. SAND, tr. Silt; loose to med. dense, dry. | | Fine to medium SAND |
| 10 | | 3 | 18 | 10-11.5 | 7-7-8 | Rusty brown m/f SAND, tr.-Silt; dry, med. dense. | | |
| 15 | | 4 | 18 | 15-16.5 | 8-10-10 | Rusty brown f/m SAND, tr- Silt, nodes of grey f. SAND, l. Silt; med. dense, dry. | | |
| 20 | | 5 | 18 | 20-21.5 | 15-12-17 | Grey & rust v.f. SAND, l. Silt. (sl. plasticity); med. dense, dry. | | Silty fine SAND |
| 25 | | 6 | 18 | 25-26.5 | 16-18-20 | Brown & grey f. to v.f. SAND, l. clayey Silt; slight plastic.; dense, dry. | | 25' Clayey silt lens |
| | | 7 | 18 | 28.5-30 | 13-15-15 | Brown & grey v.f. SAND, l. Silt; non-plastic med. dense to dense; dry. | | Silty fine SAND |
| 30 | | | | | | Bottom of boring 30 ft. | | |

| GRANULAR SOILS | | COHESIVE SOILS | |
|---|---|---|---|
| BLOWS/FT. | DENSITY | BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE | < 2 | V. SOFT |
| 4-10 | LOOSE | 2-4 | SOFT |
| 10-30 | M. DENSE | 4-8 | M. STIFF |
| 30-50 | DENSE | 8-15 | STIFF |
| >50 | V. DENSE | 15-30 | V. STIFF |
| | | >30 | HARD |

REMARKS:

GZA

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. B-214

GOLDBERG-ZOINO & ASSOCIATES, INC.
255 SOUTH MAIN ST., PROVIDENCE, RHODE ISLAND
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
Orleans Treatment Facilities
Orleans, Mass.

REPORT OF BORING No. B-215
SHEET 1 OF 1
FILE No. G-1485.7
CHKD. BY

BORING Co. Murelco Enterprises
FOREMAN Frank Perry
GZA ENGINEER Mike Sherrill
BORING LOCATION Primary Settling Tank No. 2
GROUND SURFACE ELEVATION _____ DATUM _____
DATE START 11-1-82 DATE END 11-1-82

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb. HAMMER FALLING 24 in.
CASING SIZE: OTHER:

GROUNDWATER READINGS

| DATE | TIME | WATER AT | CASING AT | STABILIZATION TIME |
|---|---|---|---|---|
| | | none | | |
| | | | | |
| | | | | |

| DEPTH (ft) | CASING (bl/ft) | SAMPLE No. | SAMPLE PEN. (in) / REC. | SAMPLE DEPTH (ft) | SAMPLE BLOWS/6" | SAMPLE DESCRIPTION (Burmister CLASSIFICATION) | REMARKS | STRATUM DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 18 | 0.5-2 | 7-5-4 | Brown/grey v.f. SAND, tr+ Silt, tr- c/m Sand; loose, dry. | | Asphalt Paving |
| 5 | | 2 | 18 | 5-6.5 | 3-3-4 | Lt. brn/tan f. SAND, tr. Silt, tr. m.Sand; loose, dry. | | Loose fine SAND |
| 10 | | 3 | 18 | 10-11.5 | 3-4-4 | Brn/grey f. SAND, tr. Silt, tr. c/m Sand; dry, loose. | | |
| 15 | | 4 | 18 | 15-16.5 | 4-7-8 | Lt. brown f+/m SAND, tr. Silt, med. dense; dry. Change to f/m Sand. | (1) | Medium dense fine to medium SAND |
| 20 | | 5 | 18 | 20-21.5 | 5-7-9 | Brown m/f SAND, tr. c. Sand, tr. Gravel, tr.- Silt. | | |
| | | | | | | Bottom of boring 21.5 ft. | | |

| GRANULAR SOILS | |
|---|---|
| BLOWS/FT. | DENSITY |
| 0-4 | V. LOOSE |
| 4-10 | LOOSE |
| 10-30 | M. DENSE |
| 30-50 | DENSE |
| >50 | V. DENSE |

| COHESIVE SOILS | |
|---|---|
| BLOWS/FT. | DENSITY |
| < 2 | V. SOFT |
| 2-4 | SOFT |
| 4-8 | M. STIFF |
| 8-15 | STIFF |
| 15-30 | V. STIFF |
| >30 | HARD |

REMARKS:
(1) Change not seen in spoon; jar sample only.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

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**SECTION 01311**

**CONSTRUCTION PROGRESS SCHEDULES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work covered by this section of the specifications includes furnishing all labor, equipment, tools, and materials, and in performing all operations in connection with developing and updating construction progress schedules.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. No payment shall be made for any work on this project unless these requirements have been met.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

C. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

D. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise accepted by Engineer.

E. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

F. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

G. Event: The starting or ending point of an activity.

H. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

I. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Construction Progress Schedules includes administrative and procedural requirements for documenting the progress of construction during performance of the Work and shall include at least the following:

1. Startup construction schedule. Within 15 days after execution of the Agreement, submit preliminary schedule indicating planned operations during first 60 days. Include cost of activities expected to be completed before submission and acceptance of the complete schedule.

2. Contractor's construction schedule. Initial schedule, of size required to display entire schedule for entire construction period.

3. Monthly construction schedule updating reports. Submit with Applications for Payment.

4. Daily construction reports. Submit weekly.

5. Material location reports.

6. Site condition reports. Submit at time of discovery of differing conditions

7. Special reports. Submit at time of unusual event

**1.05 – PRODUCT HANDLING – Not Used**

**1.06 – DESIGN CRITERIA – Not Used**

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

**1.08 - COORDINATION**

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

**PART 2 - PRODUCTS**

**2.01 - CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL**

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 working days, unless specifically allowed by Engineer.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, acceptance, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in DIVISION 1 - GENERAL REQUIREMENTS, SECTION 01300, SUBMITTALS in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 45 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Limitations of continued occupancies.

b. Uninterruptible services.

c. Partial occupancy before Substantial Completion.

d. Use of premises restrictions.

e. Seasonal variations.

2. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.

b. Completion of mechanical installation.

c. Completion of electrical installation.

d. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.

2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.

4. Notations on returned submittals.

5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 10 or more working days behind the current accepted schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, as well as the date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

**2.02 - STARTUP CONSTRUCTION SCHEDULE**

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within 15days of date of execution.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

**2.03 - CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)**

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

**2.04 - REPORTS**

A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

**2.05 - SPECIAL REPORTS**

A. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable. Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Weekly Look Ahead Schedule – The Contractor shall prepare and submit a Weekly Look Ahead Schedule for all crews on the Thursday prior to the next week. Failure to comply with this requirement will result in no payment for work performed.

**PART 3 - EXECUTION**

**3.01 - CONTRACTOR'S CONSTRUCTION SCHEDULE**

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of accepted schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION**

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**SECTION 01400**

**QUALITY ASSURANCE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes preparation and implementation of the Quality Assurance Program.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Within 20 days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner, for review and comment, a draft of the Contractor's CQC program.
2. Prior to commencement of the work but not later than 60 days after the Notice to Proceed, the Contractor shall submit to the Owner for review the following:
    a. The CQC program.
    b. An inspection and test index identifying all required inspections and tests to be performed under the Contract Documents and the CQC program.
    c. Those implementing procedures required for quality control of Work scheduled to be performed within 180 days after receipt of the Notice to Proceed together with a schedule of Contractor procedures for the balance of Work activities.
    d. A list of all quality records that are to be developed and turned over to the Owner as a result of implementing the quality control program and procedures.

3. The Contractor shall submit any revisions or changes to the CQC program or implementing procedures previously submitted to and reviewed by the Owner.
4. Resumes of the QC Manager and Resident inspection personnel shall be submitted and reviewed prior to their commencement of work.
5. Prior to Subcontractors' and suppliers' commencement of work for which their own quality control (SQC) program will be implemented, the Contractor shall review, approve and submit to the Owner for review the SQC program and the resumes of the SQC Manager and Resident inspection personnel to be used.
6. During performance of Contract Work, the Contractor shall submit the following to the Owner for information and as a condition of payment:
    a. Monthly quality control reports as specified herein.
    b. Copies of inspection and test results.
    c. Manufacturer representative reports (in duplicate) within 10 days of each field visit as specified herein including final reports which certify that equipment or systems have been satisfactorily installed and are functioning correctly. If the duration of field visits are greater than one week, the Contractor shall submit weekly reports.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - REFERENCED STANDARDS**

A. The Contractor shall indicate any instance where specified reference standards conflict with Contract Documents and request clarification from Owner before proceeding.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - QUALITY CONTROL AND CONTROL OF WORK**

A. The Contractor shall control the quality of Work including work of its Subcontractors and suppliers. The Contractor shall develop and maintain a quality control program which complies with the requirements of this Section. The Contractor Quality Control (CQC) program shall explain the Contractor's approach to on-site quality control, off-site quality control, the CQC organization, documentation of quality control activities, and provide all other information necessary to demonstrate to the Owner that the Contractor and its Subcontractors and suppliers will provide quality control services that comply with the Contract Documents. The CQC program shall identify the Contractor's individuals responsible for the execution of the program and identify those Subcontractors/suppliers working to the CQC program and those working to their own Subcontractor/Supplier Quality Control (SQC) program. The Quality Control programs shall apply to the control of quality throughout all areas of contract performance including the procurement, identification, stocking, and issue of material; the entire process of construction; and the installation and testing of equipment.

B. Overall administration of the CQC program shall be vested in an element of the Contractor's organization, hereinafter referred to as the QC Organization, under a QC Manager who has clear access to senior level offsite home office management and to Subcontractors' officers responsible for the execution of the SQC Program. The QC Manager shall manage and administer the CQC program. The QC Manager shall be assigned full time to the Project for the duration of the Contract, shall be on-site at all times and shall have no other duties in the company. The Contractor shall perform the work covered by this Section with a QC Manager having five (5) years of experience, all in the last ten (10) years, in quality control management of resident inspection personnel performing quality control inspection on construction Projects, and with a staff of resident inspection personnel each having three (3) years of experience, all in the last ten (10) years, in quality control inspection on construction Projects. The staff of resident inspection personnel shall inspect the Work in process for completeness and acceptance including multi shift Work and multi operations occurring concurrently. The size and composition of the resident inspection staff may vary as the job progresses but at all times it shall be compatible with the level of effort and capability required by the Contract and construction schedule.

C. The QC Organization shall consistently maintain quality requirements and shall be independent from that portion of the Contractor's organization responsible for production.

D. Written quality control inspection and test procedures shall be used for all operations. These procedures shall contain instructions for performing the required inspection or test, contain the accept/reject criteria for each inspection or test activity (i.e., applicable drawing, specification section, industry code or standard), shall establish the frequency for performing the inspection or test, and shall provide for recording the results of inspections and tests on checklists. These procedures shall be available at all locations where inspections and tests are to be performed. Payment will not be processed until these procedures are submitted to and reviewed by the Owner.

E. The Contractor's procurement documents shall require subcontractors and supplies to implement their own (SQC) program or require them to implement the CQC Program. Copies of the Contractor's procurement documents shall be provided to the Owner in accordance with the requirements specified herein. The Contractor shall comply fully with manufacturers' instructions, including completing each step-in sequence. Should manufacturers' instructions conflict with Contract Documents, the Contractor shall request clarification from the Owner before proceeding.

F. Work to be done away from the construction site is subject to inspection by the Owner during its fabrication, manufacture, testing, or before shipment. The Contractor shall give notice to the Owner of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Owner in accordance with SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING so that the necessary arrangements for inspections and witnessing of shop tests can be made. The Owner has the right but not the responsibility to perform inspection or to witness tests. The Owner's right to perform inspection or to witness tests does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents.

G. The Owner has the right to perform inspections, witness tests, or otherwise monitor or assess the Work and activities. The Owner's right to perform inspections, witness tests, or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the work.

H. Procedures shall be established for controlling the identification, inspection status, handling, and storage of raw and fabricated material. These controls shall be maintained from the time of receipt of the material until delivery to the Owner, in order to protect the material from damage, deterioration, loss or substitution.
The Contractor shall maintain control over construction and installation processes to assure compliance with specified requirements. In-process and final inspection and testing of construction shall be performed in accordance with written implementing quality control inspection and test procedures to assure that contract requirements have been met. The results of in-process and final inspections shall be recorded on inspection checklists developed by the Contractor and reviewed by the Owner.

I. The CQC and SQC programs are subject to periodic audit by the Owner to assure compliance with the Contract Documents. However, audit by the Owner does not relieve the Contractor of the requirements for the CQC and SQC programs.

J. Monthly quality control reports shall be submitted as specified herein and shall address: status of the Contractor quality control program including procedure development, status of Subcontractor/supplier quality control programs and procedures, number of inspections and tests performed during the month, unsatisfactory and nonconforming items identified as well as those that remain open or were closed during the month, and any other quality problems experienced.

K. The Contractor's Project Superintendent, meeting the same QC Manager qualifications, may also act as the QC Manager.

**1.09 - QUALITY ASSURANCE/CONTROL OF SUBCONTRACTORS/SUPPLIERS**

A. The Contractor shall be responsible for controlling the quality of Work performed by its Subcontractors and suppliers. Unless Subcontractors and suppliers implement their own quality control (SQC) program, approved by the Contractor and reviewed by the Owner, the Contractor shall instruct the Subcontractor or supplier to implement the CQC program on all Work performed and the Contractor shall perform the Quality Control inspections of the Subcontractor's or supplier's Work and activities at their facilities. The CQC program shall list all Subcontractors and suppliers and identify which quality program, CQC or SQC, they are to implement.

**1.10 - OWNER FURNISHED TESTING AND INSPECTION SERVICES**

A. The Contractor shall furnish a construction schedule and a minimum of 48-hour notice of readiness for testing and inspection of the work. The Owner shall determine the exact time and location of field sampling and testing, and may require such additional sampling and testing as necessary to determine that materials and equipment conform with data previously furnished by Contractor and with the Contract Documents.

B. The Contractor shall schedule the work to permit adequate time for testing and re-testing should test results not conform to the contract documents. Lack of testing or inspection which is attributable to insufficient notice by the Contractor or failure of the Contractor to cooperate, will be cause for rejection of the work.

C. The Contractor shall deliver materials in sufficient quantities to the Owner testing agency as may be required. Laboratory testing shall be performed within a reasonable time, consistent with the specified standards.

D. The Contractor shall furnish material samples and cooperate in the field sampling and testing activities. The Contractor shall furnish personnel, facilities and access to assist in the sampling and testing activities.

**1.11 - CONTRACTOR'S ON-SITE QUALITY CONTROL TESTING AND INSPECTION**

A. The Contractor shall perform inspections, tests, and other services required by the Contract Documents, the CQC programs, and in accordance with all applicable laws, codes, rules, and regulations and document the results on checklists as specified herein.

B. The Contractor shall provide 48 hour notice to the Owner so that the Owner may witness Contractor’s on-site inspections and tests. The Owner's witnessing of inspections and tests does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents.

C. The Contractor shall develop an inspection and test index identifying all required inspections and tests as indicated in the Contract Documents and the CQC program. This index shall be submitted to the Owner for review and be included as part of the CQC program. The Contractor shall provide the original inspection and test results upon completion to the Owner witnessing the inspection or test.

**1.12 - OWNER QUALITY CONTROL ACTION ITEMS**

A. The Contractor shall promptly undertake appropriate action, at no additional cost to the Owner, to respond and correct any unsatisfactory, nonconforming, or otherwise deficient conditions reported to the Contractor by the Owner. These conditions may be identified as a result of Owner inspections, audits or surveillances.

**1.13 - MANUFACTURERS' FIELD INSTALLATION SERVICES AND REPORTS**

A. When specified in the Contract Documents, the Contractor shall require material or product suppliers and manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, (test, adjust, and balance of equipment) and to provide instructions for installation.

B. The Contractor shall report to the Owner in writing any observations and site decisions or instructions given by the manufacturer’s representatives to the Contractor that are supplemental or contrary to manufacturers' written instructions.

C. The Contractor shall submit manufacturer representative reports (in duplicate) within 10 days of each field visit, to the Owner for review. If the durations of field visits are greater than one week, the Contractor shall submit weekly reports. Final report shall certify that the equipment or systems have been satisfactorily installed and are functioning correctly.

**PART 2 - PRODUCTS AND SERVICES – Not Used**

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. Inspections and tests shall be made by the Contractor and the appropriate documentation produced as each element of Work is executed.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

SEE ATTACHMENT A – ELEMENTS OF A QUALITY CONTROL PROGRAM

# ATTACHMENT A - ELEMENTS OF A QUALITY CONTROL PROGRAM

## A-1 - INTRODUCTION

A. The Quality Control Program is the basic quality document for the construction of a Project, and it identifies quality program commitments. The Quality Control Program assigns responsibilities, authority levels, and interface requirements for activities, which affect quality. Activities which affect quality are those activities which affect the features and characteristics important to the equality of an item, such as soil compaction, concrete curing, etc. The Quality Control Program serves as the basis for Quality Control Procedures, which contain the administrative and implementation requirements for quality control activities.

B. A Quality Control Program must address the following program topics/elements as they relate to the equipment, material or service being furnished:

1. Organization
2. Quality Assurance Program
3. Design Control
4. Control of Procurement Documents
5. Instruction and Procedures
6. Control of Documents
7. Control of Material, Equipment, and Services
8. Survey/Field Coordination
9. Control of Special Processes
10. Inspection and Tests
11. Unsatisfactory/Nonconformance Control
12. Quality Control Records
13. Surveillance and Audits
14. Attachments:
    a. Inspection Report
    b. Nonconformance Report
    c. List of Procedures
    d. List of Subcontractors and Suppliers and applicable QC program
    e. List of inspections and tests
    f. List of QA Records

## A-2 - ORGANIZATION

A. This section the QC program must:

1. Specify that the responsibility for the program is retained and exercised by the Contractor.
2. Describe how responsibility is exercised for the overall program including oversight, and how the Contractor evaluates the performance of work by the delegated organization.
3. Describe lines of communication between the contractor/suppliers to assure quality control program direction.

4. Contain organization charts clearly identifying all on-site and off-site organizations which function under the cognizance of the quality control program (such as design, engineering, procurement construction, subcontractors, suppliers, etc.), lines of responsibility and a description of the size of the quality control organization including the inspection staff.
5. Describe the delegation of contract work and the quality control responsibility for the quality control program and which:
    a. Is at the same or higher organizational level as the highest line manager responsible for contract activities affecting quality.
    b. Has communications with other senior management positions.
    c. Has responsibility for approval of QC Manual(s).
    d. Has no other duties or responsibilities.
    e. Has access to senior level management to identify quality problems; initiate, recommend or provide solutions to problems; and verify implementation of solutions.
6. Require that verification of conformance to established requirements is accomplished by individuals or groups within the QC organization who do not have direct responsibility for performance of the work being verified and are independent from that portion of the contractor's organization responsible for production.
7. Assure that QC personnel are sufficiently free from direct pressures due to cost/schedule, and have the responsibility delineated in writing to stop unsatisfactory work and control further processing, delivery, or installation of nonconforming material.
8. Document and make mandatory the corporate level policies regarding the implementation of the QC program.

**A-3 - QUALITY CONTROL PROGRAM**

A. This element of the program must:
1. Describe the scope of the QC program applicability.
2. Establish provisions to assure that quality-affecting procedures required to implement the QC program are consistent with QC program commitments and corporate policy and are properly documented, controlled, and made mandatory through signature of the responsible official.
3. Provide for the submittal of quality affecting procedures to the Authority for review with documented agreement of acceptance prior to initiation of activities affected by the program and procedure.
4. Address how management regularly assesses the scope, status, adequacy and compliance of the QC program to the contract requirements.
5. Establish requirements for training such that:
    a. Personnel performing quality-affecting activities are instructed as to the purpose, scope and implementation of the quality control program and procedures.
    b. Personnel verifying activities affecting quality are trained and qualified in the principals, techniques, and requirements of the activity being performed.
    c. Documentation of training and qualification including the subject, content of the training, attendees, and date of attendance is maintained.

**A-4 - CONTRACTOR DESIGN CONTROL**

A. This element of the program must:

1. Describe the scope of design control, if any, including Contractor's design activities associated with the preparation and review of design documents including the correct translation from the contract documents.

2. Define the organizational responsibilities for preparing, reviewing, approving and verifying design documents.

3. Establish internal and external design interface controls, procedures, and lines of communication among participating design organizations and across technical disciplines.

**A-5 - PROCUREMENT DOCUMENT CONTROL**

A. This element of the program must:

1. Require that procurement documents are reviewed to determine that quality requirements are correctly stated, inspective and controllable; and there are adequate acceptance and rejection criteria.

2. Require that procurement documents, to the extent necessary, require suppliers and subcontractors to provide an acceptable quality control program.

3. Assure that procurement documents identify applicable technical, administrative and reporting requirements; drawings, specifications; codes and industrial standards; test and inspection requirements; and special process instructions that must be complied with by suppliers.

4. Require procurement documents to indicate that the work is subject to inspection by the Contractor and others on behalf of the Authority during its fabrication, manufacture, testing, or before shipment.

**A-6 - INSTRUCTION AND PROCEDURES**

A. This element of the program must:

1. Describe organizational responsibilities for assuring that activities affecting quality are prescribed by documented instructions and procedures and that the activities are accomplished through implementation of these documents.

2. Require that instructions and procedures be developed that include quantitative (such as dimensions, tolerances, and operating limits) and qualitative (such as workmanship samples) acceptance criteria for determining that important activities have been satisfactorily accomplished.

3. List, as an attachment, all quality administrative and quality-affecting procedures developed or to be developed to implement the program.

**A-7 - DOCUMENT CONTROL**

A. This element of the program must:

1. Describe the scope of the document control program and identify the types of documents to be controlled. Controlled documents shall include:

a. Design documents (e.g., calculations, drawings, specifications, analyses).

b. Instructions and procedures for such activities as fabrication, construction, modification, installation, test and inspections.

c. As-built documents.

d. Quality control manuals and quality-affecting procedures.

2. Establish procedures for:

   a. Assurance that changes to documents are reviewed and approved by the same organizations that performed the initial review and approval.

   b. Assurance that the documents are available at the location where the activity will be performed and obsolete documents are removed.

**A-8 - CONTROL OF MATERIAL, EQUIPMENT AND SERVICES:**

A. This element of the program must:

1. Describe the organizational responsibilities for the procurement of material, equipment and services including the interface between the design, procurement and QC organizations.

2. Describe requirements for verification of subcontractors' and suppliers' activities during fabrication, inspection, testing and shipment of materials, equipment and components by the QC organization in accordance with written procedures to assure conformance to the procurement document.

3. List, as an attachment, all subcontractors and suppliers to be utilized on the project and indicate whose QC program will be implemented on the work.

4. Require receiving inspection by the QC organization to assure:

   a. Material, equipment and components are identified and conform to the procurement document requirements.

   b. That the supplier furnished the documentation required by the Contract and procurement documents and that the documentation identifies the purchased item and the specific procurement requirements (e.g., codes, standards, and specifications) met the item.

5. Describe the measures for the control and identification of materials, equipment, parts, and components to preclude the use of incorrect or defective items. When Contract Documents require to be traceable in order to show locations, heat numbers, chemical analysis, physical properties or other inspection/test results for materials used, the Program must:

   a. Establish procedures to assure that identification is maintained either on the material item or on records traceable to the material/item.

   b. Require that correct identification of material items is verified and documented prior to release for fabrication, assembly, shipment and installation.

   c. Require identification to be traceable to the appropriate drawings; specifications; purchase/manufacturing/inspection documents; and physical/chemical test reports.

6. Describe the control of the handling and storage of material, equipment, and components to assure that they are protected from damage, deterioration, loss or substitution and installed in accordance with the design drawings.

**A-9 - SURVEY/FIELD COORDINATION**

A. This element of the Program must:

1. Describe the organizational responsibilities for the control of survey accuracy and integrity.

2. Establish a procedure for surveying which addresses:

   a. Verification of the continuing accuracy and integrity of both horizontal and vertical surveys.

   b. Establish control traverse, baseline and benchmarks.

   c. Performance of survey checks of detailed layout of the work and accuracy of preparations for field installations as work progresses.

   d. Verify dimensional location and tolerances of completed work.

3. Require preparation of as-built plans.

**A-10 - CONTROL OF SPECIAL PROCESSES**

A. This element of the Program must:

1. Contain a listing of those processes that are controlled as special processes.
2. Describe the organizational responsibilities including those of the QC organization for qualification of the special process, equipment, and personnel, in accordance with the applicable codes, standards, QC procedures and specifications.
3. Establish requirements for performance of the special process using qualified procedures, equipment and personnel, including documentation of the results.
4. Establish requirements for retention of qualification records of procedures, equipment and personnel associated with special processes.

**A-11 - INSPECTION AND TESTS**

A. This element of the Program must:

1. Describe the scope of the inspection and test program and the organizational responsibilities for performing inspection and tests.
2. Require that individuals performing inspections and tests be independent of those who performed or directly supervised the activity being inspected.
3. Establish and document the qualification requirements for inspectors, including Non-Destructive Testing (NDT) personnel, and test personnel.
4. Establish procedures for calibration (technique and frequency), maintenance, and control of measuring and test equipment (instruments, tools, gages, fixtures, etc.) used in acceptance measurement, inspection and testing. The Program/Procedures must:
    a. Require the identification and be able to trace Measuring and Test equipment to the calibration test data.
    b. Specify intervals of calibration based on the required accuracy, purpose, usage or other conditions affecting the measurement.
    c. Require calibration against standards that have a higher degree of accuracy then the Equipment being calibrated to assure that the Equipment being calibrated will be within required tolerance.
    d. Require reference and calibration standards to be traceable to nationally recognized Standards.
5. Require preparation of inspection and test procedures, instructions, or checklists which require:
    a. Identification of characteristics and activities to be inspected or tested.
    b. Describe the method for performing tests or inspections.
    c. Acceptance and rejection criteria.
    d. Prerequisites such as calibrated measuring and test equipment and instrumentation.
    e. Method of recording or documenting inspection and test results and data.
6. Determine acceptability of inspection results or test data and results.

**A-12 - UNSATISFACTORY/NONCONFORMANCE CONTROL**

A. This element of the Program must:

1. Establish procedures for identification, documentation, segregation, review, disposition and notification to affected organizations of unsatisfactory and nonconforming materials, parts, components, and services, if disposition is other than to scrap.

2. Require re-inspection of items reworked, repaired or replaced to determine compliance with contract documents or approved engineering dispositions.

3. Require nonconformances or unsatisfactory conditions to be corrected or resolved prior to the initiation of pre-operational tests on the item.

**A-13 - QUALITY CONTROL RECORDS**

A. This element of the Program must:

1. Describe the scope of the QC Records including a list of the record types, which will be generated as a result of implementing the program. QC records include results of reviews, assessments, inspections, tests, audits and surveillances; material analysis; monitoring of work performance; qualification of personnel, procedures and equipment; and other documentation such as drawings, specifications, procurement documents, calibrations procedures and reports, nonconformance reports and corrective action reports.

2. Identify the organizational responsibilities for the implementation and retention activities related to QC records including turnover to the Authority.

**A-14 - SURVEILLANCE AND AUDITS**

A. This element of the Program must:

1. Require an audit of the QC program on an annual basis by personnel having no direct responsibilities for the area being audited.

2. Establish requirements and procedures describing the audit and surveillance programs which includes:

   a. Performance of audits and surveillances to pre-established written procedures or checklists by trained personnel having no direct responsibilities in the areas being evaluated.

   b. Analysis of data.

   c. Issuance of reports to appropriate management for action, review and assessment.

   d. Tracking of deficient areas until satisfactory resolution.

   e. Re-audit of deficient areas to verify correction and closure.

**A-15 – SUBMITTALS**

A. Submit the following:

1. Inspection Report

2. Nonconformance Report

3. List of Procedures

4. List of Subcontractors and Suppliers and applicable QC program

5. List of QA Records

**END OF ATTACHMENT**

**SECTION 01500**

**TEMPORARY FACILITIES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, tools, equipment and materials, performing all operations necessary to provide temporary facilities as specified herein and as directed by the Engineer.

B. The materials covered by this specification are intended to be standard materials of proven ability as manufactured by reputable concerns. Materials shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**PART 2 - PRODUCTS**

**2.01 - TEMPORARY BUILDINGS**

A. Furnish temporary offices, storage and fabrication facilities as required and obtain all necessary applicable permits and/or approvals required for their use. Such buildings shall be located as required and as to not interfere with the work of the project and shall be completely removed at the completion of the work.

B. Engineer's Field Office

1. Provide at the start of the work and for the duration of the project, unless otherwise directed, a field office for the use of the Engineer. The office shall be of approximately 500 square feet divided into three rooms plus a lavatory with hot and cold running water and a closet. Legally dispose of sanitary wastes. The office and rooms shall be constructed in a manner, and of materials, satisfactory to the Engineer. Office shall be weathertight with a minimum of six windows and two exterior doors. The office shall be adequately lighted for detailed working conditions, heated and air conditioned during the appropriate seasons (each room to be individually controlled). Thoroughly clean and mop the trailer on a weekly basis and shall restock all paper products such as but not limited to cups, towels, toilet paper, office copy paper, printer paper and plastic liners for waste baskets.

   a. The rooms shall be designated Room "A", Room "B" and Room “C” and of the approximate sizes: Room "A" - 100 square feet, Room "B" - 300 square feet and Room “C” – 100 square feet. Separate entrances shall be provided to each Room.

   b. Furniture, furnishings and equipment subject to approval of the Engineer, shall be provided in the designated rooms as follows:

      (1) Room "A"

      1 - Executive desk

      2 - Executive chairs

      1 - Bookcase (6' high x 3' wide)

      1 - 4 drawer steel files (locking, legal size)

      1 - Waste basket

      1 - Cordless telephone (with hands free speaker and speed dialing)

      1 - Telephone answering machine with recorder

      1 - Dell All-In-One Printer 962 or equal.

      (2) Room "B"

      3 - Tables (2'-6 x 6'-0)

      1 - Plan table (3’-0” x 4’-0”)

      1 - Plan rack (mobile stand and handling clamps by rack manufacture)

      2 - 4 drawer steel files (locking, legal size)

      12 - Folding metal chairs

      1 - Water Cooler/Heater with up to ten 5-gallon supply containers furnished per month for the duration of the contract

      1 - 2.5 cubic foot refrigerator

      1 - Small microwave oven

      1 – Black and White and Color copy machine, self-feeding, with 8-1/2" x 11" and 11" x 17" printing capability, enlargement/reduction capability and scanning capability; provide cartridges, toner, paper, etc., for the project duration

      1 – Wi-Fi service

      1 - Push broom and dust pan

      1 - First aid kit

      1 - Fire extinguisher

      1 - Waste basket

1 - Canon Power Shot ELPH 180 - digital camera or equal

(3) Room "C"

1 - Executive desk

2 - Executive chairs

1 - Bookcase (6' high x 3' wide)

1 - 4 drawer steel files (locking, legal size)

1 - Waste basket

1 - Cordless telephone (with hands free speaker and speed dialing)

3. The Engineer's Field Office shall be located at the work site where it will not interfere with the construction work. Space shall be provided with crushed stone base for at least three vehicles adjacent to the office for the exclusive use of the Engineer and visitors. Remove snow, mud, and control dust in the parking area adjacent to the office.

**2.02 - TEMPORARY OPERATIONS**

A. General

1. The Contractor shall conduct operations in such a manner and sequence that shall neither result in a disruption of the amenities, nor interfere with the functional organization and workings of existing infrastructure.

2. The Contractor is required to provide all temporary facilities required to maintain the operation of the existing infrastructure.

3. The Contractor shall prepare a carefully planned and detailed construction schedule showing the proposed sequences of operation and the methods to be used for maintaining continued operations of existing infrastructure. No payment will be made until the carefully planned and detailed construction schedule has been developed by the Contractor and approved by the Owner and the Engineer. The following provides the minimum requirements to be addressed by the Contractor while preparing the construction schedule. It should be noted that the following is not intended to be all inclusive.

B. In order to maintain continuous operations during construction (if applicable), the Contractor is required to furnish, install, maintain and remove all necessary temporary by-pass systems. The Contractor shall fully maintain the temporary by-pass systems at all times. The temporary by-pass systems shall include, but is not limited to, piping, valves, flow control devices, electrical connections, and power supply, if necessary. The temporary by-pass equipment shall remain in operation and be fully maintained by the Contractor until the applicable equipment or system has been approved by the Engineer and approved by the Owner.

**PART 3 - EXECUTION**

**3.01 - TELEPHONE SERVICES**

A. Provide separate temporary telephone services in the field offices for use by the Contractor, subcontractors and the Engineer up to the time of final acceptance of the project.

B. The Engineer's Field Office shall be provided with one telephone line.

**3.02 - WATER**

A. Make connections to the nearest municipal water supply and use this supply for construction purposes. Any portions, which are to become a part of the permanent system, shall conform to the applicable sections of these specifications.

B. Furnish, maintain and subsequently provide the water meters and backflow preventers at each location. Furnish all extensions required. Provide drinking water, satisfactorily cooled.

**3.03 - ELECTRICITY**

A. Arrange for, furnish and maintain all expenses for all electricity required for proper lighting, the use of power tools, for temporary heat for construction operations and for field offices up to the time of final acceptance of the project.

B. Furnish all wiring, fixtures, lamps and other accessories required for his or his subcontractors' work, and for proper lighting, the use of power tools and for temporary heat for construction operations up to the time of final acceptance. Power shall be obtained directly from power company lines or from portable, gasoline driven generator sets.

**3.04 - SANITARY CONVENIENCES**

A. Provide sanitary conveniences for the duration of the project for the use of all persons employed on the project, including all other contractors and subcontractors.

B. Sanitary conveniences shall be properly screened from public observation, provided in sufficient numbers, and in such manner and at such points as shall be approved by the Engineer and/or Owner. The contents shall be removed and legally disposed of at a frequency acceptable to the public health agency having jurisdiction or as required.

**3.05 - PROJECT SIGNS**

A. Contractor shall provide Project Sign(s) in accordance with SECTION 00902, PROJECT SIGN.

**3.06 - BARRICADES AND GUARD LIGHTS**

A. Barricades, signs, fences and similar safety and warning devices shall be provided as required, in order to insure the protection of employees and others concerned with their duties and presence on the premises at the project site.

B. Provide and maintain guard lights at all barricades, obstructions in plant ways, and at all trenches and pits adjacent to traveled ways.

**3.07 - TEMPORARY HEAT**

A. During the months of October through April, provide heat, fuel and services necessary to protect all of the work and materials against injury from dampness and cold and to maintain temperature above 55 degrees F in all enclosed portions of the project. Provide temporary heating devices, electrical power, adequate and proper fuel, fire enclosures, and the like, as required for the work of all trades, and shall have watchmen constantly in attendance when fires are burning. Only Underwriters' Laboratory approved equipment shall be used. Open salamanders will not be allowed.

B. The permanent heating system may be used for temporary heat prior to the occupancy of the buildings by the Owner, or as otherwise approved by the Engineer, however, the use of permanent equipment for temporary heat purposes shall not affect the guarantee period stated elsewhere in these specifications. Operate and maintain the heating system (including fuel) and the equipment used for temporary heat until final completion of the project, and repair and replace all items damaged during temporary use. Clean all of the permanent heating equipment if it is used for temporary heat before turning the system over to the Owner.

**3.08 - TEMPORARY CLOSURES**

A. Temporary doors and closures for all openings shall be furnished and installed to keep out inclement weather and intruders until the permanent units are installed. Any loss or damage caused by failure to comply with the above provisions shall be replaced and/or repaired at no additional cost to the Owner.

**3.09 – SCAFFOLDING AND HOISTING**

A. The Contractor shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of the work except for the work performed by the Filed Sub-Bid subcontractors. The Contractor shall provide, set up and maintain in a safe condition all derricks and hoisting machinery, perform all hoisting operations in a safe method and remove all derricks and hoisting machinery as required for the execution of their work, except for the work performed by the Filed Sub-Bid subcontractors.

B. All Filed Sub-Bid subcontractors shall furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of their work. All Filed Sub-Bid subcontractors shall provide, set up and maintain in a safe condition all derricks and hoisting machinery, perform all hoisting operations in a safe method and remove all derricks and hoisting machinery as required for the execution of their work.

C. Neither the Engineer nor the Owner will act as an arbitrator on questions of whether the Contractor or any of his subcontractors shall furnish or remove scaffolding required for any portion of the work.

### 3.10 - SHELTER AND PROTECTION OF MATERIALS

A. Provide adequate storage facilities for all materials required for the work. The facilities shall be enclosed, heated and provided with moisture control, as required to provide adequate protection and shall be satisfactory to the Engineer.

### 3.11 - BRACING, SHORING AND SHEETING

A. Provide all bracing, shoring and sheeting as required for safety and for the proper execution of work. Unless otherwise ordered by the Engineer, all bracing, shoring, and sheeting shall be removed when work is completed.

## 3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 01570**

**TRAFFIC MANAGEMENT AND MAINTENANCE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work under this section includes furnishing all engineering, materials, labor, and equipment required for traffic management and maintenance on state highways and/or municipal roadways within the limits of construction under this contract.

B. All practices and traffic control devices shall conform to the relevant provisions of the Manual on Uniform Traffic Control Devices, latest edition and State of Massachusetts Department of Transportation (hereinafter called State) Standard Specifications for Road and Bridge Construction.

C. Develop a traffic management plan to be reviewed and approved by the Owner, state, local, and/or jurisdictional agencies as appropriate. The traffic management plan shall meet with standard practices of the above references, requirements of this specification, and special requirements required by the project.

D. Furnish adequate notice to police and fire departments, public transportation authorities, and school departments/districts of the proposed traffic maintenance plan including, but not limited to, detours, lane closures, and alternate routes.

E. Furnish, erect and maintain traffic control devices, as required by the traffic maintenance plan. Provide traffic control devices including lights, markings, barricades, warning signs, and all other safety precautions necessary to protect streets, sidewalks, access to adjoining property, and the traveling public within the area of the construction. Reference is made to the drawings for general guidelines for typical traffic control devices and their placements. These are intended as a guide only, and do not necessarily include all possible warning devices, control devices, or police details, which may be required by the project.

F. Remove, replace and/or reposition all traffic control devices, as necessary.

G. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT and as follows:

1. Any traffic control devices provided under this section which are lost, stolen, destroyed or deemed unacceptable while in use on the project, shall be immediately replaced at no additional cost to the Owner.

2. Uniformed Police Officers shall be paid for in accordance with SECTION 01025, MEASUREMENT AND PAYMENT.

3. Payment for work under this Item shall include, but not be limited to, supplying drums, signs, Type III barricades, arrow boards, message boards, removing and replacing damaged traffic control devices, moving and removing drums during non-work hours, providing steel plates as required, and moving traffic control devices to provide uninterrupted abutter access.

4. No payment shall be made for any work on this project until a Traffic Management Plan has been developed, submitted and approved by the Owner and/or Engineer.

B. The Contractor is responsible to obtain and provide two surety bonds. A $2,500,000 surety bond to cover the work located within the MassDOT Roadways identified as Cranberry Highway (Route 6A) and South Orleans Road (Route 28), and a second $500,000 surety bond to cover the Crossing work located within the MassDOT Roadway identified as Mid Cape Highway (Route 6).

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Traffic Management Plan.
2. Written Approval of the Traffic Management Plan from the Owner’s Safety Officer/Municipalities’ Safety Officer.

**1.05 - SPECIAL REQUIREMENTS**

A. Notify the Owner, state, local, and/or jurisdictional agencies well in advance of commencing construction. Arrange all detours, partial road closures, and alternate traffic patterns. Inform emergency departments on the daily status of project roadways.

B. Arrange for the services of uniformed police officers, as required to protect and facilitate the flow of vehicular and pedestrian traffic through the construction work zone.

C. During winter months, remove snow and prevent ice conditions within active construction work zones, and assist local or state agencies in clearing roads used as detour routes to facilitate uninterrupted movement of traffic.

D. No Work shall be started on the Project until a detailed Project Schedule and Engineered Traffic Management Plan has been submitted to and approved by the Engineer and MassDOT. In addition, during the construction of the Project update the Project Schedule weekly and inform the Engineer, Owner, MassDOT for work in the State Highway Layout, and all other applicable utilities or other entities affected by the Work in writing of changes to the approved Project Schedule.

**PART 2 - PRODUCTS**

**2.01 - SAFETY CONTROLS AND SIGNING FOR CONSTRUCTION OPERATIONS**

A. All signs, barricades and drums shall have reflective sheeting, in accordance with the Manual on Uniform Traffic Control Devices, latest edition and State of Massachusetts Department of Transportation Standard Specifications for Road and Bridge Construction.

B. The Contractor shall use sandbags or provide other suitable means to weigh down Portable Breakaway Barricades to minimize the disturbance of barricades by vandals.

C. Furnish, erect and maintain throughout the construction period warning and directional signs.

D. All traffic control devices not conforming in type, composition, and size to the standards specified herein shall not be used under this contract.

E. Each day, remove or cover all erected signs not consistent with the use of the roadway.

**2.02 - FLAGS FOR ADVANCE WARNING SIGNS**

A. Standard orange or red-orange flags (16 inch by 16-inch minimum) shall be mounted on all advance work area signs. Flags shall not interfere with a clear view of the sign face.

**2.03 - TEMPORARY PRECAST CONCRETE BARRIER**

A. Temporary Precast Concrete Barriers shall conform the State Standard Specifications.

B. Furnish, set up, move, maintain, and remove Temporary Precast Concrete Barriers, when positive traffic barriers are needed for traffic control and safety in construction zones.

C. Each run or bay of Temporary Precast Concrete Barrier units shall be installed and fastened together to form a continuous chain, in accordance with the requirements of the state or local agencies having jurisdiction.

**2.04 - PORTABLE BREAKAWAY BARRICADE TYPE III**

A. Portable Breakaway Barricades shall be a 4-foot unit and conform to the latest edition of the State Construction Standards, as shown on the drawings and any additional requirements of this specification.

B. Reflectorized sheeting shall conform to the State Standard Specifications. Alternating 6-inch-wide stripes shall be orange and white and shall slope downward at 45 degrees toward the end by which traffic is to pass. Pipe shall be Polyvinyl Chloride (PVC) pressure rated SDR 26 conforming to ASTM D2241. Fittings may be PVC conforming to ASTM D2665 or Acrylonitrile Butadiene Styrene (ABS) conforming to ASTM D2661 (Drainage Waste and Vent).

C. Furnish, set up, move, maintain (in good and serviceable condition), and remove Portable Breakaway Barricades as required by the performance of this work or as may be required by jurisdictional authorities, at no additional cost to the Owner.

**2.05 - PORTABLE BARRIER FENCE**

A. Construction of Portable Barrier Fences shall be as shown on the drawings. Include the necessary signs, reflectors, and all incidental equipment in order to provide the portable barrier fence, complete in place.

**2.06 - REFLECTORIZED DRUMS**

A. Reflectorized drums shall conform to the State Standard Specification and shall be as shown on the drawings. Other drum-type products providing equivalent target value and stability, and accepted by the State, may be used.

B. Drums shall be used in the protection of driveways, utility structures, and pedestrian control and safety throughout the construction period.

C. Warning lights shall conform to the State Standard Specifications. Drums shall be maintained in a satisfactory manner including the removal of dirt or road film that may cause a reduction in reflective efficiency.

D. The Contractor shall furnish, set up, move, maintain (in good and serviceable condition), and remove reflectorized drums with or without warning lights as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner.

**2.07 - ADVANCED WARNING ARROW PANELS**

A. Advance Warning Arrow Panels shall consist of a black background panel meeting the requirements of the State Standard Specifications. Each Special Lighting Unit shall automatically provide for a minimum of 50 percent dimming from their rated lamp voltage at night. The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute. The arrow panels shall have the capability of the following mode selections: (1) left or right flashing or sequential arrows; and (2) double flashing arrows.

B. Minimum height should be seven feet above the roadway to the bottom of the panel.

**2.08 - PORTABLE CHANGEABLE MESSAGE SIGNS**

A. The Contractor shall provide portable changeable message signs to provide advance warning to motorists prior to entering the construction area. The portable changeable message signs shall be available for immediate use throughout the duration of the project and be positioned in accordance with the Temporary Traffic Control Plan and/or at the direction of the Engineer. If the unit is found to be defective in any way it shall be replaced immediately at the Contractor's expense.

B. The portable changeable message signs display shall be full matrix LED signs utilizing 18-inch high characters on a display of 3 rows of characters with a minimum of 8 characters per line. The variable message signs shall have an encryption feature that provides data security.

C. Portable changeable message signs shall be Sunray 480 as manufactured by National Sign Incorporated, or equal.

**2.09 - TEMPORARY PAVEMENT MARKINGS AND RAISED PAVEMENT MARKERS**

A. Paints, tapes, and glass beads used for temporary pavement markings shall conform to the State Standard Specifications. The colors of the marking materials shall be white, yellow or black.

B. Raised pavement markers shall conform to the State Standard Specifications.

**2.10 - PEDESTRIAN BARRICADE**

A. Pedestrian Barricade shall be ADA Compliant, no trip hazard for pedestrians that meets or exceeds ADA Guidelines and Manual on Uniform Traffic Control Devices Standards.

B. Pedestrian Barricade shall be:

1. Approximately 38-inches high, 43-inches long and 16-inch wide.
2. Modular system can be shaped to any layout.
3. Stable in windy conditions.
4. Quick and easy to install without the use of supporting devices such as sandbags or water barrels.
5. Orange with retroreflective sheeting.
6. Anti-tamper linking system difficult for unauthorized personnel to dismantle when linked.

C. Pedestrian Barricade shall be Plasticade, Des Plaines, IL or approved equal.

D. Contractor shall provide 100 sections of Pedestrian Barricade to be used during construction.

**PART 3 - EXECUTION**

**3.01 - PERFORMANCE**

A. Furnish, erect and maintain suitable barriers, barricades, signs, markings, drums and all other traffic control devices necessary to protect all roadways, which are partially obstructed or closed to vehicular or pedestrian traffic, as a result of this project.

B. The Owner reserves the right to suspend work, if inadequate traffic control devices are provided to control and protect both vehicular and pedestrian traffic.

C. Completely backfill all trenches at the end of each workday and/or when work is suspended for indefinite periods. In addition, install temporary trench patch each and every Friday or the last day of the work week, whichever comes first.

D. All damage to the work, pedestrians and/or public/private property due to failure to place or maintain adequate warning or directional signs or other traffic control devices shall be corrected and/or replaced at no additional cost to the Owner.

E. Furnish, supply, maintain and remove temporary white and/or yellow reflectorized and/or black non-reflectorized pavement markings, as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner. For the purpose of this specification, temporary markings shall mean markings with an effective marking period of 90-days.

F. Remove existing pavement markings as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner. Pavement marking removal methods shall not cause damage to the pavement or cause significant change in its texture. Any damage to the pavement or surfacing caused by pavement marking removal shall be satisfactorily repaired, at no additional cost to the Owner.

G. Provide all necessary temporary pavement markings, and/or temporary raised pavement markers following the completion of each week's operation, change in detour routing or prior to opening the roadway to traffic. Make all necessary arrangements for this work, as required. Continually replace the temporary pavement markings until the final pavement markings have been provided on the final pavement.

H. Transport and relocate any or all signs, barriers, barricades, or other safety devices as specified herein, as required or directed during the project. No additional payment will be provided for relocating and removing traffic control devices.

**3.02 - TRAFFIC MANAGEMENT PLAN**

A. The hours of operation shall be limited as required by permitting agencies and/or as required by the municipality.

B. $L = S \times W$ for speeds of 45 mph or more and/or $L = W \times S / 60$ for speeds of 40 or less where:

1. L = minimum length of taper
2. S = numerical value of posted speed limit prior to work or 85th percentile speed
3. W = width of offset

C. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.

D. The maximum spacing between channelizing devices should be approximately equal in feet to two times the speed limit.

E. Channelizing devices are to be extended to a point where they are visible to approaching traffic.

F. Warning lights (steady burn Type C) should be used to mark channelizing devices at night as needed.

G. Pavement markings no longer applicable which could create confusion shall be removed. Temporary pavement markings shall be used as necessary and shall be in place prior to work completed each night.

H. Signs and sign supports shall meet criteria in NCHRP 350. No signs shall be attached to drums or cones. All signs shall be attached to independent supports.

I. Exact location of signs shall be approved by the engineer. Distances may be adjusted slightly to meet with field conditions.

J. All traffic control signs shall be completely covered or removed at the end of each work day or when otherwise not in effect.

K. Advisory speed at site to be determined by the municipality prior to the start of construction.

L. As required by the local safety officer, police details shall be used to direct traffic around a work area if traffic must be temporarily stopped or rerouted to allow for movement of work vehicles or other equipment.

M. As required by the local safety officer, in low volume traffic roadways, if the entire work area is visible from one station, a single police officer may be used. A single officer shall be stationed on the shoulder opposite the obstruction or work place or in a position where good visibility and traffic control can be maintained at all times.

N. As required by the local safety officer, in areas of heavy traffic volume or critical work areas, 2 or more police officers shall be used. Where 2 or more police officers are required, all police officers must be in communication with each other and should be clearly visible to the traffic which is being controlled.

O. Flood lights should be provided to mark police detail stations at night as needed.

P. Operation of traffic signal controls at intersections should be coordinated with local authorities.

Q. The contractor shall square off full width of roadway (10:1 slope) at the end of each work day, where applicable.

R. At the end of the work day the contractor shall ensure that safe access/egress of all driveways, entrances and exits are maintained during night time and on weekends.

S. If detour plans which use local roadways are required, they must be approved by engineer in writing prior to commencing work.

**3.03 - PORTABLE CHANGEABLE MESSAGE SIGNS**

A. Portable changeable message signs shall be positioned in accordance with the traffic control plan and/or at the direction of the Engineer. The portable changeable message signs shall be visible from a minimum distance of 900 feet with a viewing angle of no less than 30 degrees. The Contractor shall take appropriate measures as needed within the roadway layout to provide the required minimum sight distance. The Contractor shall be responsible for the maintenance of each device and appurtenance.

B. The Contractor shall be responsible for all maintenance associated with all portable changeable message signs. This includes, but is not limited to knockdowns, power outages, equipment malfunctions, temporary modifications to support the traffic control plan during construction and any other incidents within the project limits.

**3.04 - PEDESTRIAN BARRICADE**

A. Pedestrian barricades shall be installed to protect pedestrians at locations within the Project areas.

B. Pedestrian barricades shall be unassembled and reassembled, as necessary, throughout the duration of construction.

C. The Pedestrian Barricades shall remain the property of the OWNER upon completion of the Project. Following construction activities, the Contractor shall clean the Pedestrian Barricade and replace sections damaged during construction.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 01600**

**CONTROL OF MATERIALS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products including:

1. Definitions.
2. Submittals.
3. Spare parts.
4. Quality assurance.
5. Delivery, storage and handling.
6. Warranty.
7. Products.
8. Substitution and “Or Equal” items.
9. Reuse of existing material.
10. Owner Furnished Products.
11. Manufacturer’s instructions.
12. Special tools.
13. Lubrication.
14. Nameplates.
15. Loads and seismic forces.
16. General material and equipment requirements.
17. Materials and Equipment.
18. Field Quality Control; Installation, and Instructional.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

C. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and accepted through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of acceptance or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Contractor shall arrange deliveries of materials and equipment in accordance with construction Progress Schedule, coordinate to avoid conflict with Work and conditions at Project site.

C. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or their packaging.

D. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

E. Owner assumes no responsibility for damage or loss due to storage of materials and equipment.

F. Interior Storage:

1. Store with seals and labels intact and legible.
2. Store materials and equipment subject to damage by elements in weathertight enclosures.
3. Maintain temperature and humidity within ranges required by manufacturer’s instructions.

G. Exterior Storage:

1. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment subject to deterioration with impervious sheet coverings. Provide ventilation to avoid condensation.

2. Store loose granular materials in well drained area on solid surfaces to prevent mixing with foreign matter.

3. Store materials such as pipe, reinforcing steel, structural steel, and equipment on pallets or racks, off ground.

H. Inspection and Maintenance:

1. Arrange storage to provide easy access for inspection, maintenance, and inventory.

2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions are free from damage or deterioration, and coverings are in-place and in condition to provide required protection.

3. Perform maintenance on stored material and equipment in accordance with manufacturer's written instructions and in presence of Owner or Engineer.

a. Notify Engineer 24 hrs before performance of maintenance.

b. Submit report of completed maintenance and condition of coverings to Engineer with each Application for Payment.

c. Failure to perform maintenance, to notify Engineer of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

I. Contractor shall assume responsibility for protection of completed construction and repair and restore damage to completed Work equal to original condition.

J. Wheeling of loads over finished floors, with or without plank protection, is not permitted in anything except rubber tired wheelbarrows, buggies, trucks or dollies. This applies to finished floors and exposed concrete floors, as well as those covered with composition tile or other applied surfacing.

K. Where structural concrete is also finished surface, avoid marking or damaging surface.

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

**1.08 - REFERENCED STANDARDS**

A. American Society of Mechanical Engineers (ASME):

1. B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)

B. American Society for Testing and Materials International (ASTM):

1. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. A325/A325M: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SPARE PARTS**

A. Provide spare parts for Products as specified in the individual technical Specification sections.

B. Pack spare parts to protect them during storage. Tag spare parts and containers to clearly identify them in accordance with Contractor's parts numbering system as reviewed by Engineer. All parts shall be cross-referenced to their applicable the Specification section.

**1.10 - WARRANTY**

A. Warranties specified in other Specification sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.

3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in SECTION 01700, CONTRACT CLOSEOUT

D. Unless otherwise specified in the individual equipment sections that equipment warranties are limited to 12 months from the date of Substantial Completion.

**1.11 - PRODUCTS**

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

**1.12 - ACCEPTANCE OF MATERIALS**

A. Unless otherwise specified, only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by Contractor shall be subject to the inspection and acceptance of Engineer. No material shall be delivered to the Project site without prior acceptance of the Engineer.

B. As specified in SECTION 01300, SUBMITTALS, Contractor shall submit to Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.

C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by Contractor. If the Engineer requires, either prior to beginning or during the progress of the Work, Contractor shall submit additional samples or materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, stored, packed, and shipped at Contractor's expense. Except as otherwise noted, Owner will make arrangements for and pay for the tests.

D. Any delay of acceptance resulting from Contractor's failure to submit samples or data promptly shall not be used as a basis of a claim against Owner or Engineer.

E. In order to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes, and surfaces, Contractor shall provide such samples of workmanship or finish as may be required.

F. The materials and equipment used on the Work shall correspond to the accepted samples or other data.

**1.13 - REUSE OF EXISTING MATERIAL**

A. Except as specifically indicated or specified, do not use materials and equipment removed from existing structure(s) in new Work.

B. For material and equipment specifically indicated or specified to be reused in Work:

1. Use special care in removal, handling, storage, and reinstallation to ensure proper function in completed Work.

2. Contractor shall arrange and pay for transportation, storage, and handling of products which require off-site storage, restoration or renovation.

3. Off-site storage areas and buildings shall conform to requirements of this Specification section.

**1.14 - OWNER-FURNISHED PRODUCTS – Not Used**

**1.15 - MANUFACTURER'S INSTRUCTIONS**

A. Installation of equipment and materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including two (2) copies to Engineer.

1. Maintain one (1) set of complete instructions at the Project site during installation and until completion of Work.

B. Handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with the Specifications.

1. If Project site conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions. Do not proceed with Work without written instructions.

**1.16 - SPECIAL TOOLS**

A. For each type of equipment furnished, Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.

B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

C. Pack items to protect them during storage. Tag items and containers to clearly identify them in accordance with Contractor's part system, as reviewed by Engineer. Cross reference all items to their applicable Specification section.

D. Special tools shall be delivered at the same time as the equipment to which they pertain. Contractor shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to Owner.

E. Contractor shall furnish and erect one (1) or more steel wall cases with flat key locks and clips or hooks to hold each tool in arrangement.

**1.17 - LUBRICATION**

A. Where lubrication is required for proper operation of equipment, incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.

B. Where oil is used, reservoir shall be of sufficient capacity to supply unit for 24 hr period.

C. Provide adequate and, as far as practicable, automatic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routing greasing

using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure nipples and tubing to the equipment at appropriate locations. Indicate on the working drawings submitted, the types of lubricants to be used. Use grease nipples of a consistent type, Alemite button head type or equivalent. Provide grease gun(s) of the appropriate size(s) and pressure(s).

D. Provide a one (1) year supply of all lubricants necessary for the routine, daily operation of the equipment. All lubricants to be readily available to the Owner. Provide a complete schedule of all the lubricant including the manufacturer name, type, name and local address and phone number of where each lubricant can be purchased for each piece of equipment.

**1.18 - NAMEPLATES**

A. With the exceptions mentioned below, each piece of equipment shall be provided with a nameplate of non-corrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information.

B. This requirement shall not apply to standard, manually operated hydrants or to gate, globe, check and plug valves.

**1.19 - LOADS AND SEISMIC FORCES**

A. Provide anchorage and supports for products, including equipment, assemblies, and pipe, designed to resist the following loads and seismic forces.

1. Horizontal forces: 100 percent of dead and live loads acting in any direction in the horizontal plane applied to the center of gravity of the load.

2. Vertical forces: 50 percent of the dead and live load, acting either upward or downward applied at the center of gravity of the load.

3. Cantilevered anchorages/supports: 100 percent of the dead and live loads acting in any direction applied at the center of gravity of the load.

B. Seismic force determination: Maximum dead and live loads conditions while operating.

C. Products, including equipment and assemblies, in normal submerged condition operation: analysis of seismic forces in both submerged/dry condition.

D. Above ground tanks, their supports and anchorages: Design fabricate and install to comply with the seismic requirements of applicable codes.

E. Analysis of loads and seismic force: Performed by a registered structural professional Engineer in the Commonwealth of Massachusetts with experience in this type of work.

F. Furnish copies of all analyses with the submittals for equipment, assemblies, and pipe.

**1.20 - GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS**

A. The requirements of this Paragraph shall constitute the standards for the material and equipment specified herein. Should these requirements conflict with the Supplier’s recommendations or in any way be less stringent than the Supplier’s requirements, they shall be superseded by the Supplier’s requirements.

B. Bolts, Anchor Rods and Nuts:

1. All necessary bolts, anchor rods, nuts, washers, plates and bolt sleeves shall be furnished by the contractor in accordance herewith. Anchor rods shall have suitable washers and hexagonal nuts.

2. All anchor rods, nuts, washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated or specified.

3. Unless otherwise specified, stud, tap, and machine bolts, and nuts shall conform to the requirements of ASTM Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A325. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to ANSI Standard B1.1 for Unified Inch Screw Threads (UN and UNR Thread Form).

4. Bolts, anchor rods, nuts, and washers, specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

5. Bolts, anchor rods, nuts, and washers specified to be stainless steel shall be Type 316 stainless steel.

6. Anchor rods shall be set accurately. They shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and set in the concrete forms with suitable pipe sleeves, or both. If anchor are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

C. Grease Fittings:

1. Provide extension fittings and tubing on all grease fittings that are installed in an inaccessible location. The extension is to be located so that equipment can be lubricated from the operating level without the use of ladders, staging or shutting down the equipment. Tubing: 316 stainless steel.

D. Concrete Inserts For Hangers:

1. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

E. Equipment Foundations, Installation and Grouting:

1. Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by him, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.

2. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

3. In setting pumps, motors, and other items of equipment customarily grouted, Contractor shall make an allowance of at least 1-inch for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-metallic, non-shrink grout.

4. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

5. Where such procedure is impracticable, the method of placing grout shall be as accepted byEngineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an accepted manner and given a burlap-rubbed finish.

F. Equipment Drive Guards:

1. All equipment driven by open shafts, belts, chains, or gears shall be provided with acceptable all-metal guards enclosing the drive mechanism. Guards shall be constructed of galvanized sheet steel (12 gage minimum) or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. Guards shall conform in all respects to all applicable safety codes and regulations.

2. Provide pivoting access covers for shaft speed measurements.

G. Sleeves:

1. Unless otherwise indicated on the Drawings, or specified, form openings for the passage of pipes, conduits, and circular ducts through floors and walls using sleeves of standard weight, galvanized-steel pipe. Provide sleeves of ample diameter to pass the pipe and its insulation, if any, and to permit expansion as may occur. Provide sleeves that are flush at the walls and at the bottom of slabs and project 4-inches above the finish floor surface. Threaded nipples shall not be used as sleeves.

2. Sleeves in exterior walls below ground or in walls that have liquids on one or both sides, shall have a 2-inch annular fin of 1/8-inch plated welded with a continuous weld completely around the sleeve at mid-length. Galvanize sleeves after the fins are attached.

3. Sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built.

H. Protection Against Electrolysis:

1. Where dissimilar metals are used in conjuction with each other, provide insulation between adjoining surfaces to eliminate direct contact and any resultant electrolysis. Provide bituminous insulation, heavy bituminous coatings, nonmettalic separators or washers, impregnated felt, or other means to provide insulation.

## PART 2 - PRODUCTS AND SERVICES

### 2.01 - MATERIALS AND EQUIPMENT

A. Material and Equipment Incorporated into Work:

1. Conform to applicable specifications and standards.

2. Comply with size, make, type, and quality specified or as accepted by Submittal.

B. Manufactured and Fabricated Materials and Equipment:

1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.

2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

3. Two (2) or more items of same kind shall be identical, by same manufacturer.

4. Material and equipment shall be suitable for service conditions.

5. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically accepted, in writing.

6. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be proportioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.

7. Design so working parts are readily accessible for inspection and repair, easily duplicated, and replaced.

8. Design structural members of equipment for anticipated shock and vibratory loads.

9. Design machinery such that working parts are readily accessible for inspection and repair, and that each part is suitable for the service required.

C. Do not use material or equipment for purpose other than for which it is designed or specified.

**PART 3 - EXECUTION**

**3.01 – FIELD QUALITY CONTROL; INSTALLATION, AND INSTRUCTIONAL SERVICES**

A. General

1. Provide on-site services of Supplier's representatives for equipment provided by Contractor during construction, installation, equipment startup, and training of Owner's personnel for equipment or plant operation as specifically required in Specification sections for equipment or systems.
2. Include and pay costs for Supplier's services.
3. Work day is defined as 8 hr period during Owner's or Contractor's typical calendar day. Work day for purposes of this section does not include travel to or from the Project Site.
4. Specification sections include minimum mandays to provide basis for bidding. If additional time is required to perform services Contractor shall include that time in the Contract Price.

B. Installation Services

1. Where installation services are called for in the Specifications, provide competent and experienced technical representatives of manufacturers of material or equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment and calibration to conform to the Specifications and manufacturer's requirements and instructions.
3. Provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system is ready for startup and system demonstration.

C. Training

1. Do not start training until Installation Services have been completed.
2. Where training is called for in the Specifications, provide competent and experienced technical representative of Supplier to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include operation and maintenance of instrumentation and equipment in classroom and on-site. Training shall include electrical, mechanical, and safety aspects of equipment.
3. Submit documentation identifying name of specific representative, factory authorization, and background of named individual(s) to conduct training. Submit information 30 days before scheduled training period for review and acceptance by Engineer.
4. Coordinate training periods with Engineer, Owner and Supplier's representatives.
    a. No training shall be conducted unless instructor has been accepted by Engineer.
    b. Notify Engineer at least 48 hrs before training sessions are to begin so Engineer can make arrangements with Owner's operating personnel.
    c. Reschedule canceled training sessions 48 hrs in advance.
    d. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hrs in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to Owner for time lost by Owner's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hr for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hr, after 1 hr training will be rescheduled.
    e. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hrs in advance of need to cancel scheduled training or failure to arrive within 30 min of start of scheduled training shall result in reimbursement to Owner for expenses and time incurred by Engineer in traveling and time spent on-site. Minimum time billed shall be 8 hrs.

5. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in specific Specification section.
6. O&M data shall constitute basis of instruction. Review data contents with personnel in full detail to explain aspects of operations and maintenance.
7. Instructional Services shall be completed before start of performance testing required in SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.
8. Provide “Certificate of Instructional Services”, cosigned by Owner and Supplier’s representative, verifying training has been accomplished to satisfaction of each party.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 01610**

**DELIVERY, STORAGE AND HANDLING**

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1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS – Not Used ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA – Not Used ..... 3
PART 2 – PRODUCTS – Not Used ..... 3
PART 3 – EXECUTION – Not Used ..... 3

## PART 1 - GENERAL

### 1.01 - SCOPE

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - PRODUCT HANDLING**

B. Transportation and Delivery

1. Transport and handle items in accordance with manufacturer's printed instructions.
2. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.
3. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
4. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
5. All items delivered to the site shall be unloaded by the Contractor and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic. The Owner shall not offload any materials or equipment at the site.
6. Provide equipment and personnel to unload all items delivered to the site.
7. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. Owner, other Contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

C. Storage and Protection

1. Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer by him. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.
2. Arrange storage of products and equipment to permit access for inspection. Periodically inspect to make sure products and equipment are undamaged and are maintained under specified conditions.
3. Provide protective maintenance during storage consisting of manually exercising equipment, inspecting mechanical surfaces for signs or corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer necessary for its protection and all other precautions to assure proper protection of all equipment stored and for compliance with manufacturers' requirements related to warranties.
4. Store loose granular materials on solid flat surface in a well-drained area. Prevent mixing with foreign matter.
5. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulation of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in manner to reduce breakage, cracking and spalling to a minimum.

6. All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.

    a. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

    b. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding".

    c. Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

    d. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

    e. For electrical equipment (including switchgear, switchboards, motor control centers, and variable frequency drives) installed in areas where temperature and humidity are not controlled for, provide temporary heaters in accordance with manufacturer’s recommendations to prevent condensation prior to energization of equipment.

    f. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

**1.06 - DESIGN CRITERIA – Not Used**

**PART 2 – PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF SECTION**

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**SECTION 01650**

**FACILITY START-UP AND TESTING REQUIREMENTS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Contractor shall be responsible for furnishing of all labor, equipment, appliances and materials and performing all operations in connection with the facility testing and inspection and startup and performance testing prior to final acceptance of all process systems, including the coordination of all performance tests and the furnishing of operating instructions for all equipment.

B. Start-up and Testing Requirements for individual equipment systems shall be as indicated for all equipment as specified in individual sections in DIVISION 11 - EQUIPMENT, DIVISION 15 - MECHANICAL and DIVISION 16 - ELECTRICAL.

C. HVAC systems shall be tested and balanced in accordance with DIVISION 15, MECHANICAL. Fire Protection Systems shall be commissioned in accordance with DIVISION 10, SPECIALTIES and DIVISION 15, MECHANICAL.

D. Electrical and Fire Alarm tests shall be performed as specified in DIVISION 16 - ELECTRICAL.

E. The Instrumentation and Control System tests shall be performed as specified in DIVISION 13 - SPECIAL CONSTRUCTION

F. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 1, GENERAL REQUIREMENTS, Specification Sections, apply to this section

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. An allowance has been identified in SECTION 01020, ALLOWANCES for the Contractor to perform Performance Testing following Substantial Completion. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials, supplies, manufacturer's services, and the like, in order to perform Performance Testing as specified herein and in other sections. Detailed expenditures shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

10. "Shop Testing" shall mean testing that is done by the manufacturer either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment meets the requirements of the pertinent technical specification(s). All costs associated with Shop Testing shall be at no additional cost to the Owner.

11. "Physical Checkout, Inspection and Certification" shall mean the process of physically inspecting products by the Contractor and manufacturer/supplier after they have been installed in the work, and then certifying that the products have been properly and completely installed and are ready for field and/or start-up. All costs associated with Physical Checkout, Inspection and Certification shall be at n0 additional cost to the Owner.

12. "Field Testing" or "Functional Testing" shall mean testing that is performed by the Contractor and manufacturer/supplier on process equipment that has been installed in the work and after the Physical Checkout, Inspection and Certification, for the purpose of proving that the tested products meet the

requirements of the pertinent technical specifications. All costs associated with Field Testing or Functional Testing shall be at no additional cost to the Owner.

13. "System Testing" shall mean testing performed on a "system" comprised of two or more pieces of equipment, after the equipment has been installed in the work, and after Physical Checkout, Inspection and Certification and Field Testing has been completed, for the purpose of providing that the system meets requirements as specified and as indicated. All costs associated with System Testing shall be at n0 additional cost to the Owner.

14. "Clear Water Testing" shall mean a test conducted on all items and systems performed with portable water after Physical Checkout, Inspection and Certification, Field Testing and System Testing have been satisfactorily conducted by the Contractor and manufactures/suppliers and the they are satisfied that the equipment is operating as specified. All costs associated with Clear Water Testing shall be at no additional cost to the Owner except as specified herein.

15. "Start-up" shall mean the initial operation of the completed facility and processes by the Owner, utilizing wastewater and related substances (sludge, wastewater, scum), or other media which the facility has been designed to process.

16. "Performance Testing" shall mean testing performed by the Contractor and manufacturers/supplies to verify performance of the individual components under actual operating conditions. The tests shall indicate compliance with the performance requirements in the individual specification sections. All costs associated with Performance Testing shall be at no additional cost to the Owner.

17. "Final Acceptance" shall mean passing of the Performance Testing of individual components under actual operating conditions.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data and certificates in accordance with SECTION 01300, SUBMITTALS and as specified herein.

2. Detailed specific start-up plans for each mechanical or process system.

**1.05 - SHOP TESTING**

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty days written notice indicating the time and place of testing. Submit the following for approval thirty days prior to this notice.

1. Description of the Test - Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing Devices That Will be Used in the Tests - Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience shall be submitted. As a minimum, personnel shall have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.

4. Schedule for Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Submit all forms used to record and report on shop test data, for approval, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall conform to the Engineer's format for heading and check off sections. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have me the required criteria, and that the equipment will operate as indicated and as specified.

B. Shop test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the shop test procedure and proposed test date. The Contractor will be notified, in writing by the Engineer, if a formal resubmission is required with the transmittal of the review comments.

C. Submit the following within one week after completion of the tests for approval:

1. Completed test forms, for each device tested, on forms as approved prior to the test.

2. Completed certification, the content of which was approved prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

**1.06 - PHYSICAL CHECKOUT, INSPECTION AND CERTIFICATION**

A. When required by the technical specifications, perform field or functional testing on installed equipment. If none are required by the technical specifications, complete field / functional testing as detailed below. Field / functional testing shall be in addition to and not in lieu of, any shop testing either required or otherwise performed. Perform testing as a part of the overall testing process defined herein. However, the following specific instructions shall also apply. Provide thirty days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces.

Submit with this notice the following for approval by the Engineer:

1. Description of the Tests - Outline how the test will conform to the requirements in the technical specifications.

2. Testing Devices That Will Be Used in the Tests - Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience. As a minimum, personnel must have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.

4. Schedule of Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Review and comment on all forms provided by the Engineer for recording reporting on the field test data, prior to the test.

6. Material and Equipment Required for the Test - This material and equipment shall be supplied by the Contractor or his/her subcontractors at no additional cost to the Owner.

7. Water and Power Requirements - Water and power requirements shall be identified in the plan by the Contractor and will be supplied by the Contractor for field testing purposes only. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water.

8. Disposal of Waste – The Contractor is responsible for the legal disposal of all wastes generated from the testing.

B. Field test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Engineer if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Engineer for approval.

1. Completed test forms for each device tested on forms provided prior to the tests.
2. Completed certification documentation, the content of which was approved prior to the tests.
3. A written summary of testing, reporting on the results and summarizing the entire procedure.
4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

D. Minimum Field Test Requirements

1. Calibrate equipment as required. For pumps, use water as a calibration liquid.
2. Test equipment and systems through a normal start, normal stop, and all emergency shutdown sequences.
3. Complete a four-hour running test. For variable speed units, the test shall include running for three complete cycles of one-hour duration at the maximum and minimum speeds for one half of each of those cycles. Operate each system through its normal automatic sequence of operation. During the four-hour test, observe and record all level indications, flow indicators, and pressure indicators.
4. If the equipment utilizes a local programmable logic controller (PLC), verify that the PLC is capable of operating and controlling the system as specified in the individual specification sections. Also verify all communications with distributed control system (DCS) are as specified.
5. For equipment not supplied with a PLC, verify that the instrumentation and control system is capable of operating and controlling the system.
6. Check safety devices, and interlocks for satisfactory operation. Check instrumentation and control systems for conformance with the Specifications.
7. Check for system leaks and proper valve operation.
8. Demonstrate to the Owner's Representative that all temporary jumpers and/or bypass have been removed and that all of the components are operating under their own controls as designated.
9. Coordinate start-up activities with the Owner's representative and with the Engineer prior to commencing system start-up.

E. Motor Testing

1. Visually inspect the motor for any physical damage.
2. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.
3. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and the results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

F. Engine Generator Test

1. Visual and Mechanical Inspection.
    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect correct anchorage and grouting.

2. Electrical and Mechanical Tests.

   a. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE Standard 43. Calculate polarization index.

   b. Test protective relay per applicable NETA standards.

   c. Perform phase-rotation test to determine compatibility with load requirements.

   d. Functionally test engine shutdown for low oil pressure, over temperature overspeed, and other features as applicable.

   e. Conduct performance test in accordance with ANSI/NFPA Standard 110, (Installation Acceptance).

   f. Verify correct function of governor and regulator.

   g. Test circuit breakers per applicable NETA standards.

G. Upon completion of installation of all permanent equipment and related shop and field testing, the manufacturer's technical service representative shall inspect and, as necessary, adjust and/or calibrate the equipment. The inspection shall consider the completeness and integrity of the installation, the alignment and clearances of the equipment parts with respect to each other, and the sufficiency of any required sealing, lubricants or packing.

H. The technical service representative shall submit the results of the inspection including certification that the equipment was properly installed and is operating as specified and as installed. The report should verify that the equipment is ready for sustained operation and free from defects that would render the guarantee null and void.

**1.07 - FIELD TESTING OR FUNCTIONAL TESTING**

A. Field Testing or Functional Testing shall be made at on each piece of process equipment.

B. Field Testing or Functional Testing shall be conducted by the Contractor and manufacturer/supplier utilizing portable water to demonstrate to the satisfaction of the Engineer that the equipment is ready for System Testing.

C. Fourteen days' notice of scheduled start-up of individual equipment items or mechanical systems, the Contractor shall prepare a schedule of activities and provide the schedule to the Engineer for review and approval. The following representatives, as appropriate, shall be present simultaneously for the Field Testing or Functional Testing

   1. General Contractor;

   2. Electrical Subcontractor;

   3. Equipment Manufacturer's Technical Service Representative;

   4. Instrumentation and Control Equipment Representative;

   5. System Integrator; and

   6. Owner, OPM and Engineer.

D. The following must be completed prior to start-up and testing:

   1. Controls and alarm systems shall be tested to show it is capable of transmitting and annunciating all specified control points to the facility-wide SCADA system;

   2. All safety equipment shall be installed and operating properly;

   3. Training of Contractor Operator personnel by manufacturer's technical service representatives has been completed; and

   4. All spare parts, tools, lubricants shall be delivered to the Owner.

   5. Installation drawings delivered to the Owner.

E. The Contractor shall, upon orders by the Engineer, startup, adjust and place in satisfactory operation all equipment constructed under this contract. At the discretion of the Engineer, individual startups may be required for various phases of the work or individual systems. The Engineer may order the start-ups prior to the completion of non-essential items of work.

F. As soon as practical after the initial start-up, the Contractor shall arrange for the manufacturer's representatives to perform all field tests and complete all additional training.

**1.08 - SYSTEM TESTING**

A. System Testing shall be made after all equipment that comprises of a complete system has been installed and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and manufacturer/supplier and the Contractor is satisfied that the equipment is operating as specified. System are identified as follows:

1. Liquid Stream (Influent Screen, Pre-Equalization Tanks, Mixing Blowers, SBR Transfer Pumps, SBRs and SBR Blowers) as shown on Drawing 00 D-006 - Process Flow Diagram I and Drawing 00 D-007 - Process Flow Diagram II;

2. Effluent Stream (Disk Filters, Post Equalization Tank, Post Equalization Tank Mixers, Effluent Pumps, UV System and Effluent Disposal) as shown on Drawing 00 D-007 - Process Flow Diagram II;

3. Plant Water (Plant Water System, Bladder Tank, Foam Spray Pump and Plant Water Storage Tank) as shown on Drawing 00 D-007 - Process Flow Diagram II;

4. Septage Receiving (Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-008 - Process Flow Diagram III;

5. Sludge Processing (Sludge Transfer Pumps, Rotary Drum Thickeners, Polymer Feed System, Thickened Sludge Storage Tank, Mixing Bowers and Thickened Sludge Pumps) as shown on Drawing 00 D-008 - Process Flow Diagram III; and

6. Odor Control (Odor Control System and Septage Receiving Station, Waste Sludge Tanks, Mixing Bowers as shown on Drawing 00 D-009 – Odor Control Air Flow Diagram.

B. The successful performance of all systems shall be demonstrated to the satisfaction of the Engineer by completing the System Testing utilizing portable water. Unless especially required in technical specifications, the System Testing will consist of operating each system for an uninterrupted four hours or as otherwise specified.

C. Failure of equipment to operate as specified will require the System Test to be reperformed for the full period. At no time during the System Testing shall any equipment or system be operated under a more severe condition than the maximum design condition for which the equipment is rated.

**1.09 - CLEAR WATER TESTING**

A. Clear Water Testing (4-hour) shall be conducted on all items and systems shall be made after all equipment has been installed for a given unit process and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor and the Contractor is satisfied that the equipment is operating as specified.

B. Clear Water Testing shall not be conducted until completion of the “Certification of Proper Equipment Installation” by the Equipment Manufacturer and “Verification of Manufacturer’s Training” (Refer to SECTION 01030, SPECIAL REQUIREMENTS on each piece of process equipment.

C. The Contractor shall continue to conduct the Clear Water Test until the test has successfully run for 4 continuous hours.

D. The Contractor is responsible for all repairs and/or replacement of equipment and/or components of the equipment that does not function in accordance with the Contract Documents, approved shop drawings and manufacturer’s operational requirements.

E. The Contractor is responsible for all costs associated with conducting the 4-hour Clear Water Test including but, not limited to, labor, equipment, tools and supplies except as follows:

1. The Contractor is responsible for making all arrangements and gathering necessary permissions from the Owner's water district for use of water.
2. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and shall be borne by the Contractor.
3. The water is obtained from the Owner ate not cost but, the water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

F. The Clear Water Test shall be performed with the OWNER, OPM, ENGINEER, Contract Operator and MassDEP in attendance. The Clear Water Test shall be scheduled at least twenty-one (21) days in advance so that OWNER, OPM, ENGINEER, Contract Operator and MassDEP personnel can be present.

**1.10 - SUBSTANTIAL COMPLETION**

A. Issuance of Substantial Completion shall occur following the successful completion of Clear Water Testing.

**1.11 – START UP**

A. Contract Operations

1. The Town of Orleans, Massachusetts will seek proposals from qualified firms capable of providing full-service operation and maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.
2. Operation and Maintenance services will be provided in a safe, secure, effective and efficient manner and will be in full compliance with GWDP Permit requirements of the MassDEP, applicable laws of the Commonwealth of Massachusetts and regulations of the Massachusetts Department of Environmental Protection.
3. Procurement of the Contract Operator is anticipated to be completed July 2021. Personnel from the Contractor Operator will be on-site during the last 6 to 8 months of construction to observe and/or be involved with the following:
    a. Construction Activities;
    b. Physical Checkout, Inspection and Certification;
    c. Field Testing or Functional Testing;
    d. Training;
    e. System Testing; and
    f. Clear Water Testing.
4. The Contract Operator is a separate contract directly between the Town and a third-party Service Provider and is not part of the scope of work of this Project.

B. Operation and Maintenance

1. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the OWNER will notify Property Owners that they have up to one year to connect into the wastewater system.
2. Upon the successful completion of the Clear Water Testing and the Issuance of the Substantial Completion, the Contract Operator will be responsible for Start-up and Operation and Maintenance of the Downtown Area Collection System, Pumping Stations, WWTF and Effluent Disposal.

3. Operation and Maintenance shall include, but not be limited to, the following

   a. Staffing – Number and Qualifications Required by MassDEP.

   b. Maintenance - Building and Grounds, Equipment, etc.;

   c. Maintain the Inventory of Spare Parts, Tools and Supplies, and the like;

   d. Process Control – SCADA System, Sampling and Analysis, etc.;

   e. Septage Receiving and Processing;

   f. Sludge Processing and Legal Disposal;

   g. Consumables – Power, Chemicals and the like; and

   h. Training of their Personnel –Additional Training (i.e. Safety Program, Standard Operating Procedures, etc.) Not Including Training Specified and Conducted by the Contractor and Manufacturers/Suppliers.

**1.12 - PERFORMANCE TESTING**

A. Performance Testing by the Contractor shall occur within the one-year warranty period but shall not occur until an average of 50,000 gpd of raw wastewater is being received at the facility. The Performance Testing will occur as soon as an average of 50,000 gpd of raw wastewater being received at the facility.

B. Since the facility may be underloaded during start-up, the following is required:

   1. The Contractor shall coordinate the stat-up activities with the SBR manufacturer, Aqua Aerobics.

   2. The system will be started-up by placing one SBR reactor in service.

   3. Aqua Aerobics has run a preliminary design scenario for the reactor at its lowest loading to determine the quantity of seed required to be obtained by the Contractor. Refer to the attachment to this section.

      a. The design shows how much flow from the Pre-Equalization Tanks(s) is required for the SBR biology to be self-sustaining.

      b. This is an estimate based on a blend of raw wastewater entering the facility and flow from the Septage Receiving Station.

      c. At the time of Performance Testing, the Engineer, Contract Operator and Aqua Aerobics will determine if seed (i.e. quantity and quality) is required to be obtained by the Contractor. If required, the costs to obtain the seed shall be paid for under the allowance specified in SECTION 01020, ALLOWANCES.

C. Performance Tests and Performance Criteria: Specific performance testing criteria are listed for specific equipment and systems in the Division 11 through Division 16 specifications. Compliance with these performance test requirements shall be demonstrated during the full system testing or otherwise demonstrated prior to substantial completion.

D. In the event of a failure to demonstrate satisfactory facility performance on the first or any subsequent attempt, it shall be the responsibility of the Contractor to make all the necessary and required changes, replacements, and tests to make the units meet the specified operating and efficiency requirements.

E. If equipment is unable to operate, initial calibration and/or additional adjustments are required, or representatives are absent, the start-up or tests shall be canceled at that time and full rescheduling will be required. Damages shall be assessed to the Contractor for time and expenses wasted on scheduling, coordinating and attending the failed performance test by the Owner, OPM, Engineer and Manufacturer Representatives.

F. Once the complete facility system has successfully passed the Performance Testing, the Contractor can submit a request for payment for money withheld (five percent of the equipment purchase price minus value of warranty work) for the following:

   1. SECTION 11333, SEPTAGE RECEIVING STATION

   2. SECTION 11365, ROTARY DRUM THICKENERS

3. SECTION 11399, EFFLUENT DISK FILTERS

4. SECTION 11600, SEQUENCING BATCH REACTORS

**1.12 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING**

A. The Contractor shall not operate any of the existing facilities at any time. This shall include the starting and stopping of equipment or opening and closing of valves. Whenever the Contractor believe their work will affect or be impacted by the existing facilities operation, they shall so notify the Engineer in writing three (3) working days prior to the intended start of the work. This notification shall clearly detail the work to be completed, the method by which the existing facilities operation may be impacted, and the assistance requested of the Owner.

B. Contractor's Responsibilities: The Contractor shall be responsible for furnishing and installing all of the several kinds and types of equipment required in the treatment facilities, and for testing each individual piece of equipment, all combinations of equipment as they may operate one in conjunction with another, and the complete system, such that each component and the total unit may operate in an acceptable fashion to the Engineer, the Owner, and to any other municipal, State or Federal authorities within whose jurisdiction the operation of the facility may be a concern, at no additional costs to the Owner:

1. Develop specific start-up plans and schedule.

2. Provide specific start-up material and operating supplies until substantial completion. Supplies include lubricants, chemicals, gases, specialized fluids, electric power, water and all other required appurtenances.

3. Provide all specified third-party testing and laboratory costs at no additional costs to the Owner.

4. Provide manufacturer's representative to provide guidance during performance testing.

5. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the start-up and performance testing.

6. Provide the necessary craft or labor assistance, in the event of an emergency equipment failure requiring immediate attention, (emergency is defined as a failure of function which precludes the further operation of a critical segment of; or the whole of the work) with a response time of not less than four hours from the time of notification. The time of notification is defined as the time of contact between the Engineer's representative and the Contractor's representative.

7. Correct all failures or equipment problems identified during start-up when notified by the Engineer. Resolve and correct all equipment or system failures during the performance testing.

8. Provide manufacturer's representatives and operating supplies for retesting of systems that fail to pass the initial performance tests due to deficiencies in products or workmanship at no additional cost to the Owner.

9. Provide training as specified.

10. Prior to starting the start-up and testing, the Contractor shall provide and field calibrate certified flow meters (by using volumetric calibration), flow recorders, all electrical meters, and electrical recorders. The Contractor shall provide a test procedure, wiring diagram of field test recorders and instrumentation, and a field calibration report on the installed meter.

11. Review procedures for performance testing.

12. Attend meetings related to the review of start-up plan(s).

13. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract Documents.

14. Provide an initial full fill of the emergency generator fuel tank to be used for start-up and testing. Refill the fuel tank following start-up and testing. Payment for the cost of the diesel fuel shall be made via the allowance specified in SECTION 01020, ALLOWANCES.

C. The Owner's Responsibilities

1. Assist in the start-up testing activities. The Owner will endeavor to be cooperative with the Contractor when required. However, it is emphasized that the existing facilities operations and treatment take precedence and only requests that do not adversely affect the flow or treatment will be considered. Additionally, any assistance given to the Contractor must be completed when the Owner's schedule and manpower permit. There may be instances when the Owner cannot provide assistance at the time of the Contractor's request and this shall not be the basis for a claim by the Contractor.

2. Provide staff to operate and maintain equipment, systems, and facilities requiring start-up.

**1.13 - TREATMENT EQUIPMENT USAGE**

A. Any partial or full usage of the proposed equipment by the Contractor, and/or his employees or agents, prior to acceptance shall be the responsibility of the Contractor.

**1.14 - OPERATIONAL EXPENSES**

A. During the construction stage and start-up period, before Substantial Completion, the Contractor shall bear all expenditures and operational expenses of all systems included in the project including, but not limited to, labor, equipment, tools, electrical power, chemicals, maintenance, and fuel.

B. The Contractor shall be responsible for the proper handling, sampling, and lab testing and analysis from the testing and start-up of facility processes.

C. During Performance Testing, the Contractor shall bear the costs for Contractor and manufacturer/suppliers, including but not limited to labor, equipment, tools, supplies, manufacturer's services and the like, as approved by the Engineer. The manufacturer of the following equipment shall perform an equipment check-out and complete any repairs necessary within one month of the Contractor conducting Performance Testing:

1. SECTION 11333, SEPTAGE RECEIVING STATION
2. SECTION 11365, ROTARY DRUM THICKENERS
3. SECTION 11399, EFFLUENT DISK FILTERS
4. SECTION 11600, SEQUENCING BATCH REACTORS

The allowance specified in SECTION 01020, ALLOWANCES shall be used to cover these costs.

**1.15 - GUARANTEE**

A. The Contractor shall guarantee the materials and equipment furnished and the performance thereof to be in accordance with the requirements of the Contract Documents.

B. The Contractor agrees upon written notice to make promptly and without charge, all necessary changes, corrections, and replacements (including installation of replacement parts) required to make good all defects developing in the material or equipment, under ordinary use and proper care, within a period of twelve months after substantial completion of the Project.

**PART 2 - PRODUCTS**

**2.01 - TEST EQUIPMENT**

A. The Contractor shall provide all test equipment, including kWh demand meters and recorders, instruments, analyzers, handling equipment, etc., required to sample and test the various systems. All test equipment must have been tested and calibrated within six months of their use on this contract.

**PART 3 - EXECUTION – Not Used**

**END OF TEXT**

See Attachment

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# AquaSBR - Sequencing Batch Reactor - Design Summary

**Design#: 158326**

**Project:** ORLEANS MA

**Option:** Sample Start up Conditions for SBR

*Designed by Tamera Knapp on Thursday, November 7, 2019*

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

## DESIGN INFLUENT CONDITIONS

**Avg. Design Flow** = 0.05 MGD = 189 m3/day

**Max Design Flow** = 0.05 MGD = 189 m3/day

## DESIGN PARAMETERS

| | Influent | mg/l | Effluent Required | <= mg/l | Effluent Anticipated | <= mg/l |
|---|---|---|---|---|---|---|
| **Bio/Chem Oxygen Demand:** | BOD5 | 200 | BOD5 | 15 | BOD5 | 15 |
| **Total Suspended Solids:** | TSS | 200 | TSS | 15 | TSS | 15 |
| **Total Kjeldahl Nitrogen:** | TKN | 40 | -- | -- | -- | -- |
| **Total Nitrogen:** | -- | -- | TN | 7 | TN | 7 |
| **Phosphorus:** | Total P | 4 | -- | -- | -- | -- |

## SITE CONDITIONS

| | Maximum | Minimum | Design | Elevation (MSL) |
|---|---|---|---|---|
| **Ambient Air Temperatures:** | 77 F 25.0 C | 30 F -1.1 C | 77 F 25.0 C | 60 ft |
| **Influent Waste Temperatures:** | 68 F 20.0 C | 50 F 10.0 C | 68 F 20.0 C | 18.3 m |

## SBR BASIN DESIGN VALUES

**No./Basin Geometry:** = 1 Rectangular Basin(s)

**Freeboard:** = 2.0 ft = (0.6 m)

**Length of Basin:** = 65.0 ft = (19.8 m)

**Width of Basin:** = 45.0 ft = (13.7 m)

| | Water Depth | | Basin Vol./Basin | | |
|---|---|---|---|---|---|
| **Min** | = 14.5 ft | = (4.4 m) | **Min** | = 0.318 MG | = (1,203.4 m³) |
| **Avg** | = 15.7 ft | = (4.8 m) | **Avg** | = 0.343 MG | = (1,298.0 m³) |
| **Max** | = 15.7 ft | = (4.8 m) | **Max** | = 0.343 MG | = (1,298.0 m³) |

| | | |
|---|---|---|
| **Number of Cycles:** | = 2 per Day/Basin (advances cycles beyond MDF) | |
| **Cycle Duration:** | = 12.0 Hours/Cycle | |
| **Food/Mass (F/M) ratio:** | = 0.026 lbs. BOD5/lb. MLSS-Day | |
| **MLSS Concentration:** | = 1200 mg/l @ Min. Water Depth | |
| **Hydraulic Retention Time:** | = 6.858 Days @ Avg. Water Depth | |
| **Solids Retention Time:** | = 43.6 Days | |
| **Est. Net Sludge Yield:** | = 0.799 lbs. WAS/lb. BOD5 | |
| **Est. Dry Solids Produced:** | = 66.6 lbs. WAS/Day | = (30.2 kg/Day) |
| **Est. Solids Flow Rate:** | = 100 GPM (1997 GAL/Day) | = (7.6 m³/Day) |
| **Decant Flow Rate @ MDF:** | = 333.0 GPM (as avg. from high to low water level) | = (21.0 l/sec) |
| **LWL to CenterLine Discharge:** | = 3.0 ft | = (0.9 m) |
| **Lbs. O2/lb. BOD5** | = 1.25 | |
| **Lbs. O2/lb. TKN** | = 4.60 | |
| **Actual Oxygen Required:** | = 181 lbs./Day | = (82.1 kg/Day) |
| **Air Flowrate/Basin:** | = 154 SCFM | = (4.4 Sm3/min) |
| **Max. Discharge Pressure:** | = 8.4 PSIG | = (58 KPA) |
| **Avg. Power Required:** | = 181.2 KW-Hrs/Day | |

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**SECTION 01680**

**PHYSICAL CHECKOUT; SHOP, FIELD AND FUNCTIONAL TESTING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The physical inspection and testing requirements in this Section are in addition to those requirements defined in the individual technical specification sections. This testing shall be performed during Contract Closeout.

B. Provide the following checkout and testing activities:

1. Physical checkout and inspection of equipment and materials to verify conformance of the installed equipment and materials as indicated and as specified.
2. Shop Testing of equipment as specified in the sections of Division 2 through 16 and as specified herein.
3. Field Testing of equipment as specified in the sections of Divisions 2 through 16 and as specified herein.
4. Functional Testing of equipment as specified in the sections of Divisions 2 through 16 and as specified herein.
5. Provide a Checkout Plan covering the entire checkout and testing process as specified herein.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

D. This section shall apply to all components of the facility except as otherwise specified in other sections.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Shop Testing: Is defined as testing that is done by the Supplier or Manufacturer, either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment supplied under the Contract meets the requirements of the pertinent technical specification(s).
11. Field Testing: Is defined as testing that is performed by the Contractor, on equipment supplied under the Contract after its been installed in the Work, and after the performance of physical checkout, for the purpose of proving that the tested equipment meets the requirements of the pertinent technical specifications.
12. Physical Checkout: Is defined as the process of physically inspecting equipment after it has been installed in the Work to determine if the equipment has been properly and completely installed and is ready for Field and/or Functional Testing.
13. Functional Testing: Is defined as testing performed on a "system" normally comprised of two or more pieces of equipment, after the equipment has been installed in the Work, and after Physical Checkout and Field Testing has been completed, for the purpose of proving that the system meets requirements as specified and as indicated.
14. Supplier's Representative: Sometimes referred to in the technical specifications as a Factory-Trained Service Representative, is defined as a person, or persons provided by the Supplier, who is qualified by having the training and experience, to provide technical and/or process related advice, and/or assistance, relating to the installation or utilization of the Products provided by that same Supplier, for installation and utilization in the Work.
15. The Testing and Checkout Coordinator: Is defined as the person provided by the Contractor to coordinate and oversee the total spectrum of testing and inspection activities required by the Contract Documents. The Testing and Checkout Coordinator shall have been in responsible charge of two similar Projects in the last four years.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - ROLES AND RESPONSIBILITIES**

A. Provide all outside services, materials, labor, supplies, test equipment and other items necessary to perform the testing specified herein. In addition, arrange for and provide the participation or assistance of survey crews, quality control technicians, Supplier's representative(s), and required governmental agency representatives.

B. Provide the services of the Supplier’s representative(s) for the following activities:

1. Assistance during installation.
2. Shop Testing
3. Field Testing
4. Functional Testing

C. The Supplier's representatives activities required by this Section are in addition to the requirements for vendor training and other services specified elsewhere in the Contract Documents. Timing for the performance of these services are to be defined in the Contractors Checkout Plan, specified herein.

D. The Owner will review and comment on the Contractor’s deliverables, participate in the physical inspection activities, witness the shop and field testing, and witness functional testing. The Owner’s right to perform inspections, witness tests or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the Work.

**1.08 - CHECKOUT PLAN**

A. Submit a Checkout Plan based upon the requirements defined herein to the Owner. Six copies of the Checkout Plan (preliminary) shall be submitted for review 90 days prior to the proposed date of the first test. The plan shall define:

1. The performance of physical inspections, shop, field and functional tests including:
    a. A chronological schedule of all testing and inspection activities.
    b. A checklist of all inspection and testing activities broken down by location, discipline, system, and device or item.
    c. All blank forms proposed by the Contractor for verification or recording of the shop testing.
    d. An index which cross references the forms to their intended application(s).
    e. A list of all shop tests, and supplier certifications, including those required by the applicable technical specifications. Provisions shall also be included for retesting, in the event it is required.
2. Participants in the testing.
3. Special test equipment.
4. Sources of the test media (water, power, air.)
5. The proposed method of delivery of the media to the equipment to be tested.
6. Temporary or interim connections for the sequencing of multiple units.
   Ultimate disposal of the test media.

B. The plan shall be reviewed by the Owner, modified or revised as necessary by the Contractor, then re-reviewed by the Owner. The Contractor shall continue to update the checkout plan, working in conjunction with the Owner prior to the start of the scheduled equipment checkout and functional testing activities as specified herein. Each specific element of the plan must receive review or comment by the Owner two weeks prior to the actual commencement of testing as defined herein.

C. The Contractor shall designate, in the checkout plan, a Testing and Checkout Coordinator, to coordinate and manage the activities defined in the checkout plan.

**1.09 - SHOP AND FIELD TESTING REQUIREMENTS**

A. In the event no reference to procedures are made, or no procedures for shop and field testing are contained in a technical specification for the following test parameters, the following shall be the checkout requirements. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements for checkout testing.

B. Hydrostatic Testing:

1. AWWA C600 standards latest edition are the standards for all hydrostatic testing.

2. Visually inspect all welds prior to testing, for cracks, undercut on surface greater than 1/32-in. deep, lack of fusion on surface, reinforcement greater than Table 127.4.2 located in ANSI B31.1 Power Piping, and incomplete penetration (when accessible). Repair or rework as directed by the Owner, at no additional cost to the Owner.

3. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90 percent of its yield strength at test temperature.

4. After 10 minutes of full hydrostatic test pressures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.

5. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.

6. Pressure holding time shall be 10 minutes plus the time required to inspect for leakage.

7. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

**1.10 - WITNESSING OF TESTS**

A. Provide 30 days written notice to the Owner so that the Owner, may witness the Contractor's Shop, Field, and Functional tests. The Owner may witness the performance of any or all tests, at their option.

**1.11 - SHOP TESTING**

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty (30) days written notice indicating the time and place of testing. Submit the following for review thirty days prior to this notice:

1. Description of the test: Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Resumes, qualifications, and experience shall be submitted. Personnel shall have three (3) years' experience with the manufacture and operation of the equipment to be tested and will have participated in 5 similar tests during this period of experience.

4. Schedule for testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.

5. Test forms: Submit all forms used to record and report on Shop Test data, for review, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have met the required criteria, and that the equipment will operate as indicated and specified.

B. Shop test procedures will be reviewed and returned by the Owner within 30 days of receipt. Incorporate comments on the procedures, equipment, or personnel prior to testing. Comments by the Owner will require a resubmission of the shop test procedure and proposed test date.

C. Submit the following within one week after completion of the tests for review:

1. Complete test forms, for each device tested, on forms as reviewed prior to the test.

2. Completed certification, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required. Perform any retesting required to fulfill the technical specification test requirements at no additional cost to the Owner. Additional travel required by the Owner to witness retesting shall be provided by the Contractor, at no additional cost to the Owner. Reimbursement for travel expenses required for retesting will be applied as a debit against the Contractor's subsequent Application for Payment.

**1.12 - FIELD TESTING OF EQUIPMENT**

A. When required by the technical specifications, perform field testing on installed equipment. Field testing shall be in addition to, and not in lieu of, any shop testing either required or otherwise performed. Perform field testing as a part of the overall physical and functional testing process defined herein and in accordance with the reviewed checkout plan. However, the following specific instructions shall also apply. Provide ninety (90) days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces. Submit with this notice the following for review by the Owner:

1. Description of the tests: Specifically outlining how the test will conform to the requirements in the technical specifications.

2. Testing devices that will be used in the tests: Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Submit resumes, qualifications, and experience. Personnel must have three years experience with the manufacture and operation of the equipment to be tested and will have participated in five similar tests during this period of experience which shall have occurred over the last five years.

4. Schedule of Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.

5. Test forms: Submit Contractor provided test forms to the Owner for recording and reporting on the Field Test data, prior to the test.

6. Material and equipment required for the test: This material and equipment shall be supplied at no additional cost to the Owner.

7. Water and Power For Field Testing: Water and power for field testing shall be provided by the Contractor at no additional cost to the Owner. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water. When testing is performed with water during freezing conditions the Contractor shall take measures to prevent damage to the Work caused by freezing of the water.

8. Provide seven days written notice to the Owner prior to the actual start of any testing. This will include a statement by the Contractor that the equipment and facilities to be tested have been thoroughly inspected and cleaned of construction debris or other extraneous materials and all lubrication, materials, and preparations are completed.

B. Field test procedures will be reviewed and returned by the Owner within 30 days of receipt. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Owner will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Owner if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Owner for review:

1. Completed test forms, for each device tested, on forms provided prior to the tests.

2. Completed certification documentation, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

**1.13 - PHYSICAL CHECKOUT AND INSPECTIONS**

A. Physical Checkout and inspections provide verification of conformance to the requirements of the technical specifications and contract drawings for physical presence; dimensions; and location, for proper materials, parts, and items; and for integrity of materials, equipment and systems to determine their condition and readiness for field and/or functional testing, and for Substantial Completion. Inspection includes the following elements, where applicable:

1. Exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, gates, and signage.

2. Building structural integrity, masonry, architectural, mechanical systems, electrical/lighting, communications, and HVAC systems.

3. Concrete structures for structural integrity, finish, tolerance, durability, appearance, embedded and inserted items, painting and surface applications.

4. Steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.

5. Mechanical systems and items for installation, alignment and securing, adjustments of packing and seals, lubrication, drive connection and alignment, motor rotation, belt/chain tension, painting or surface applications, and tagging for identification.
Piping systems for material, size, components, direction, alignment of joints and bolting/welding, valves, packing and seals, screens, filters and strainers, painting, identification labeling and color coding, hangers, anchors, supports, and expansion provisions.

6. Electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit identification, terminal installation and identification, major switches, circuit breakers and components, and labeling for system identification.

7. Communication systems including telephone, fire/smoke alarm, security, page/party; similar to electrical above.

8. Computer systems by station, function, and network interface.

B. Tanks, pipes, conduits, vessels, equipment, systems, buildings, areas and other items provided under the contract must be clean and free from debris or materials which will interfere with subsequent testing requirements or routine operations.

C. Upon completion of the inspection, submit to the Owner six copies of each completed inspection form, developed by the Contractor and reviewed by the Owner prior to the inspection, signed by an authorized representative of the Contractor who participated in the inspection. The Owner will review and comment on the contents of the forms. A copy of each reviewed inspection form will be provided to the Owner. Should a re-inspection be required, it shall be performed at no additional cost to the Owner

**1.14 - FUNCTIONAL TESTING**

A. When listed in Part 4, Appendix A of this section, specific functional tests shall be performed in addition to the requirement for shop, field, and other tests called for in the technical specifications. Functional tests will be performed with fluid or gaseous substances that are generally non-septic, non-corrosive, non-toxic, and non-inflammable.

B. Provide thirty (30) days written notice indicating the date and time during which the specific functional test is proposed. Submit with this notice, the following to the Owner for review:

1. Changes to the test procedures (if any) outlined in the technical specifications.

2. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Submit resumes, and qualifications. Personnel must have three years experience with the operation of the equipment and/or system to be tested and have participated in five similar tests during this period of experience.

4. Schedule for Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or system test failure.

5. Test forms: Submit test forms for review by the Owner for recording and reporting on the test data prior to the test.

6. List of material and equipment required for the test. This material and equipment will be in addition to that specified in SECTION 01600, CONTROL OF MATERIALS.

C. Operational requirements: Include valve positions, set-ups, and gate positions that are required to run the tests in the written request so that the Owner can anticipate and plan for the testing. Provide all temporary piping, connections or other temporary requirements related to performance of the functional tests including water and power.

D. The Owner may witness these tests, at their option. Provide seven (7) days written notice to the Owner prior to the actual start of any testing. This will include a statement by the Contractor that the equipment and facilities to be tested have been thoroughly inspected and cleaned of construction debris or other extraneous materials and all lubrication, materials, and preparations are completed.

E. Review of the functional test plan and requirements as provided in Part B above by the Owner will be made within two weeks of the test date. Incorporate comments on the procedures, equipment, and personnel prior to testing.

F. Submit within one week after completion of the tests, the following to the Owner for review:

1. Completed test forms, for each device, or system tested, on forms reviewed prior to the test.

2. Completed certification, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required, including changes to procedures, testing devices, or personnel. Any retesting required to fulfill the intent of the test requirements, due to negligence, poor workmanship, or Products that fail to meet the Contract requirements, shall be at no additional cost to the Owner.

**1.15 - CORRECTIONS TO THE WORK**

A. Correct any items of Work failing to meet the specified requirements, at no additional cost to the Owner. Correct the nonconforming items by re-work, modification, or if the equipment fails to pass the specified requirements after three testing attempts, replace the items. This includes the provision of all required labor, materials, and requirements for retesting as specified herein, to verify that the items conform with Contract Documents.

**1.12 - SAFETY**

A. Conduct all specified test procedures in compliance with all applicable safety standards and regulations.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION – Not Used**

**END OF SECTION**

**SECTION 01700**

**CONTRACT CLOSEOUT**

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1.01 SCOPE ..... 1
1.02 MEASUREMENT AND PAYMENT ..... 1
1.03 DEFINITIONS ..... 1
1.04 SUBMITTALS – Not Used ..... 2
1.05 SPECIAL REQUIREMENTS – Not Used ..... 2
PART 2 - PRODUCTS – Not Used ..... 2
PART 3 - EXECUTION ..... 2
3.01 CLOSEOUT PROCEDURES ..... 2
3.02 FINAL CLEANING ..... 2
3.03 ADJUSTING ..... 2

## PART 1 - GENERAL

### 1.01 - SCOPE

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to: Closeout procedures; Final Cleaning; and Adjusting.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - SPECIAL REQUIREMENTS – Not Used**

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - CLOSEOUT PROCEDURES**

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payment and sum remaining due.

**3.02 - FINAL CLEANING**

A. Complete the following cleaning operations, as applicable, before requesting inspection for Certification of Substantial Completion.

1. Remove labels that are not permanent labels.
2. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean.
3. The installing Subcontractor shall wipe surface of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
4. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

**3.03 - ADJUSTING**

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

**END OF SECTION**

**SECTION 01710**

**CLEANING UP**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS – Not Used ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 2
1.06 - DESIGN CRITERIA – Not Used ..... 2
1.07 - SPECIAL REQUIREMENTS – Not Used ..... 2
PART 2 - PRODUCTS – Not Used ..... 2
PART 3 - EXECUTION ..... 2
3.01 – CONTRACT CLOSEOUT ..... 2

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, equipment, tools, and materials necessary for the performance of all cleaning up the project sites, as specified herein, and as shown on the drawings.

1. During its progress, the work and the adjacent areas affected thereby shall be cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

2. Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

3. On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

4. The Contractor shall thoroughly clean all materials and equipment installed by him and his sub-contractors, and on completion of the work shall deliver it undamaged and in fresh and new-appearing condition. All mechanical equipment shall be left fully charged with lubricant and ready for operation.

5. The Contractor shall restore or replace, when and as directed, any public or private property damaged by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable as work progresses and shall not be left until the end of the contract period.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - SPECIAL REQUIREMENTS – Not Used**

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 – CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 01740**

**WARRANTIES AND BONDS**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 3
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1.07 - REFERENCED STANDARDS – Not Used ..... 3
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PART 2 - PRODUCTS AND SERVICES – Not Used ..... 3
PART 3 - EXECUTION ..... 3
3.01 - CONTRACT CLOSEOUT ..... 3

## PART 1 - GENERAL

### 1.01 - SCOPE

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
11. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit written warranties to the Owner prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Owner.
2. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within fifteen days of completion of that designated portion of the Work.
3. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Engineer for approval prior to final execution.
4. Refer to individual Sections of DIVISION 2 through DIVISION 16, inclusive, for specific content requirements, and particular requirements for submittal of special warranties.
5. At Final Completion, compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
6. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-in. by 11-in. paper.
7. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section in which specified, and the name of the product or work item.
8. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer, supplier, and manufacturer.
9. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name, address, and telephone numbers of the Contractor and equipment supplier.
10. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.
11. Schedule of Special Warranties

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - REFERENCED STANDARDS – Not Used**

**1.08 - WARRANTY REQUIREMENT**

A. Related Damages and Losses - When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty - When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost - Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse - Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights or remedies.

E. Rejection of Warranties - The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. Disclaimers and Limitations - Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

G. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

**PART 2 - PRODUCTS AND SERVICES – Not Used**

**PART 3 - EXECUTION**

**3.01 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 01900**

**SEISMIC AND WIND REQUIREMENTS**

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1.08 - SEISMIC AND WIND DESIGN REQUIREMENTS ..... 3
1.09 - SPECIFIC COMPONENTS ..... 3
PART 2 – PRODUCTS – Not Used ..... 3
PART 3 – EXECUTION – Not Used ..... 3

## PART 1 - GENERAL

### 1.01 - SCOPE

A. This section establishes the minimum seismic and wind loading design requirements for architectural, mechanical, electrical and non-structural components.

B. The Contractor shall be responsible for compliance with the seismic and wind requirements specified including conformance by all Subcontractors, manufacturers and Suppliers.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Components are defined as systems, equipment, parts, or other elements, including supporting structures and attachments.
11. The reference Building Code is the building code cited on the structural drawings or specified herein for the design of the basic structure.
12. The specified seismic criteria is defined as the seismic criteria cited on the structural drawings or specified herein for the design of the basic structure.
13. The specified wind criteria is defined as the wind criteria cited on the structural drawings or specified herein for the design of the basic structure.
14. The specified wind criteria is defined as the wind criteria cited on the structural drawings or specified herein for the design of the basic structure.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Where specified in the technical specifications, provide and complete the Certificate of Unit Responsibility form in SECTION 01300, SUBMITTALS and submit to Engineer prior to manufacture of components.
2. In addition, submit the following support data along with Certificate of Unit Responsibility:
    a. Certification, signed and sealed by a Professional Structural Engineer registered in the jurisdiction in which the project is located stating that all systems, equipment, and other elements, including supporting structures, attachments and connections are designed to withstand the required seismic and wind forces and displacements.
    b. Codes and specifications to which structural design conforms.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - REFERENCES**

A. American Society of Civil Engineers (ASCE):

1. ASCE/SEI 7: Minimum Design Loads for Buildings and Other Structures

B. American Society of Mechanical Engineers (ASME):

1. B31: Code for Pressure Piping

C. International Code Council (ICC):

1. International Building Code

D. Manufacturers Standardization Society of the Valve and Fitting Industry:

1. SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

E. National Fire Protection Association (NFPA):

1. Standard for the Installation of Sprinkler Systems

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - SEISMIC AND WIND DESIGN REQUIREMENTS**

A. Refer to structural drawings for project specific seismic and wind requirements and also conform to the requirements specified herein.

B. Seismic and wind design shall conform to the International Building Code and ASCE/SEI 7.

C. Architectural, mechanical, electrical and non-structural components shall be designed and constructed to resist the seismic and wind forces and displacements based upon ASCE/SEI 7, the reference building code, and the specified seismic and wind criteria. In the case of conflict the more stringent requirements shall govern.

D. The interrelationship of components and their effect on each other shall be such that the failure of one component shall not cause the failure of any other component.

E. Components shall be anchored to the building structure to transfer seismic and wind forces. Connections shall be bolted, welded or otherwise positively anchored to the structure. Anchorage shall not rely on friction for force transfer.

F. Post-installed anchors in concrete shall be prequalified for seismic applications in accordance with ACI 355.2, ICC-ES AC-193, or ICC-ES AC-308. Drop-in anchors are prohibited for concrete anchorage.

G. Post-installed anchors in masonry shall be prequalified for seismic applications in accordance with ICC-ES AC-01, or ICC-ES AC-58. Drop-in anchors are prohibited for masonry anchorage.

H. Exceptions: Exemption from the requirements for seismic and wind analysis and design are permitted only to the extent permitted by applicable codes and standards.

**1.09 - SPECIFIC COMPONENTS**

A. Compound Equipment: Connecting elements for equipment combinations such as pumps and motors, valves and operators, engines and generators, etc. which are not capable of transferring seismic and/or wind loads or accommodating seismic and wind displacements shall be protected by appropriate design.

B. Storage Tanks: Tanks, supporting structures and anchorages shall be designed for the weight of the tank, appurtenances and the tank contents at the maximum capacity. Tank contents shall not be considered in resistance to seismic and wind loads.

C. Ductwork: Equipment installed within ductwork shall be independently supported and braced. Support and bracing of heating and cooling coils shall account for the weight of the contents.

D. Piping Systems: Support and bracing of piping systems shall account for the weight and hydrodynamic effects of the contents.

E. Pressure Piping: Pressure piping support and bracing shall conform to ASME B 31 in addition to the force and displacement requirements of the reference code.

F. Sprinkler Systems: Sprinkler system support and bracing shall conform to NFPA 13 in addition to the force and displacement requirements of the reference code.

G. General Supports: Pipe, duct, raceways and cable tray supports and bracing shall conform to the AISC Manual of Steel Construction and MSS SP-58 in addition to the force and displacement requirements of the reference code.

**PART 2 – PRODUCTS – Not Used**

**PART 3 – EXECUTION – Not Used**

**END OF SECTION**

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**SECTION 02100**

**SITE PREPARATION**

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1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS – Not Used ..... 2
1.05 - PRODUCT HANDLING – Not Used ..... 2
1.06 - DESIGN CRITERIA ..... 2
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PART 2 - PRODUCTS – Not Used ..... 2
PART 3 - EXECUTION ..... 3
3.01 - GENERAL REQUIREMENTS ..... 3
3.02 - CLEARING, GRUBBING, TREE AND STUMP REMOVAL ..... 3
3.03 - DISPOSAL OF WASTE MATERIALS ..... 3
3.04 - SEDIMENT AND EROSION CONTROL ..... 4
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, equipment, tools, and materials necessary for the performance of all operations in connection with clearing and grubbing, and the removal of pavement, curbing and all incidental and appurtenant work pertaining thereto, as specified herein, and as shown on the drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS – Not Used**

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - SPECIAL REQUIREMENTS**

A. Prior to the performance of any work of this section or any related work required by other sections of the specifications, the Limit of Work Line shall be laid out and staked in the field by the Contractor, according to the drawings. The Contractor shall be responsible for maintaining the Limit of Work Line during the construction operation.

B. At all times throughout the duration of this contract, the Contractor shall be responsible for the appearance and condition of the area within and surrounding the project site. The Contractor shall repair or replace, at no additional expense to the Owner, any structures, either natural or man-made such, as but not limited to, utilities, trees, plants, water bodies, and pavements that are damaged or destroyed by any actions or sequences of events related to the Contractor's operations.

C. Any existing plant materials designated to be saved, protected and/or undisturbed, that are cut or damaged without prior approval of the Engineer, shall be replaced in kind and size by the Contractor, at no expense to the Owner. If the Engineer agrees that tree replacement is impossible or impractical, the Contractor shall pay the Owner damages of One Thousand Five Hundred Dollars ($1,500.00) per inch of diameter measured four (4) feet from the ground surface.

D. Disposal of waste/surplus materials may involve securing permits, licenses, or approvals, which may vary according to the type of material to be disposed of prior to the start of construction. The Contractor shall apply for these, as they may be required by the various governing agencies and pay all required fees. The Contractor shall have sole responsibility for the legal disposal of all waste surplus material of this project. The Contractor shall be responsible for any and all fines due to any illegal activity with regards to the disposal of waste/surplus materials.

**PART 2 - PRODUCTS – Not Used**

## PART 3 - EXECUTION

### 3.01 - GENERAL REQUIREMENTS

A. All graded areas, and all areas within the Limit of Work Line on which proposed work is to be installed, shall be cleared and grubbed as indicated on the drawings.

B. The Contractor shall be careful to note any areas that may be designated on the drawings to receive only selective clearing and thinning.

### 3.02 - CLEARING, GRUBBING, TREE AND STUMP REMOVAL

A. Trees

1. Preparation of the site shall include the complete removal of all trees within the Limit of Work Line, except in those areas where selective clearing and thinning is required. Any trees within the Limit of Work Line not to be removed shall be protected from damage during clearing and construction operations by barriers or by such other methods as conditions may require. No construction materials or debris shall be stored or stockpiled, or vehicles parked or operated within the limits of the branch spread of the trees to be saved.

2. Clearing operations shall be performed in a manner which will prevent damage by falling trees to trees left standing or to structures under construction, and by methods which will provide for the safety of employees and other persons.

3. Limited clearing and thinning shall be performed in areas identified on the drawings, as required or as directed by the Engineer. This work will involve the removal of brush, small trees, dead, damaged and/or diseased trees. The Engineer will tag or otherwise mark and designate trees and brush to be saved. Where branches of trees which are to be saved interfere with the work, limbs and branches shall be trimmed off neatly and cleanly close to the bole of the tree or to main branches. Cut surfaces shall be painted with a tree wound paint. Pruning shall be done in accordance with the National Arborist Association "Pruning Standards for Shade Trees" and only by persons experienced with this work. The Contractor shall legally dispose of all branches and limbs off site.

4. All trees, above a four-inch caliper, which are designated to be removed shall become the property of the Contractor to be disposed of by sale or otherwise, provided that such material shall be removed from the property of the Owner before the completion of the site clearance work. The Owner assumes no responsibility for the protection and safekeeping of such materials. The Contractor shall be responsible for all taxes, if any, incurred in the sale of materials.

B. Grubbing shall consist of the grubbing up, removal and disposal of all stumps, roots larger than 1-1/2 inches in diameter, and matted root formations from the designated areas. All rocks or boulders near the existing surface grade, which may interfere with planned construction operations, shall be removed and disposed of as surplus/waste material, or used as fill, where specifically permitted by the Engineer.

### 3.03 - DISPOSAL OF WASTE MATERIALS

A. All cleared and grubbed materials shall be legally disposed of off-site by the Contractor. Burning of cleared and grubbed materials is not permitted.

B. 500 Cubic yards of pavement millings shall be disposed of at the Orleans Public Works Department, 40 Giddiah Hill Road, Orleans, MA 02563. The remaining pavement millings shall be legally disposed of off-site by the contractor.

C. All waste materials shall be legally disposed of off-site by the Contractor.

**3.04 - SEDIMENT AND EROSION CONTROL**

A. The Contractor shall take such actions as may be required to ensure that his construction activities do not interfere with or adversely impact the hydraulic characteristics or aesthetic qualities of any natural or manmade watercourse or drain.

B. The Contractor shall provide acceptable siltation control devices such as straw bales and/or straw wattles sediment control devices; control basins for the settling and filtering of fine sands, silts and clay resulting from rainfall runoff or dewatering operations. Any natural areas or manmade structures which have been affected by siltation or erosion due to construction activities shall be restored to their pre-construction condition by the Contractor at no additional cost to the Owner.

C. For more specific requirements for control of erosion and siltation, refer to SECTION 01140, ENVIRONMENTAL PROTECTION.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02140**

**DEWATERING**

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1.06 - PROJECT/SITE CONDITIONS ..... 4
PART 2 - PRODUCTS ..... 4
2.01 - MATERIALS ..... 4
PART 3 - EXECUTION ..... 4
3.01 - EXECUTION ..... 4
3.02 - CONTRACT CLOSEOUT ..... 5

## PART 1 - GENERAL

### 1.01 - SCOPE

A. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and permit work to be performed under dry and stable conditions. Work to be done as part of dewatering includes, but is not limited to:

1. Lower the groundwater level.
2. Lower hydrostatic pressure.
3. Prevent surface water from entering the excavation and other work areas on the project during construction.
4. Control and remove seepage, surface water, and precipitation in excavations and/or work areas.
5. Implement erosion control measures for disposing of discharge water.
6. Provide and monitor observation wells and geotechnical instrumentation as specified.

B. Groundwater within the excavation area shall be lowered to at least 2 feet below the lowest excavation levels as specified and as indicated.

C. Common dewatering methods include, but are not limited to, sump pumping, deep wells, well points, vacuum well points or any combinations thereof.

D. The Contractor shall obtain the required permits for discharge from the Contractor’s dewatering systems in accordance with 40 CFR Part 122 and 61 FR 19284. The discharge location shall be in accordance with permit requirements.

E. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Brochures and/or Catalogue Cuts of All Materials.
2. Qualification of the Contractor’s dewatering specialist's or firm's qualifications a minimum of four (4) weeks prior to execution of any dewatering. The submittal shall include, but not be limited to:
    a. Qualifications of specialist's or firm's Registered Professional Engineer in the Commonwealth of Massachusetts and as specified in Paragraph 1.07.
    b. Qualifications of specialist's or firm's field representative, as specified in Paragraph 1.07, who shall oversee the installation, operation and maintenance of the dewatering system.
3. Submit a dewatering plan at least two weeks prior to start of any dewatering operation. Do not submit design calculations. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:
    a. Dewatering plan and details stamped and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts.
    b. Certificate of Design: Refer to SECTION 01300, SUBMITTALS.
    c. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.
    d. Detailed description of dewatering, maintenance, and system removal procedures.

e. Monitoring plan and details, including, but not limited to, number and locations of observation wells, and geotechnical instruments such as settlement markers and piezometers, and frequency of reading the monitoring devices.

f. Erosion/sedimentation control measures, and methods of disposal of pumped water.

g. List of all applicable laws, regulations, rules, and codes to which dewatering design conforms.

h. List of assumptions and mode for design of dewatering, including but not limited to groundwater levels, soil profile, permeabilities, and duration of pumping.

i. The proposed methods for removing the dewatering system elements, including method to ensure that no significant ground movements will occur as a result of extraction that could adversely impact any structures. If deemed necessary, the Contractor shall describe locations of, or conditions under which dewatering systems will be left in place, including proposed cutoff levels and methods for tremie grouting the wells or well points.

4. Measurement records consisting of observation well groundwater records and the geotechnical instrumentation readings within one day of monitoring.

5. A modified dewatering plan within 24 hours, if open pumping from sumps and ditches results in boils, loss of fines or softening of the ground.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance.

B. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

C. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials and equipment shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with Section 01400, and as specified.

B. Employ the services of a dewatering specialist or firm having the following qualifications:

1. Have completed at least five (5) successful dewatering projects of equal size and complexity and with equal systems within the last five (5) years.

2. Retain the services of a Registered Professional Engineer registered in the Commonwealth of Massachusetts and having a minimum of five (5) years experience in the design of well points, deep wells, or equal systems.

3. Retain the services of a field representative having a minimum of 5 years experience in installation of well points, deep wells, or equal systems.

C. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Engineer, stabilize the subgrade, and modify system to perform as specified at no additional cost to the Owner.

D. Notify the Engineer immediately if any settlement or movement is detected on structures. If the settlement or movement is deemed by the Engineer to be related to the dewatering, take actions to protect the adjacent structures and submit a modified dewatering plan to the Engineer within 24 hours. Implement the modified plan and repair any damage incurred to the adjacent structures at no additional cost to the Owner.

E. If oil and/or other hazardous materials are encountered after dewatering begins, immediately notify the Engineer.

**1.06 - PROJECT/SITE CONDITIONS**

A. Subsurface Conditions: Refer to Appendix A.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Provide observation wells, settlement markers, piezometers and/or any other geotechnical instruments in accordance with the submitted dewatering plan or as specified.

B. Provide casings, well screens, piping, fittings, pumps, power and other items required for dewatering system.

C. Provide sand and gravel filter around the well screen. Wrapping geotextile fabric directly around the well screen shall not be allowed.

D. When deep wells, well points, or vacuum well points are used, provide pumping units capable of maintaining high vacuum and handling large volumes of air and water at the same time.

E. Provide and store auxiliary dewatering equipment, consisting of pumps and hoses on the site in the event of breakdown, at least one (1) pump for every five (5) used.

F. Provide and maintain erosion/sedimentation control devices as indicated or specified and in accordance with the dewatering plan.

G. Provide temporary pipes, hoses, flumes, or channels for the transport of discharge water to the discharge location.

H. Provide cement grout having a water to cement ratio of 1 to 1 by volume.

**PART 3 - EXECUTION**

**3.01 - EXECUTION**

A. Execution of any earth excavation, installing earth retention systems, and dewatering shall not commence until the related submittals have been reviewed by the Engineer with all Engineer's comments satisfactorily addressed and the geotechnical instrumentation has been installed.

B. Furnish, install and maintain dewatering system in accordance with the dewatering plan.

C. Permanent utilities and piping shall not be used as part of the dewatering system.

D. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.

E. Do not excavate until the dewatering system is operational.

F. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below groundwater level have been completed such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

G. Discontinue open pumping from sumps and ditches, if such pumping is resulting in boils, loss of fines, softening of the ground, or instability of the slopes. Modify dewatering plan and submit to the Engineer at no additional cost to the Owner.

H. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials in accordance with SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING at no additional cost to the Owner.

I. Dewatering Discharge

1. Install sand and gravel filters in conjunction with well points and deep wells to prevent the migration of fines from the existing soil during the dewatering operation.
2. Transport pumped or drained water to discharge location without interference to other work, damage to pavement, other surfaces, or property.
3. Provide separately controllable pumping lines.
4. The Engineer reserves the right to sample discharge water at any time.
5. Immediately notify the Engineer if suspected contaminated groundwater is encountered. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations.

J. Monitoring Devices and Records

1. Install, maintain, monitor and take readings from the observation wells and geotechnical instruments in accordance with the dewatering plan.
2. Install settlement markers on structures within the zone of influence for dewatering a distance equal to twice the depth of the excavation, from the closest edge of the excavation. Conduct and report settlement surveys to 0.01 feet.
3. For linear excavations such as trenches, the zone of influence for dewatering shall be established by the Contractor's specialist based on the soil conditions and depth of dewatering.
4. For large rectangular, square or circular mass excavations the zone of influence shall be defined by the actual cone of watering influence corresponding to a 10 percent increase in effective vertical stress.

K. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the dewatering plan.

L. Removal

1. Do not remove dewatering system without written approval from the Engineer.
2. Backfill and compact sumps or ditches with screened gravel or crushed stone wrapped with geotextile fabric in accordance with SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.
3. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02160**

**EXCAVATION SUPPORT SYSTEMS**

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3.03 - REMOVAL OF EARTH RETENTION SYSTEM ..... 8
3.04 - CONTRACT CLOSEOUT ..... 8

## PART 1 - GENERAL

### 1.01 - SCOPE

A. Design, furnish and install excavation support systems as required to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, railroads and other facilities.

B. The requirement of sheeting left in place in areas indicated on the drawings does not relieve the Contractor from the responsibility of furnishing and installing proper excavation support systems in other areas.

C. Common types of excavation support system include, but are not limited to, singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheet pile wall, timber sheet pile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

D. Wherever the word "sheeting" is used in this section or on the contract drawings, it shall be in reference to any type of excavation support system specified except trench box.

E. Construction of the excavation support systems shall not disturb the existing structures or the completed proposed structures. Damage to such structures shall be repaired by the Contractor at no additional cost to the Owner.

F. Adjacent structures are those that bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures as specified and indicated.

G. Vibration monitoring for excavation support systems will be performed by Contractor's vibration consultant and monitoring firm. Vibration due to Contractor's operations shall not exceed thresholds specified herein.

H. Construction operations not to exceed specified noise limits in accordance with SECTION 01110, ENVIRONMENTAL PROTECTION PROCEDURES.

I. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the excavation support systems. The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the Owner.

J. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit the following qualifications four (4) weeks prior to the construction:

a. Qualifications of independent vibration consulting and monitoring firm as specified in Paragraph 1.07 D.

b. Qualifications of Contractor's excavation support system designer as specified in Paragraph 1.07 G.

c. Qualifications of Contractor's excavation support system installer as specified in Paragraph 1.07 H.

d. Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph 1.07 I, if a tieback system is utilized.

e. Qualifications of Contractor's excavation support system installation supervisor as specified in Paragraph 1.07 J.

f. Qualifications of vacuum excavation subcontractor as specified in Paragraph 1.07 F, if deformation monitoring points (DMPs) for utilities are utilized.

2. Submit an excavation support plan stamped and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts, at least two weeks prior to start of the construction. Do not submit design calculations. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

   a. Proposed excavation support system(s), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

   b. Certificate of Design: Refer to SECTION 01300, SUBMITTALS.

   c. A list of all design assumptions, including safety factors used for the excavation support system(s) and all lateral pressures used for each system.

   d. If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Engineer for information only.

   e. Requirements of dewatering during the construction.

   f. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

   g. List of equipment used for installing the excavation support systems.

   h. Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, geotechnical instrumentation (deformation monitoring points, inclinometers, etc.) and observation wells/piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period.

3. Submit a Construction Contingency Plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

4. Monitoring data within one (1) day of data collection from vibration and noise recording equipment, observation wells, deformation monitoring points and offset lines. Data shall include:

   a. Horizontal and vertical movements of geotechnical instruments and groundwater readings.

   b. New movements since the initial readings of the geotechnical instruments.

   c. Weekly summary in tabular and graphic form at the end of each week.

   d. A schematic plan of excavation and/or relevant construction activities at the time of monitoring.

5. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

    a. Survey locations of the temporary excavation support systems, including coordinates of the ends and points of change in direction.

    b. Type of the excavation support system.

    c. Elevations of top and bottom of the excavation support systems left in place.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. Design of excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.

2. Design a bracing system to provide sufficient reaction to maintain stability.

3. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced excavation support systems shall not be less than 5 feet below the bottom of the excavation.

5. Design temporary excavation support systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

6. Maximum width of pipe trench excavation shall be as indicated on the drawings.

7. Do not cast permanent structure walls directly against excavation support walls.

8. The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

C. Construction operations to conform to noise regulations provided in the Noise Control Plan and as required by local regulations.

D. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

1. Preparing, reviewing and signing of monitoring plans and daily reports, and overseeing of the monitoring and interpretation of the vibration data shall be performed by personnel with the following qualifications:

   a. Be a Registered Professional Engineer in the Commonwealth of Massachusetts.

   b. Have a minimum of five (5) years' experience in the vibration consulting field.

   c. Have successfully completed at least five (5) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

2. Assist Contractor in selecting pile driving equipment which will generate the lowest vibration and noise levels.

3. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

   a. Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.

   b. Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

E. The peak particle velocity for pile driving, or other vibration-inducing operations, shall not exceed the following:

| **Type of Concrete** | **Age of Concrete hrs.** | **Peak Particle Velocity in/sec** |
|---|---|---|
| Mass Concrete (footings, mats, slab-on-grade, fill concrete, etc.) | 0 – 11<br>11 and over | 1.0<br>2.0 |
| Concrete Structures (walls, columns, elevated slabs, etc.) | 0 – 11<br>11 – 24<br>24 and over | 0.5<br>1.0<br>2.0 |
| Existing Structures, residences or utilities | | 0.5 |

F. If utilizing DMPs for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

G. Prepare design, including calculations and drawings, under the direction of a Professional Engineer registered in the Commonwealth of Massachusetts and having the following qualifications:

1. Not less than ten (10) years' experience in the design of specific excavation support systems to be used.

2. Completed not less than five (5) successful excavation support system projects of equal type, size, and complexity within the last five (5) years.

H. Excavation Support System Installer's Qualifications:

1. Not less than five (5) years' experience in the installation of similar types and equal complexity as the proposed system.

2. Completed not less than five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

I. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

1. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.

2. Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.

3. Have not less than five (5) years' experience in testing of tieback systems of similar type and equal complexity as the proposed system.

4. Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

J. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:

1. Not less than five (5) years' experience in installation of systems of similar type and equal complexity as the proposed system.

2. Completed at least five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

K. All welding shall be performed in accordance with AWS D1.1.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A416: Standard Specification for Low Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

3. A572: Standard Specification for High-Strength Low Alloy Columbium Vanadium Structural Steel.

4. A722: Specification for High-Strength Steel Bars for Prestressed Concrete

5. A615: Standard Specifications for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. American Wood Protection Association (AWPA) Standards.

C. American Welding Society (AWS) Code: D1.1.

D. Federal Standard, FS TT-W-571 and Supplements: Wood Preservation and Treating Practices.

E. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.

F. American Concrete Institute (ACI)

1. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PROJECT/SITE CONDITIONS**

A. Subsurface Conditions: Refer to SECTION 01310, MISCELLANEOUS TESTING AND SOIL DATA.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstops and accessory steel shapes shall conform to ASTM A36.

B. Steel Sheet Piling: ASTM A572, continuous interlocking type.

C. Timber Lagging Left in Place: Pressure treated per appropriate AWPA standards.

D. Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.

E. Raker Ties: ASTM A615 Grade 60.

F. Cement Grout Materials and Admixtures for Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi at 7 days and 5000 psi at 28 days.

G. Concrete: SECTION 03300, CAST-IN-PLACE CONCRETE.

H. Tamping tools adapted for backfilling voids after removal of the excavation support system.

I. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

**2.02 - EQUIPMENT**

A. The sheetpile driving equipment shall meet the vibration/noise requirements of the specifications.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Installation of the excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Engineer with all Engineer’s comments satisfactorily addressed.

B. Install excavation support systems in accordance with the excavation support plan.

C. If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Engineer. Testing performed without the Engineer present will not be accepted. Repeat testing in the Engineer's presence at no additional cost to the Owner.

D. Do not drive sheeting within 100 feet of concrete less than seven (7) days old.

E. Carry out program of excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.

F. Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.

G. Install and read geotechnical instrumentation in accordance with the excavation support plan. Notify the Engineer immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Engineer and at no additional cost to the Owner.

H. Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Contingency Plan) as required.

I. Notify utility owners if existing utilities interfere with the excavation support system. Modify the existing utility with the utility owner's permission or have the utility owner make the modifications at no additional cost to Owner.

**3.02 - GROUND DEFORMATION ADJACENT TO EXCAVATION SUPPORT SYSTEMS**

A. Allowable Vertical (heave/settlement) and Lateral Movements: 2 inches maximum for the trench box excavation support system, and 1 inch maximum for other types of excavation support systems at any location behind the excavation support system.

B. Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

C. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

D. Notify the Engineer when the allowable ground deformation is exceeded.

E. Implement Construction Contingency Plan under direction of the excavation support system designer and the Engineer.

**3.03 - REMOVAL OF EARTH RETENTION SYSTEM**

A. Sheeting shall be left in place unless otherwise indicated or approved in writing by the Engineer.

B. When indicated or approved by the Engineer, remove the excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

C. When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the work.

D. The excavation support system left-in-place shall be cut-off a minimum of 2 feet below the bottom of the next higher foundation level or a minimum of 5 feet below finished grade.

E. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02210**

**EARTH EXCAVATION, BACKFILL, FILL AND GRADING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Earth Excavation, Backfill, Fill and Grading as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Perform the following earth excavation, backfill, fill and grading as indicated or specified:

1. Make excavations to accommodate piping, conduits, foundations and other structures.
2. Provide materials for backfilling excavations and constructing embankments and fills as indicated and specified.
3. Construct embankments of compacted materials. Grade surfaces to meet finished grades indicated.
4. Immediately notify the Engineer if suspected hazardous materials are encountered and cease operations in that part of work.
5. Remove boulders within the excavation limits.

D. Existing on-site materials may be used for backfilling non-structural excavations and constructing embankments and fills.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Percentage of compaction is defined as the ratio of the field dry density, as determined by ASTM D1556 to the maximum dry density determined by ASTM D1557 Procedure C, multiplied by 100.

11. Proof Roll: Compaction with a minimum of 4 passes of a vibratory steel drum or rubber tire roller. Vibratory plate compactors shall be used in small areas where vibratory steel drum or rubber tire roller cannot be used.

12. Acceptable Material: Material which does not contain organic silt or organic clay, peat, vegetation, wood or roots, stones or rock fragments over 6-inch in diameter, porous biodegradable matter, loose or soft fill, excavated pavement, construction debris, or refuse. Stones or rock fragments shall not exceed 40 percent by weight of the backfill material.

13. Unacceptable Materials: Materials that do not comply with the requirements for the acceptable material or which cannot be compacted to the specified or indicated density.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Qualifications of the Contractor's Independent Testing Laboratory as specified in Paragraph 1.06.G, four (4) weeks prior to the execution of any earth excavation, backfilling, filling, or compaction process.

2. Submit an excavation, backfilling, and filling plan at least two weeks prior to start of any earth moving activities. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include, but not be limited to the following items:

a. Detailed sequence of work.

b. General description of construction methods.

c. Numbers, types, and sizes of equipment proposed to perform excavation and compaction.

d. Details of dust control measures.

e. Proposed locations of stockpiled excavation and/or backfill materials.

f. Proposed surplus excavated material off-site disposal areas and required permits.

g. Details of erosion and sedimentation control measures which will prevent erosion and sedimentation during the earth moving activities.

3. The following material submittals shall be submitted to the Engineer prior to backfilling and filling:

a. Screened Gravel: As specified in SECTION 02223, SCREENED GRAVEL.

b. Bank-run Gravel: As specified in SECTION 02224, BANK-RUN GRAVEL.

c. Select Borrow: As specified in SECTION 02225, SELECT BORROW.

d. Crushed Stone: As specified in SECTION 02435, CRUSHED STONE.

e. Other Acceptable Materials: Laboratory testing results of gradation and moisture-density relationship. Submittal shall include specific location of the source and the date when sample was taken.

4. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Engineer before placing the next lift or constructing foundations.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. All products delivered to the project site shall be accompanied by test reports certifying that the product conforms to the ASTM specifications listed herein, where applicable. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

C. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 – QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Dewatering and Groundwater Control: Provide and maintain as specified in SECTION 02140, DEWATERING.

C. Excavations shall be performed in the dry, and kept free from water, snow and ice during construction. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over the bedding and backfill material.

D. Temporary Excavation Support Systems: Provide and maintain as specified in SECTION 02160, EXCAVATION SUPPORT SYSTEMS.

1. The Contractor shall be solely responsible for making all excavations in a safe manner. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

2. Do not excavate, construct embankments, or fill until all the required submittals have been reviewed by the Engineer.

3. Formulate excavation, backfilling, and filling schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.

E. Employ an Independent Testing Laboratory to perform particle size and gradation analyses in accordance with ASTM D422, and to determine compactibility in accordance with ASTM D1557 for all the proposed backfill and fill materials, and monitoring field compaction operations. The Contractor’s Independent Testing Laboratory shall have the following qualifications:

1. Be accredited by the American Associates of State Highway and Transportation Officials (AASHTO) Accreditation Program.

2. Have three (3) years’ experience in sampling, testing and analysis of soil and aggregates, and monitoring field compaction operations.

3. Able to provide three (3) references from previous work.

F. Field Testing and Inspections

1. By Contractor’s Independent Testing Laboratory, acceptable to the Engineer, at Contractor's expense as specified in herein.

2. Location of tests mutually acceptable to testing laboratory and the Engineer or as directed by the Engineer.

3. In the event compacted material does not meet specified in-place density, recompact material and retest this area until specified results are obtained at no additional cost to the Owner.

4. Contractor’s Independent Testing Laboratory to perform inspection at least once daily to confirm lift thickness and compaction effort for entire fill area.

G. Methods of Field Testing

1. In-Place Density: ASTM D1556, ASTM D2167, or ASTM D6938.
2. In-Place Moisture Content: ASTM D6938, ASTM D4944, or ASTM D4959.

H. Material Testing Frequency: The following testing frequencies are minimum required for all structural and non-structural fill, grading and embankment.

1. Field In-Place Density and Moisture Content - Screened gravel and crushed stone shall be compacted as specified and indicated. For other backfill and fill materials, minimum test frequency shall be as follows, and no less than one test per:
    a. Trenches under structures' foundation preparation or roadways subbase: Every 1,000 lin. ft. per lift.
    b. Trenches in areas without structures or roadways: Every 1,000 lin. ft. per alternate lift.
    c. Paved Roadways: Every 200 lin. ft. per lift.
    d. Paved Areas: 3,500 sq. ft. per lift.
    e. Under Structure: 1,000 sq. ft. per lift.
    f. Around Structures: 1,500 sq. ft. per lift.
    g. Embankment Fills: 10,000 sq. ft. per lift.
2. Moisture Density - One per source, except for screened gravel and crushed stone. Repeat the moisture density test for every 5,000 cubic yard of material use, and whenever visual inspection indicates a change in material gradation as determined by the Engineer.
3. Gradation Analysis – A minimum of one per source and for each moisture density test and whenever visual inspection indicates a change in material gradation.
4. Liquid Limit, Plastic Limit and Plasticity Index - Minimum of one test per 5,000 cubic yard of soil for use as fill material and whenever classification of material is in doubt as determined by the Engineer

I. Construction Tolerances

1. Construct finished surfaces to plus or minus 1 inch of the elevations indicated.
2. Grade cut and fill areas to plus or minus 0.20 foot of the grades indicated.
3. Complete embankment edges to plus or minus 6 inches of the slope lines indicated.
4. Provide the Engineer with adequate survey information to verify compliance with above tolerances.

J. Cut pavement with a saw or pneumatic tools to prevent damage to remaining pavement without extra compensation. Where pavement is removed in large pieces, dispose of pieces before proceeding with excavation.

K. Pipes, drains, and other utilities may exist in certain locations not indicated on drawings. No attempt has been made to show all services. Completeness or accuracy of information given is not guaranteed.

L. Dig test pits considered as incidental to the normal excavation as indicated and specified in this Section, at no additional compensation.

M. Carefully support and protect from damage, existing pipes, poles, wires, fences, curbs, property line markers, and other structures, which the Engineer determines must be preserved in place without being temporarily or permanently relocated. Should such items be damaged, restore without compensation therefore, to at least as good condition as that in which they were found immediately before the work was begun.

N. Whenever certain existing structures, as described below, are encountered, and the Engineer so directs, change the location, remove and later restore, or replace such structures, or assist the Owner in doing so. Such work to be paid for under applicable items of work, otherwise as Extra Work.

O. In removing existing pipes or other structures, include for payment only those new materials which are necessary to replace those unavoidably damaged as determined by the Engineer.

P. The preceding two paragraphs apply to pipes, wires, and other structures which meet the following: (a) are not indicated on the drawings or otherwise provided for, (b) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (c) in the opinion of the Engineer, will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.

Q. Restore existing property or structures as promptly as practicable.

R. If material unacceptable for foundation (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, remove such material to the required width and depth as directed by the Engineer and replace it with screened gravel, select borrow, or concrete.

S. Do not remove excavation materials from the site of the work or dispose of except as directed or permitted by the Engineer.

T. Haul away and dispose of surplus excavated materials at locations directed by the Engineer at no additional cost to the Owner.

U. During progress of work, conduct earth moving operations and maintain work site so as to minimize the creation and dispersion of dust. Furnish and spread calcium chloride if the Engineer decides that it is necessary for more effective dust control.

V. Provide suitable and safe bridges and other crossings where required for accommodation of travel, and to provide access to private property during construction, and remove said structures thereafter.

**1.08 - REFERENCES**

6. American Society for Testing and Materials (ASTM) Publications:
7. ASTM C33 - Specification for Concrete Aggregates.
8. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
9. ASTM D6913 – Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
10. ASTM D7928 - Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
11. ASTM D1140 - Test Methods for Determining the Amount of Material Finer than the 75 µm (No. 200) Sieve in Soils by Washing.
12. ASTM D1556 - Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
13. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft$^3$ (2,700 kN-m/m$^3$)).
14. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
15. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
16. ASTM D4718 - Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
17. ASTM D4944 - Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester.
18. ASTM D4959 - Test Method for Determination of Water Content of Soil by Direct Heating.
19. ASTM D5080 - Test Method for Rapid Determination of Percent Compaction.
20. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

21. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.
22. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SITE CONDITIONS**

23. Subsurface Conditions: Refer to SECTION 01310, MISCELLANEOUS TESTING AND SOIL DATA.

## PART 2 - PRODUCTS

**2.01 - GENERAL**

24. Use only acceptable materials from excavations or borrows.
25. Provide 1,500 psi concrete, Screened Gravel, Bank-Run Gravel, fine aggregate, Select Borrow, and Crushed Stone.
26. Provide Fine Aggregate conforming to ASTM C33.
27. Provide erosion/sedimentation control devices as indicated, including geotextile fabric in accordance with SECTION 02223, SCREENED GRAVEL.
28. Provide geotextile fabric as indicated, meeting the requirements and conforming to SECTION 02273, GEOTEXTILE FABRIC.

**2.02 - EQUIPMENT**

29. The compaction equipment shall be selected by the Contractor and shall be capable of consistently achieving the specified compaction requirements. The selected compaction equipment shall meet the following minimum requirements:
30. Manually operated vibratory plate compactors weighing no less than 200 pounds with vibration frequency no less than 1,600 cycles per minute.
31. Vibratory steel drum or rubber tire roller weighing at least 12,000 pounds.

**PART 3 - EXECUTION**

**3.01 - SITE MAINTENANCE**

32. Roadway and Site Leveling: Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

**3.02 - EXCAVATION**

33. Execution of any earth excavation shall not commence until the related dewatering, excavation support systems, and backfill and fill materials submittals are reviewed by the Engineer and all Engineer's comments satisfactorily addressed.
34. Carry out program of excavation, dewatering, and excavation support systems to eliminate possibility of undermining or disturbing foundations of existing structures or of work previously completed under this contract.
35. Excavate to widths that give suitable room for building structures or laying and jointing piping.
36. Do not plow, scrape or dig by machinery near to finished subgrade in a manner that would result in disturbance of subgrade.
37. Excavate to lines and grades indicated in an orderly and continuous program.
38. Establish limits of excavation to allow adequate working space for installing forms and for safety of personnel.
39. Excavate to elevations indicated, or deeper, as directed by the Engineer, to remove unacceptable bottom material.
40. Exercise care to preserve material below and beyond the lines of excavations.

41. Place excavated material at the approved stockpile locations and in no case closer than 3 feet from edge of excavations to prevent cave-ins of bank slides.

42. Regard small, less than one cubic yard, boulders, rock fragments, and concrete encountered during excavation as a normal part of in-place soils and not included for payment as rock.

43. Excavate for depressed foundations, where mat foundations are indicated as depressed. Sheet and shore existing ground so that adjacent sections of foundation mat will rest on undisturbed ground as indicated. Installation of sheeting shall be in accordance with SECTION 02160, EXCAVATION SUPPORT SYSTEMS.

**3.03 - SEPARATION OF EXCAVATED MATERIALS FOR REUSE**

44. Remove only existing pavement that is necessary for prosecution of work.

45. Carefully remove loam and topsoil from excavated areas. Store separately for further use or furnish equivalent loam and topsoil as directed.

46. Carefully remove acceptable material from excavated areas and store separately for further use as backfill material.

**3.04 - TRENCH EXCAVATION**

47. When pipe is to be laid in gravel bedding or concrete cradle, excavate trench by machinery to, or just below designated subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.

48. When pipe is to be laid directly on bottom of trench, do not excavate lower part of trenches by machinery to subgrade. Remove remainder of material to be excavated just before placing of pipe by use of hand tools. Form a flat or shaped bottom, true to grade, so pipe will have a uniform and continuous bearing. Support on firm and undisturbed material between joints, except for limited areas where use of pipe slings has disturbed bottom.

**3.05 - DEPTH OF TRENCH**

49. Excavate trenches to depths so as to permit pipe to be laid at elevations, slopes, or depths of cover indicated on drawings, and at uniform slopes between indicated elevations.

**3.06 - WIDTH OF TRENCH**

50. Make pipe trenches as narrow as practicable and do not widen by scraping or loosening materials from the sides. Make every effort to maintain sides of trenches firm and undisturbed until backfilling has been placed and compacted.

51. Excavate trenches with approximately vertical sides between spring line of pipe and elevation of 1 foot above the top of pipe.

**3.07 - TRENCH EXCAVATION IN FILL**

52. Place and compact material to top of fill or to a minimum height of 1 foot above the top of pipe, whichever is less, when pipe is to be laid in embankment or other recently filled material. Take particular care to ensure maximum consolidation of material under pipe location. Excavate pipe trench as though in undisturbed material.

**3.08 - EXCAVATION NEAR EXISTING STRUCTURES**

53. Discontinue digging by machinery when excavation approaches pipes, conduits, or other underground structures. Continue excavation by use of hand tools. Include such manual excavation in work to be done when incidental to normal excavation and under items involving normal excavation.

54. Excavate test pits when determination of exact location of pipe or other underground structure is necessary for doing work properly.

**3.09 - REMOVAL OF SUBSURFACE OBSTRUCTIONS**

55. Remove indicated subsurface structures and related obstructions to extent shown.

56. Promptly notify the Engineer when any unexpected subsurface facilities are encountered during excavation such as utility lines and appurtenances, walls and foundations.

**3.10 - UNAUTHORIZED EXCAVATION**

57. When the bottom of any excavation for structures is taken out beyond limits indicated or specified, backfill, with screened gravel and crushed stone wrapped with non-woven geotextile fabric or with 1,500 psi concrete.

**3.11 - REUSE AND DISPOSAL OF SURPLUS EXCAVATED MATERIALS**

58. Reuse surplus acceptable excavated materials for backfill; deposit neatly and grade so as to make or widen fills, flatten side slopes, or fill depressions; or legally dispose off-site; all as directed or permitted and without additional compensation.

**3.12 - SUBGRADE PREPARATION AND PROTECTION**

59. Remove loam and topsoil, loose vegetative matter, stumps and large roots from areas upon which embankments will be built or material will be placed for grading. Shape subgrade as indicated on drawings, and prepare by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.

60. As directed by the Engineer, over-excavate unacceptable materials below the foundation subgrade. Backfill the over-excavation with compacted screened gravel or crushed stone wrapped with nonwoven geotextile fabric. In no case shall the screened gravel be placed directly on the exposed subgrade prior to placing the geotextile fabric.

61. Proof roll the foundation subgrade prior to backfilling and filling operation or placing foundation concrete.

62. Proof roll the pipe trench foundation subgrade prior to backfilling and filling operation or placing soil-supported pipeline.

63. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the pipe trench foundation subgrade to avoid disturbance of the bearing surface. Tamp the exposed subgrade with the excavating bucket prior to backfilling and filling operation or placing soil-supported pipeline.

**3.13 - CARE AND RESTORATION OF PROPERTY**

64. Enclose uncut tree trunks adjacent to work in wooden boxes of such height as may be necessary for protection from injury from piled material, equipment, operations, or otherwise due to work. Operate excavating machinery and cranes of suitable type with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

65. Cut all branches, limbs, and roots smoothly and neatly without splitting or crushing. Neatly trim, cut the injured portions and cover with an application of grafting wax or tree healing paint as directed.

66. Protect cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations by suitable means or dig up and temporarily replant and maintain. After construction operations have been substantially completed, replant in original positions and care for until growth is reestablished. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish in their beauty or usefulness, replace by items of equal kind and quality existing at the start of the work.

67. Do not use or operate tractors, bulldozers, or other power-operated equipment on paved surfaces when their treads or wheels are so shaped as to cut or otherwise damage such surfaces.

68. Restore surfaces damaged by the Contractor's operations to a condition at least equal to that in which they were found immediately before work commenced. Use suitable materials and methods for such restoration.

**3.14 - BACKFILLING - GENERAL**

69. Do not place frozen materials in backfill or place backfill upon frozen material. Remove previously frozen material or treat before new backfill is placed.

70. Do not place, spread, roll or compact fill material during unfavorable weather conditions. If interrupted by heavy rain or other unfavorable conditions, do not resume until ascertaining that the moisture content and density of the previously placed soil are as specified.

71. Do not use puddling, ponding or flooding as a means of compaction.

**3.15 - MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS**

72. Select Borrow, and Fine Aggregate:
73. Dump and spread in layers not to exceed 8-inch uncompacted thickness.
74. Compact, fill and backfill under structure and bedding for pipes (from below pipe to spring line) as indicated but to not less than 95 percent. Compact to not less than 90 percent in other areas unless otherwise indicated.
75. Screened Gravel and Crushed Stone:
76. Dump and spread in layers not to exceed 8-inch uncompacted thickness.
77. Compact using self-propelled vibratory steel drum or rubber tire rollers with a minimum of 4 passes in directions perpendicular to one another in open areas. In small areas, use manually operated vibratory plate compactors with a minimum of 4 passes.
78. Bank-Run Gravel and Acceptable materials for use as non-structural fill:
79. Dump and spread in layers not to exceed 12-inch. uncompacted thickness.
80. Compact to not less than 90 percent unless otherwise indicated.
81. Backfilling and filling operation shall be suspended in areas where tests are being made until tests are completed and the testing laboratory has advised the Engineer that adequate densities are obtained.

**3.16 - STRUCTURAL FILL AND BACKFILL UNDER STRUCTURES**

82. Compact fill and backfill under structures and pavements with screened gravel, crushed stone, select borrow, or fine aggregate as specified and indicated.

**3.17 - NON-STRUCTURAL BACKFILL AROUND STRUCTURES**

83. Use acceptable materials for non-structural backfill around structures and compacted as specified and indicated.
84. Conduct hydraulic testing as soon as practicable after structures are constructed and other necessary work has been done. Start backfilling promptly after completion of tests.
85. Deposit material evenly around structure to avoid unequal soil pressure.
86. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage.

**3.18 - BACKFILLING PIPE TRENCHES**

87. General:
88. Begin backfilling and proceed until completed after: the pipes and conduits have been laid, joints have acquired maximum degree of hardness, pipelines and conduits have successfully passed tests and inspections as required in the Specifications, and concrete or masonry structures within the trench have reached their design strength to support all loads.
89. Backfill and compact indicated material under, around, and above pipes, conduits, and other structures to the indicated or specified compaction density requirement. Utilize compaction devices which will not damage the pipe, conduit, or structure within the trench.
90. Do not drop backfill material into trench from a height of more than 5 ft., or in a manner which will damage the pipe, conduit, or other structure within trench.

91. Pipe Trenches:

92. Materials:

93. From below pipe to 1 foot above the top of pipe: Use Screened Gravel, or Crushed Stone, unless otherwise indicated.

94. One foot above top of pipe to finished grade or to pavement subbase: Use Bank-Run Gravel or acceptable materials, unless otherwise indicated.

95. Compacting Around Pipes: Compact material around circumference of pipe and the area between the trench wall and the pipe by hand tamping in 6 inches layers.

96. Compacting Above Pipe: Compact material by hand tamping. If trench width is wide enough to accommodate power tools and the compacted material over the pipe will support the load of the power tools without damage to the pipe, use rollers or other powered compaction equipment able to more readily achieve compaction requirements.

**3.19 - MATERIAL FOR FILLING AND EMBANKMENTS**

97. Use acceptable materials for filling and building embankments unless otherwise indicated.

**3.20 - PLACING AND COMPACTING EMBANKMENT MATERIAL**

98. Compact fill material as specified and indicated.

99. Perform fill operation in an orderly and systematic manner using equipment in proper sequence to meet the specified compaction requirements.

100. Place fill on surfaces which are free of unacceptable materials.

101. Begin filling in lowest section of work area. Grade surface of fill approximately horizontal but provide with sufficient longitudinal and transverse slope to allow for runoff of surface water from every point.

102. Conduct filling so that no obstruction to drainage from other sections of fill area is created at any time.

103. Install temporary dewatering sumps in low areas during filling operation where excessive amounts of rain runoff collect.

104. Reduce moisture content of fill material, if necessary, in source area by working it over under warm and dry atmospheric conditions. A large disc harrow with two to three-foot diameter disks may be required for working soil in a drying operation.

105. Compact uniformly throughout. Keep surfaces of fill reasonably smooth and free from humps and hollows which would prevent proper and uniform compaction. Do not permit hauling equipment to follow a single track on the same layer but direct equipment to spread out to prevent over-compaction in localized areas. Take care in obtaining thorough compaction at edges of fill.

106. Slightly slope surface of fill to ensure drainage during periods of wet weather. Do not place fill while rain is falling or after a rain-storm until the Engineer considers conditions satisfactory. During such periods and upon suspension of filling operations for any period in excess of 12 hours, roll smooth the surface of fill using a smooth wheel static roller to prevent excessive absorption of rainfall and surface moisture. Prior to resuming compaction operations, remove muddy material off surface to expose firm, compacted material, as determined by the Engineer.

107. When fill is placed against an earlier fill or against in-situ material under and around structures, including around piping beneath structures or embankments, slope junction between two sections of fill, 1 vertical to 1.5 horizontal. Bench edge of existing fill 24-inches to form a serrated edge of compact stable material against which to place the new fill. Ensure that rolling extends over junction between fills.

108. When fill is placed directly upon another older fill, clean surface thoroughly of debris and remove any loose material. Then proof roll the entire old surface.

109. After spreading each loose lift to the required thickness and adjusting its moisture content as necessary, roll with sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Do not make additional passes until previous pass has been completed.

110. In the case that material of any fill sinks and weaves under roller or under hauling units and other equipment, required degree of compaction is not being obtained. Reduce the moisture content. If such sinking and weaving produces surface cracks, suspend operations on that part of the embankment until it becomes sufficiently stabilized. Ideal condition in fill is that attained when the entire fill below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as roller passes. Spread out rolling operations over the maximum practicable area to minimize condition of sinking and weaving.

111. If because of defective workmanship, compaction obtained over any area is less than that required, remedy condition at no cost to Owner. If additional rolling or other means fail to produce satisfactory results, remove material in that area down to a level of satisfactory density. Perform removal, replacement, and rerolling without additional compensation.

**3.21 - COMPACTION CONTROL OF BACKFILL, FILL, AND EMBANKMENT**

112. Compact to density specified and indicated for various types of material. Control moisture content of material being placed as specified or if not specified, at a level slightly lower than optimum.

113. The soil testing laboratory shall provide inspection during filling or backfilling operations to ensure compaction of screened gravel or crushed stone and record compaction equipment in use.

114. Moisture control may be required either at the stockpile area, pits, or on embankment or backfill. Increase moisture content when material is too dry by sprinkling or other means of wetting uniformly. Reduce moisture content when material is too wet by using ditches, pumps, drainage wells, or other devices and by exposing the greatest possible area to sun and air in conjunction with harrowing, plowing, spreading of material or any other effective methods.

**3.22 - ALLOWANCE FOR SHRINKAGE**

115. Build embankments or backfill to a height above finished grade which will, in the opinion of the Engineer, allow for the shrinkage or consolidation of material. Initially, provide at all points, an excess of at least one percent of total height of backfill measured from stripped surface to top of finished surface.

116. Supply specified materials and build up low places as directed, without additional cost if embankment or backfilling settles so as to be below the indicated level for proposed finished surface at any time before final acceptance of the work.

**3.23 -CONTRACT CLOSEOUT**

117. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02223**

**SCREENED GRAVEL**

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1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and compact Screened Gravel as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Gradation test result from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

**1.06 - DESIGN CRITERIA**

A. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913.

C. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM C33 - Specification for Concrete Aggregates
2. ASTM D6913 - Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - MATERIAL**

A. Screened Gravel: Gradation and physical property requirements of Screened Gravel shall conform to ASTM C33, Coarse Aggregate Number 67.

B. Screened Gravel shall be free from roots, vegetation, leaves, and other organic materials, and free of ice, snow, clay, frost, frozen soil particles and other fine or harmful substances.

C. Crushed rock of equivalent size and grading may be used instead of Screened Gravel.

## PART 3 – EXECUTION

### 3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

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**SECTION 02224**

**BANK-RUN GRAVEL**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and compact Bank-Run Gravel as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Gradation and compaction test results from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

**1.06 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913 and D1140. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates.
2. D1140: Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing.
3. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$ (600 kN-m/m$^3$).
4. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - MATERIAL**

A. Bank-Run Gravel shall be obtained from approved natural deposits and unprocessed except for the removal of deleterious materials and stones larger than the maximum size permitted.

B. Bank-Run Gravel shall be unfrozen and substantially free from vegetation, roots, loam and other organic matter, clay, snow, frozen particles and other fine or harmful substances.

C. Bank-Run Gravel: Inorganic granular material meeting the following gradation:

| Sieve Designation | Percentage by Weight Passing Square Mesh Sieves |
|---|---|
| 6 in. | 100 |
| 2 in. | 80 - 100 |
| No. 4. | 20 - 65 |
| No. 200 | 0 - 12 |

**PART 3 – EXECUTION**

**3.01 - PLACEMENT AND COMPACTION**

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02225**

**SELECT BORROW**

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1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
1.07 - REFERENCES ..... 2
PART 2 - PRODUCTS ..... 3
2.01 - MATERIAL ..... 3
PART 3 – EXECUTION ..... 3
3.01 - PLACEMENT AND COMPACTION ..... 3
3.02 - CONTRACT CLOSEOUT ..... 3

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Select Borrow as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Gradation and compaction test results from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not degrade quality, serviceability or appearance.

**1.06 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913 and D1140. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates
2. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
3. D1140: Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing.
4. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$ (2,700 kN-m/m$^3$).
5. D2487: Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - MATERIAL

A. Use only material free from roots, leaves, and organic matter, and free of ice, snow, frost and frozen soil particles.

B. Select Borrow shall be well-graded coarse-grained soil in accordance with ASTM D2487 and shall meet the following gradation:

| Sieve Designation | Percentage by Weight Passing Square Mesh Sieves |
|---|---|
| 3 in. | 100 |
| 1-1/2 in. | 70 - 100 |
| 3/4 in. | 50 - 85 |
| No. 4 | 30 - 60 |
| No. 50 | 10 - 25 |
| No. 200 | 0 - 5 |

Soil particles shall conform to the physical property requirements of ASTM C33.

## PART 3 – EXECUTION

### 3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02273**

**GEOTEXTILE FABRIC**

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1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
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1.06 - DESIGN CRITERIA ..... 2
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2.01 - MANUFACTURERS ..... 3
2.02 - MATERIAL ..... 3
PART 3 - EXECUTION ..... 4
3.01 - INSTALLATION ..... 4
3.02 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide nonwoven geotextile fabric in foundation preparation for separation of existing soil from Screened Gravel or Crushed Stone.

B. Provide woven geotextile fabric for temporary road reinforcement, and riprap separation as indicated or specified.

C. Provide woven geotextile fabric for silt fence as indicated or specified.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. At least two weeks prior to shipment, submit manufacturer's certificate of compliance and physical property data sheet indicating that requirements for materials and manufacture are in conformance as specified.
2. For informational purposes only, submit manufacturer’s printed installation instructions.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. Provide geotextile fabric in rolls wrapped with protective covering to protect geotextile fabric from mud, dirt, dust, debris, and ultraviolet light. Label each roll of geotextile fabric with number or symbol to identify production run.

C. Protect geotextile fabric from sunlight during transportation and storage. Do not leave geotextile fabric exposed to sunlight for more than 14 days during installation operations.

**1.06 - QUALITY ASSURANCE**

A. Producer of the geotextile fabric is to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures. Laboratory to maintain records of quality control results.

B. Do not expose geotextile fabric, except the geotextile fabric for silt fence, to ultraviolet radiation (sunlight) for more than 14 days total during the period of time following manufacture, until geotextile fabric is installed and covered with fill or backfill material.

C. Take all precautions to protect geotextile fabric from damage resulting from any cause. Either repair or replace geotextile fabric to Engineer's satisfaction at no additional cost to the Owner.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. D4355: Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon ARC Type Apparatus.
2. D4491: Test Methods for Water Permeability of Geotextiles by Permittivity.
3. D4533: Test Method for Trapezoid Tearing Strength of Geotextiles.
4. D4632: Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. D4751: Test Method for Determining Apparent Opening Size of a Geotextile.
6. D4833: Test Method for Index Puncture Resistance of Geomembranes and Related Products.
7. D6241: Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Provide the following nonwoven geotextile fabric:

1. Geotex 601 as manufactured by Propex.
2. Mirafi 160N as manufactured by TenCate Geosynthetics.
3. 150 EX as manufactured by Thrace-LINQ.
4. Or acceptable equivalent product.

B. Provide the following woven geotextile fabric except for silt fence:

1. Geotex 200 ST as manufactured by Propex.
2. Mirafi 500X as manufactured by TenCate Geosynthetics.
3. GTF 200 as manufactured by Thrace-LINQ.
4. Or acceptable equivalent product.

C. Provide the following woven geotextile fabric for silt fence:

1. Geotex 2130 as manufactured by Propex.
2. Mirafi 100X as manufactured by TenCate Geosynthetics.
3. Beltech 1935 by Belton Industries Inc.
4. Or acceptable equivalent product.

**2.02 - MATERIAL**

A. Geotextile fabric shall conforms to test requirements for minimum average roll value (weakest principle direction) for strength properties of any individual roll tested from manufacturing lot or lots of particular shipment in excess of minimum average roll value (weakest principle direction) as specified hereafter:

B. Physical Properties of Minimum Average Roll of the Nonwoven Geotextile Fabric shall be as follows:

| Property | ASTM Test Method | Units | Value |
|---|---|---|---|
| 1. Grab Strength | D4632 | lbs. | 150 (min.) |
| 2. Grab Elongation | D4632 | % | 50 (min.) |
| 3. Trapezoidal Tear Strength | D4533 | lbs. | 60 (min.) |
| 4. Puncture Strength | D4833 | lbs. | 75 (min.) |
| 5. Permittivity | D4491 | sec -1 | 1.3 (min.) |
| 6. Apparent Opening Size | D4751 | Sieve Number | 70 - 100 |
| 7. Ultraviolet Stability | D4355 | Percent | 70 (min.) |

C. Physical Properties of Minimum Average Roll of Woven Geotextile Fabric, except for silt fence, shall be as follows:

| Property | ASTM Test Method | Units | Value |
|---|---|---|---|
| 1. Grab Strength | D4632 | lbs. | 200 (min.) |
| 2. Grab Elongation | D4632 | % | 15 (min.) |
| 3. Trapezoidal Tear Strength | D4533 | lbs. | 75 (min.) |
| 4. Puncture Strength | D4833 | lbs. | 80 (min.) |
| 5. Permittivity | D4491 | sec -1 | 0.02 (min.) |
| 6. Apparent Opening Size | D4751 | Sieve Number | 30 - 70 |
| 7. Ultraviolet Stability | D4355 | Percent | 70 (min.) |

D. Physical Properties of Minimum Average Roll of the Woven Geotextile Fabric for silt fence shall be as follows:

| Property | ASTM Test Method | Units | Value |
|---|---|---|---|
| 1. Grab Strength | D4632 | lbs. | 100 (min.) |
| 2. Permittivity | D4491 | sec -1 | 0.10 (min.) |
| 3. Apparent Opening Size | D4751 | Sieve Number | 20 - 30 |
| 4. Ultraviolet Stability | D4355 | Percent | 70 (min.) |

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Install geotextile fabric in accordance with manufacturer's printed instructions.

B. Place geotextile fabric on the foundation subgrade prior to placing the screened gravel or crushed stone.

C. Overlap geotextile fabric 18-inches minimum for unsewn lap joint. Overlap fabric 6-inches at seam for sewn joint.

D. Do not permit traffic or construction equipment to travel directly on geotextile fabric.

E. Place geotextile fabric in relatively smooth condition to prevent tearing or puncturing. Lay geotextile fabric loosely but without wrinkles or creases so that placement of the backfill materials will not stretch or tear geotextile fabric. Leave sufficient slack in geotextile fabric around irregularities to allow for readjustments.

F. Patch all tears in geotextile fabric by placing additional section of geotextile fabric over tear with a minimum of 3-feet overlay.

G. Extend the geotextile fabric and wrap around the Screened Gravel or Crushed Stone along the perimeter of the foundation.

H. Install silt fence in accordance with the manufacturer's printed instructions and as indicated.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

**SECTION 02351**

**VIBRO-COMPACTION AND VIBRO-REPLACEMENT**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work specified in this section shall include the ground improvement (densification) by Vibro-Compaction and/or Vibro-Replacement of the subsurface soils below the proposed SBR tanks in Orleans, Massachusetts as indicated and specified herein.

B. Specialty Ground Improvement Subcontractor to provide all labor, equipment, tools, and materials, including delivery and placement of sand or stone backfill, for the detailed design and performance of the soil improvement.

C. The extent of the work shall cover the whole foundation area of the proposed SBR tanks as a minimum. The minimum treatment depth shall be 25 feet below the proposed foundation bottom level.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Include in the Contract Price, scheduled allowances included under the applicable Bid Item of DOCUMENT 00300, BID FORM specified in the respective specification sections and listed below:

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

10. “Vibro-Compaction” and “Vibro-Replacement” are techniques utilizing specially developed vibrators to direct compactive energy at the required improvement depth. The compactive energy results from electrically driven eccentric weight assemblies that apply a radial energy in the horizontal plane to the surrounding soil materials. Improvement is achieved by increasing the mass in situ density, increasing the mass shear strength, and reinforcing and/or locally replacing the subsurface materials with a prepared backfill.

    a. Vibro-Compaction: In principally clean, granular soils (with typically less than 15 percent fines), the vibrator energy, accompanied with water jetting, causes particle rearrangement resulting in closer packing. The Vibro-Compaction may use sand or gravel backfill added at the surface as the vibrator is intermittently withdrawn and re-penetrated to ensure densification effort and material dispersal throughout the penetration depth.

    b. Vibro-Replacement: Consists of the addition of stone which is compacted bottom-up using the vibrator to create a column of densified stone. In granular soils that exhibit some cohesive characteristic (with typical fines content ranging from 15 to 25 percent), stone backfill is placed and compacted to enhance displacement and drainage of the mass, and subsequently assist in the densification process. In more cohesive soils, the stone backfill creates a densely compacted stone column that performs as a structural reinforcement element, to increase the bearing capacity of the mass and greatly reduce total and differential settlements. .

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit all qualifications as specified in Section 1.06A, and 1.06B.
2. Certification that the installer and his crew have the experience in performing the work specified.
3. Certificate of Design:
    a. The Specialty Ground Improvement Subcontractor shall be responsible for design of the soil improvement program to increase bearing capacity and reduce settlement below the proposed SBR tank area and within its zone of influence in conformance with the design criteria presented herein.
    b. Within 10 calendar days of the award of the contract to the Contractor and prior to the commencement of the soil improvement program, the Contractor shall submit to the Engineer the following items for review:
        1) Plans(s) showing the proposed grid spacing and proposed depth of penetration of the vibrators for soil improvements within the footprint and lateral zone of influence of the facilities.
        2) The plan(s) submitted as described above shall be stamped by a Registered Professional Civil Engineer registered to practice in the Commonwealth of Massachusetts, specializing in Geotechnical Engineering with specific experience in Vibro-Compaction and/or Vibro-Replacement techniques.
    c. The anticipated field control techniques to be employed by the Specialty Ground Improvement Subcontractor to aid in the assessment of the effectiveness of soil improvement and the need for modification of the program. Confirmation of the soil improvement techniques (increased relative density) shall be made by advancement of soil borings made at locations selected by the Engineer.
    d. The methods of monitoring of ground vibrations and assessing their impact to surrounding buildings, utilities and other structures shall be the responsibility of the Contractor.
4. Provide installation and sequence of construction.
5. Proposed Test Area location.
6. The post soil improvement test boring logs and Standard Penetration Test (SPT) data.
7. Provide copies of the manufacturer specifications for the installation equipment.
8. Provide material particle size and gradation laboratory testing results for all sand/stone backfill to be used in the soil improvement system.
9. Construction records, including but not limited to the following:
    a. Submit a daily log to the Engineer which includes:
        1) Vibro-compaction/Vibro-replacement probe identification number and locations.
        2) Date.
        3) Start/finish time of probe.
        4) Elevation of top and bottom of each probe.
        5) Quantity of stone/sand placed in each probe.
        6) Estimate of ground heave or subsidence.
        7) Vibrator type and power consumption during penetration and compaction.
        8) Time to penetrate and time to form each probe.
        9) Identification of relative ammeter increases.
        10) Jetting pressure (air or water).

b. Submit details of obstructions, delays, and any unusual ground conditions.

c. Submit as-built drawings showing specific probe locations, identification numbers, and estimated depths.

d. Any change in the predetermined program necessitated by a change in subsurface conditions shall be immediately reported and submitted to the Engineer.

10. Drilling subcontractor's qualifications.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not degrade quality, serviceability or appearance.

**1.06 - QUALITY ASSURANCE**

A. Qualifications of Vibro-Compaction/Vibro-Replacement Designer:

1. Professional Civil Engineer, registered to practice in the Commonwealth of Massachusetts, and specializing in geotechnical construction and employed by the Specialty Ground Improvement Subcontractor.

2. Not less than ten (10) years' experience in the design of soil improvement projects by the Vibro-compaction/Vibro-Replacement Method.

3. Completed five successful soil improvement projects of equal type, size, and complexity.

B. Vibro-Compaction/Vibro-Replacement Installer Qualifications:

1. Specialty Ground Improvement Subcontractor performing the Vibro-Compaction/Vibro-Replacement installation shall demonstrate a minimum of 10 years' experience documenting at least 10 successful projects.

C. Field and Laboratory Testing:

1. All drilling and testing to determine specification compliance shall be provided by an independent testing agency approved by the Engineer and paid by the Specialty Ground Improvement Subcontractor.

2. Field testing will consist of continuous SPT performed in accordance with ASTM D1586, after soil improvement has been performed. The borings SPT will be advanced concurrently with the soil improvement operation to provide test results as quickly as possible after completion of soil improvement in selected areas. The locations of borings shall be as determined by the Engineer to check for specification compliance. A minimum of four (4) test borings shall be performed. The confirmatory borings shall be uniformly spaced over the treated area and will be located at the mid-points or points furthest away from surrounding probed locations.

3. Laboratory soil testing shall be conducted on the sand/stone backfill to determine compliance with gradation and material requirements. One sand or stone sample shall be tested per 500 c.y. of material.

4. The minimum SPT blow count (N-value) after soil improvement by Vibro-Compaction or Vibro-Replacement shall correspond to the 70% relative density relationship as presented by Gibbs and Holtz.

D. The Specialty Ground Improvement Subcontractor shall use the following design parameters when performing analyses and design of the soil improvement program:

| | |
|---|---|
| Design Allowable Bearing Capacity at Foundation Level: | 2,100 lbs per square foot |
| Allowable Total Settlement: | 1.00 inch |
| Allowable Differential Settlement: | 0.5 inch |

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM):

1. ASTM D1586: Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.

2. D1557: Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3 (2,700 kN-m/m3)).

B. Gibbs, H.J., and W.G. Holtz (1957), "Research on Determining the Density of Sands by Spoon penetration Testing", Proc. 4 Int. Conf. Soil Alech., London, 1, 35-39.

C. UFC 3-220-10N (2005), Design Manual 7.01, Soil Mechanics.

**1.08 – SUBSURFACE CONDITIONS**

A. Soil borings have been performed beneath and adjacent to the proposed SBR tank footprint to provide a general characterization of subsurface conditions.

B. Subsurface data obtained is presented on test boring logs included in SECTION 01310, MISCELLANEOUS TESTING AND SOIL DATA. This data is representative of the subsurface conditions at each corresponding location and does not necessarily apply elsewhere.

C. These investigations are provided solely as information to the Specialty Ground Improvement Subcontractor. Interpretation of this data for the purpose of design and implementation of soil improvement program and general earth-work is the responsibility of the Contractor and the Specialty Ground Improvement Subcontractor.

**1.09 - PERMITS**

A. The Contractor and Specialty Ground Improvement Subcontractor shall be responsible for obtaining all State and Municipal permits related to their respective operations and for conforming to all State and Local regulations. In particular, containment of water during soil improvement in accordance with all regulations shall be required.

**1.10 - WATER**

A. The water used during performance of soil improvement shall be potable, fresh, clean and free from injurious amounts of sewage, oil, acid, alkali, salts, organic matter or hazardous materials of any kind. The piping, metering, and cost of bringing water to within 500 ft. from the site at a rate of 200 gpm at 60 psi shall be paid for by the Contractor. From this point, the Specialty Ground Improvement Subcontractor shall be responsible for all water piping, connections, etc.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Vibro-Compaction:

1. Backfill for Vibro-Compaction should consist of material graded as sand or sand and gravel with less than 10 percent by weight passing the #200 sieve, and contain no clay.

B. Vibro-Replacement:

1. Stone to be used in the Vibro-Replacement work should consist of relatively hard, durable rock with a gradation generally between 3/8" to 2".

**2.02 - SAMPLES**

A. Submit the following information to the Engineer within one (1) week after receiving the notice to proceed unless otherwise noted.

B. Representative samples and grain size distribution curves of the sand backfill for vibro-compaction and stone aggregate backfill for vibro-replacement. Each sample shall be clearly labeled and shall weigh approximately 50 pounds.

C. The sand and stone backfill shall be hard, unweathered material and free from organics, frozen material or other deleterious substances.

## PART 3 - EXECUTION

### 3.01 – EQUIPMENT AND METHOD

A. Specific equipment and procedural specifications are left to the Specialty Ground Improvement Subcontractor to achieve the design criteria specified in paragraph 1.06. The following general guidelines are identified:

1. The Specialty Ground Improvement Contractor shall use a down-hole vibrator capable of providing at least 80 horsepower and 15 tons of force.

B. After penetration through the treatment zone, the vibrator should be slowly retrieved in 12 to 18-inch increments to allow backfill placement.

### 3.02 – SITE PREPARATION

A. The Contractor shall provide clearing, grubbing, stripping and removal of all unsuitable material within the limits of the soil improvement area prior to beginning the soil improvement work.

B. The Contractor shall regrade the site to provide a firm, level base on which heavy equipment can be operated without platform maintenance aside from water diversion and containment where required. Cohensionless material from off-site or on-site sources shall be used to regrade the site.

C. The Contractor shall accurately locate SBR tank corners and outlines.

### 3.03 – SEQUENCE OF CONSTRUCTION

A. The Specialty Ground Improvement Subcontractor shall commence with the soil improvement work in a mutually agreed upon Test Area in the SBR tank footprint and zone of influence. After completion of soil improvement in a sufficient area to allow access of drilling equipment (plus or minus 50 by 50 feet) within the Test Area, at least one (1) soil boring will be advanced to assess the degree of soil improvement. While the initial boring(s) is being made, the Specialty Ground Improvement Subcontractor can continue work in other sections of the Test Area. Provided the results of the boring(s) show that densification has been achieved in accordance with these specifications, work outside of the Test Area can commence once the work in this area has been completed. Should any of the borings indicate that, in the judgement of the Engineer, the requirements of the specification with regard to densification have not been met, the Specialty Ground Improvement Subcontractor shall continue work within the Test Area until the Engineer is satisfied that conditions set forth in these specifications have been met. No additional compensation shall be made by the Engineer for delays and/or additional work or borings required, due to failure to meet the project specifications with regard to Soil Improvement.

B. Subsequent to completion, and acceptance by the Engineer, of work in the Test Area, the Specialty Ground Improvement Subcontractor may commence work at available locations below the tank footprint area and its zone of influence. Sequence of work should be coordinated with the Engineer.

C. The pre-treated grade of the soil improvement area is three (3) feet above foundation grade in anticipation that surface soil materials in approximately the upper three (3) feet or more will not be adequately densified due to the vibratory nature of the densification. It will be the responsibility of the Contractor to excavate to the foundation grade or to a maximum depth of three (3) feet, whichever is deeper. The Specialty Ground Improvement Subcontractor shall be responsible for over excavation of loose soil below three (3) feet (if required) and replacement in 6-inch maximum lifts with the excavated material. The level of compaction shall be 95 percent of the maximum dry density of the material as determined by ASTM D1557.

### 3.04 – LIMITS OF WORK

A. Soil improvement (densification) is required to minimum depths of 25 feet below the foundation level throughout the entire SBR tank footprints and zones of influence. The zone of influence shall be as determined by the design. The specialty contractor shall account for variations in depth for soil improvement. In no case is it anticipated that soil improvement will extend beyond a depth of 40 feet below the foundation level.

### 3.05 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02435**

**CRUSHED STONE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and compact Crushed Stone as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Gradation test results from the Contractor’s Independent Testing Laboratory, must be submitted at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. If crushed stone is utilized, a 10-pound sample shall be submitted, if requested by the Engineer.
3. If Processed Glass Aggregate (PGA) is utilized, a 10-pound sample shall be submitted. In addition, provide a certified test report that indicates that the PGA is free of debris and other materials that is associated with the glass recycling process.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

**1.06 - DESIGN ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Qualifications of the independent soil testing laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**1.07 - REFERENCES:**

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates
2. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MATERIAL**

A. Crushed Stone

1. Gradation and physical property requirements of crushed stone shall conform to ASTM C33, Coarse Aggregate Number 67.

Crushed Stone shall be free from roots, vegetation, leaves, and other organic materials, and free of ice, snow, clay, frost, frozen soil particles and other fine or harmful substances. Other glass products (i.e. fluorescent lights, video screens, automobile glass, lead crystal, etc.) shall not be incorporated into PGA.

2.

B. Processed Glass Aggregate (PGA)

1. In lieu Crushed Stone, the Contractor may utilize PGA for bedding of pipe lines.

2. Processed Glass Aggregate shall be manufactured from an approved supplier of crushed cullet. The material shall consist of recycled glass food or beverage containers free of debris such as paper, metals, fabrics, toxins, clay, loam, or other materials that would be associated with the glass recycling process. A maximum of 5 percent mass of the material may be produced from china dishes, ceramics, plate glass or other glass products.

3. The material will have a nominal aggregate size of 3/8 inch and meet the following gradation requirements.

| Sieve Designation | Percent by Mass Passing |
|---|---|
| 3/8 inch | 100 |
| No. 4 | 70-100 |
| No. 8 | 35-88 |
| No. 16 | 15-40 |
| No. 50 | 4-12 |
| No. 200 | 0-5 |

4. The percent wear as determined by the Los Angeles Abrasion Test, Class C or D will be a maximum of 40 percent.

5. Sources of PGA are as follows:

David Johansen, Director Department of Public Works
Town of Dennis
120 Theophilus F. Smith Road
South Dennis, MA 02660
Phone: 508-760-6220
e-Mail: djohansen@town.dennis.ma.us

Reagan Bissonnette, Executive Director
Northeast Resource Recovery Association
2101 Dover Road
Epsom, NH 03234
Phone: 603-736-4401
e-Mail: rbissonnette@nrra.net

## PART 3 - EXECUTION

### 3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02444**

**CHAIN LINK FENCE AND GATES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary to furnish and install chain link fencing and gates as specified herein and as shown on the drawings.

B. The work of this section includes all labor, tools and equipment necessary to furnish, install, test and place into satisfactory operation a prewired, self-contained, slide gate operator for the horizontal sliding gate, including all selected attachments and accessory equipment as specified herein and as shown on the drawings.

C. The work of this section includes all labor, tools and equipment necessary to make repairs to the existing chain link fencing and gates as specified herein and as shown on the drawings.

D. The work of this section includes all labor, tools and equipment necessary to remove and legally disposal of tall components of the existing stockade fence as shown on the Drawings.

E. Attention is directed to the GENERAL INFORMATION and DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Wastewater Treatment Facility

1. The Contractor shall include the cost for the new fence, gates and accessories as shown of the Drawings.
2. The Contractor shall include the cost for the repair to the existing chain link fence as shown on the Drawings.
3. The Contractor shall include the cost to remove and legally disposal of the existing stockade fence as shown on the Drawings.

C. Effluent Disposal

1. The Contractor shall include the cost for the new fence, gates and accessories as shown of the Drawings.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Materials brochures.
2. Fabric and post samples showing size, color, and finish.
3. Drawings showing height of fence, width of gates, sizes and types of materials used for entire fencing system.
4. Drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. Drawings shall also show the size and location of the concrete mounting pad.
5. Underground electrical runs shall be shown on shop drawings.

6. Control Panels:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Motor and controllers for the motorized sliding gate.
    c. Annotated product cut sheets for enclosures and control panel components.
    d. Front elevations of control panels showing dimensions, location of panel internal and panel exterior mounted components. Provide elevations with and without doors.
    e. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    f. Installation instructions: Submit two (2) copies of manufacturer's installation instructions for this specific project.
    g. Test reports: Each operator shall bear a label indicating that the operator mechanism has been tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not to degrade quality, serviceability or appearance.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Quality Assurance

1. Manufacturer: A company specializing in the manufacture of gate operators of the type specified, with a minimum of ten (10) years’ experience.
2. Installer: A minimum of five (5) years’ experience installing similar equipment.

**1.07 - CODES AND REGULATORY REQUIREMENTS**

A. Operators shall be built to UL325 standards and be listed by a NRTL testing laboratory. Complete all electrical work according to local codes and National Electrical Code. All field work shall be performed in a neat and professional manner, completed to journeyman standards.

B. Adherence to safety standards requiring the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction.

C. Adherence to current safety standards requiring gate operators to be designed and labeled for appropriate usage class.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. General. Entire chain link fence and gate system shall be vinyl coated galvanized steel. The color of the vinyl coating shall be selected from manufacturer's samples by the Engineer.

B. Fabric shall be No. 9 gauge, vinyl-coated galvanized steel wire, woven into a 2-inch mesh. Minimum weight of zinc coating shall be 0.30 ounce per square foot. Minimum thickness of PVC coating shall be 0.006 inches and maximum shall be 0.010 inches. PVC coating shall be thermally fused and bonded to a primer, which is thermally cured onto galvanized steel wire. Minimum breaking strength shall be 1,290 pounds. Fabric shall be of the height shown on the Contract Drawings.

C. Barbed wire shall consist of galvanized steel barb wire of the 4-point pattern type composed of two strands of 12-1/2 gauge line wire with 14 gauge barbs spaced on approximately 5 inch centers. Galvanized barbed wire shall conform to ASTM A121, Class 3.

D. The bottom tension wire shall be 7-gauge galvanized wire. Tension wire shall be stretched taut from terminal post to terminal post and securely fastened to each intermediate post 6-inches above the grade line. Tension wire shall be attached to the fence fabric with 11-gauge rings every 24-inches.

E. The chain link fabric shall be securely fastened to all terminal posts using 3/16-inch by ¾-inch tension bars and heavy 11-gauge tension bands. One band shall be furnished for each foot in the height of fence. The fabric shall be fastened to all intermediate posts with 9-gauge tie wires, spacing not to exceed 14 inches apart. Fabric shall be tied to top rail with 9-gauge tie wires, spacing not to exceed 24 inches. All fabric connectors shall be of galvanized steel conforming to the applicable requirements of ASTM A153.

F. All posts, rails and couplings used in the construction of the fence shall conform to ASTM A120, Schedule 40 all posts, rails, and couplings shall be hot dipped galvanized steel conforming to the applicable requirements of ASTM A123 and of the nominal sizes and weights specified herein. The pipe sizes shall conform to the nominal sizes specified herein and shall be of sufficient length to extend 48-inches into concrete footings. All posts shall be equipped with tops to exclude moisture.

1. The intermediate posts shall be 2-3/8-inches OD pipe (NPS 2), with a weight of 3.65 pounds per linear foot.

2. All end, corner, pull and single leaf gate posts shall be 2-7/8-inches OD pipe (NPS 2-1/2), with a weight of 5.79 pounds per lineal foot.

3. Double leaf gate posts shall be 6-5/8-inches OD round post pipe (NPS 6), with a weight of 18.97 pounds per lineal foot, and shall be equipped with tops designed to exclude moisture.

4. The top and the intermediate rail shall be 1.66-inch OD pipe (NPS 1-1/4), with a weight of 2.27 pounds per lineal foot, provided with couplings approximately every 20 feet. Couplings shall be outside sleeve type at least 7-inches long. The top rail shall pass through the line post tops and form a continuous brace from end to end of each stretch of fence. The top rail shall be securely fastened to the terminal posts by heavy pressed steel brace bands and malleable rail end connections. The line post tops, brace bands and rail end connections shall be galvanized according to ASTM A153.

5. Bracing shall be provided as shown on the drawings.

G. Manual Gates

1. Gates shall have truss rods or intermediate braces. Gate fabric shall be attached to gate frame by methods standard with the manufacturer except that welding will not be permitted. Each gate shall be provided with a barbed wire top. Latches shall be arranged for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement. Gate frames shall be 1.90-inches O.D. galvanized steel pipe (NPS 1-1/2) with a weight of 2.72 pounds per linear foot. Gate fabric and barbed wire shall conform to the requirements specified hereinbefore. All gates shall be equipped with a positive type latching device with a means for padlocking. The double gate shall be equipped with a center plunger, rods, catch and semi-automatic outer catches to secure the leaves in open position. Hinges shall be of pressed steel.

2. All fittings shall be pressed steel in conformance with ASTM F226.

H. Slide Gates

1. General - The slide gate shall be the cantilevered type. Slide gate track/frame members shall be made of thick walled, extruded corrosion resistant aluminum alloy. Truck assembly shall operate side enclosed track on factory lubricated, anti-friction sealed roller bearings. Support shall be at the top; ground roller wheels are not acceptable. Fabric shall be secured on all four sides, with tension rods and clips.
2. Operation shall be by means of a metal rail passing between a pair of hydraulically driven solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300-pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 4000-pounds. Gate panel velocity shall not be less than 1.0-feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly.
3. Environmental Requirements: -30-degrees to 129-degrees F, 100-percent maximum relative humidity.
4. Provide equipment rated in accordance with the Area Classification Schedule on the Contract drawings.
5. Standard mechanical components shall include as a minimum:
    a. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2-inch bronze bearing surface, acting on arm pivot pins.
    b. Arm pivot pins: ¾-inch diameter, stainless steel, with integral tabs for ease of removal.
    c. Tension spring: 2-1/2-inch heavy duty, 800-pound capacity.
    d. Tension adjustment: Finger tightened nut, not requiring the use of tools.
    e. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
    f. Limit switches: Fully adjustable, toggle types.
    g. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.
    h. Chassis: ¼-inch steel base plate, and 10 gage sides and back welded and ground smooth.
    i. Cover: 16-gage galvanized sheet metal with a powder paint finish. All joints welded, filled and ground smooth. Finished corners square and true with no visible joints.
    j. Finish: Fully zinc plated then finish coat of high gloss powder paint withstanding 1000-hour salt spray test.
    k. Drive wheels: Six inch (6”) diameter Metal hub with polyurethane tread.
    l. Drive rail: Shall be extruded 6061 T6, not less than 1/8-inch thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.
    m. Hydraulic hose: Shall be ¼-inch synthetic, rated to 2,750-psi.
    n. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
    o. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
    p. Hydraulic fluid: High performance type with a viscosity index greater than 375.
    q. A 0 – 2,000 psi pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
    r. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.

6. Gate Entrance Control Panel

   a. Provide a UL listed control panel for gate control system.

   b. Control panel enclosure shall be a self-contained, NEMA 4X rated, metal and vandal resistant. Control panel shall be mounted to the gate operator.

   c. Provide all equipment to achieve a complete and fully functioning system.

   d. Provide control panel rated for a single 480VAC power feed with step-down transformers as required. Gate Entrance Control Panel shall provide 120VAC and 24VDC power for gate system switches, sensors, and ancillary devices.

   e. Provide main disconnecting circuit breaker with a minimum rating of 65 kA symmetrical.

   f. Pump motor: Shall be a 1 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater, 460 V, 3 phase.

   g. All components shall have overload protection.

   h. Input: Gate shall operate in response to closing of a remote form A contact.

   i. Auxiliary Outputs: 1 Form C contact rated at 2-Amp 120-Vac indicating gate is open.

   j. Gate shall remain open for adjustable 1-120 seconds in response to input contact.

   k. Gate Access System Controls:

      1) Provide gate access system with pushbutton to be located at WWTF Control Room to remotely open/close gate system. Provide gate control panel with hardwired contacts for use with remote pushbutton.

      2) Provide (2) keypads for local open/close control of gate. Provide (1) keypad for mounting at passenger car height, and (1) keypad for mounting at truck height. Keypads shall be hardwired to gate control panel for local open/close control of gate. Keypads shall be programmable.

      3) Provide intercom system for 2-way remote communication including (1) intercom to be located at WWTF Control Room, (1) intercom for mounting at passenger car height, and (1) intercom for mounting at truck height.

      4) The gate shall fail-safe open upon loss of power. In addition, gate shall have a manual by-pass of the gate controller.

   l. The gate shall fail-safe open upon loss of power. In addition, gate shall have a manual by-pass of the gate controller.

   m. Ten (10) openers shall be provided to be used by the Owner during construction. Openers shall be compact, one-button decodable transmitter remote control.

   n. The gate controls shall be reprogrammed following completion of the Project. Twenty (20) openers shall be provided to the Owner. Openers shall be compact, one-button decodable transmitter remote control.

7. Required external sensors: Photo eyes and gate edges shall be installed such that the gate shall reverse in either direction upon sensing an obstruction.

8. Vehicle Loop Detector System

   a. Provide vehicle loop detection system for gate entrance and gate exit.

   b. System shall include automatic closing timer with adjustable time delay before closing timer cut-off switch and loop detector designed to open and close gate and hold gate open until traffic clears and reverse gate.

c. Provide electronic detector, with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator.

d. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, to perform automatic exiting of vehicles from Plant. Refer to Contract Civil Site and Electrical Site Plan drawings for details.

9. Heater with thermostat control. Heater shall be powered from Gate Entrance Control Panel.

10. Weather-stripped drive rail slot in chassis, and snow wiper blades for drive rail.

**2.02 - FACTORY TESTING**

A. Fully assemble and test, at the factory, gate operator to assure smooth operation, sequencing and electrical connection integrity. Apply physical loads to the operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the fully rated capacity of the operator components.

B. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity. Check welded corners and edges to assure they are square and straight.

C. Inspect painted finish for completeness and gloss. Touch up imperfections prior to shipment.

D. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

**2.03 - PRODUCT AND MANUFACTURER**

A. Provide slide gate operator as manufactured of one of the following:

1. Model 222 E, or equivalent, as manufactured by Hy-Security.

2. Or equal.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

**3.02 - INSTALLATION**

A. Installation shall be made by skilled mechanics experienced in erection of this type of fence. All posts shall be set in concrete foundations to a minimum depth of 48 inches. Diameter of the foundation shall be pipe O.D. plus 12-inches. The foundation shall be a 1-2-4 mixture of concrete and shall be 54 inches deep, minimum. All foundations shall extend approximately 1 inch above grade and shall slope away from the post to provide for proper drainage. Edge of foundation shall be flush with finish grade. Foundations shall be of the shape and sizes shown on the details.

B. Line posts shall be spaced at a maximum of 10-foot intervals. Intermediate rails shall be used to brace end and gate posts to the adjacent line post, and corner posts to the 2 adjacent line posts. Changes in line of 30 degrees or more shall be considered corners.

C. Top rails shall pass through the barbed wire support arms of line posts, forming a continuous brace from end to end of each stretch of fence. Lengths of top of rail shall be jointed by sleeve type couplings. Top rails shall be securely fastened to terminal posts by pressed steel fittings.

D. Chain link fabric shall be placed on the face of the post outside the enclosed areas. The fabric shall be placed approximately two inches above the ground and on a straight grade between posts. The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, gate, and corner posts shall be with stretcher bars and fabric

bands spaced at one foot intervals. Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh. Chain link fabric shall be fastened to the end bars of the gate frame by stretcher bars and fabric bands, and to the top and bottom bars of the gate frames by tie wires in the same manner as specified for the chain link fabric; or by other standard methods if approved by the Engineer. Vinyl fabric shall be protected from abrasion during shipping, storage and installation. Any abraded areas of fence shall be replaced or protected by painting with a matching PVC paint.

E. Barbed wire support arms shall be installed to slope towards the outside of the fenced area.

F. The motorized cantilevered slide gate shall be connected to the building electrical system as shown on the electrical drawings.

G. Locate concrete mounting pad in accordance with approved shop drawings.

H. Make sure that gate is operating smoothly under manual conditions before installation of gate operators. Do not proceed until gate panel is aligned and operates without binding.

**3.03 - FIELD QUALITY CONTROL**

A. Test gate operator through ten (10) full cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.

B. All anchor bolts shall be fully concealed in the finished installation.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

**SECTION 02445**

**VINYL FENCE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary to furnish and install vinyl fence as specified herein and as shown on the drawings.

B. Attention is directed to the GENERAL INFORMATION and DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Materials brochures.
2. Fabric and post samples showing size, color, and finish.
3. Drawings showing height of fence, sizes and types of materials used for entire fencing system.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not to degrade quality, serviceability or appearance.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM):

1. D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
2. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
3. D638: Standard Test Method for Tensile Properties of Plastics.
4. D648: Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. General. Entire fence and gate system shall be white vinyl.

B. Materials of Construction

1. Cell classification as per ASTM D1784 - 14344B
2. Tensile Strength - 6,500 psi as per ASTM D638
3. Izod impact (ft. lbs/in notch) 23'C - 5.0 O'C - 2.0 - ASTM D256
4. Tensile modulus 425,000 psi as per ASTM D638
5. Deflection Temperature 67° C as per ASTM D648
6. Thermal expansion 3 x 10.5 in / in F

### 2.02 - COMPONENTS

| Component | Cross Section (inch) | Wall Thickness (inch) | Corner Radius (inch) |
|---|---|---|---|
| Posts | 4 x 4 | 0.140 | 11/32 |
| | 5 x 5 | 0.135 - Standard Wall | 3/8 |
| | 5 x 5 | 0.170 - Heavy Wall | 3/8 |
| Rails | 1 1/2 x 1 1/2 | 0.120 | 7/32 |
| | 1 3/4 x 3 1/2 | 0.100 | 13/32 |
| | 3 x 3 1/2 - 'T' Rail | 0.095 | 13/32 |
| | 2 x 6 - Hollow | 0.125 | 5/16 |
| | 1 1/2 x 5 1/2 - Ribbed | 0.090 | 11/32 |
| | 2 x 6 - Ribbed | 0.090 | 5/16 |
| | 3 x 3 | 0.110 | 5/16 |
| | 3 1/2 x 3 1/2 | 0.115 | 3/8 |
| Pickets | 7/8 x 1 1/2 | 0.060 | 3/16 |
| | 7/8 x 1 1/2 - Heavy Wall | 0.090 | 3/16 |
| | 7/8 x 3 | 0.060 | 3/16 |
| | 7/8 x 6 - Ribbed | 0.060 | 3/16 |
| | 7/8 x 7 - Tongue & Groove | 0.060 | 1/16 |
| | 1 1/2 x 1 1/2 | 0.060 | 7/32 |

### 2.03 - GATES – NOT USED

## PART 3 - EXECUTION

### 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

### 3.02 - INSTALLATION

A. Installation shall be made by skilled mechanics experienced in erection of this type of fence.

B. All posts shall be set in concrete foundations to a minimum depth of 48 inches. Diameter of the foundation shall be post O.D. plus 12-inches. The foundation shall be a 1-2-4 mixture of concrete and shall be 54 inches deep, minimum. All foundations shall extend approximately 1 inch above grade and shall slope away from the post to provide for proper drainage.

C. Line posts shall be spaced at a maximum of 10-foot intervals. Intermediate rails shall be used to brace end and gate posts to the adjacent line post, and corner posts to the 2 adjacent line posts. Changes in line of 30 degrees or more shall be considered corners.

D. All connections shall be in accordance with the manufacturer’s recommendations.

E. Any abraded areas of fence shall be replaced at no cost to the Owner.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

**SECTION 02483**

**PLANTING OPERATIONS**

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3.08 – CONTRACT CLOSEOUT ..... 6

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes furnishing all labor, equipment, tools, materials and accessories necessary for the complete planting and maintenance of trees, shrubs and ground cover as may be indicated on the drawings, and as specified herein.

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. An allowance has been established to provide planting materials. Should the actual charges exceed or be less than the amount indicated, the difference will be paid by or returned to the Owner. A paid invoice from the nursery shall be submitted to the Engineer by the Contractor. Refer to SECTION 01020, ALLOWANCES.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with provisions of DOCUMENT 00700, GENERAL CONDITIONS.

B. Submittals shall include shop drawings including at least the following:

1. Information about the Landscape Contractor or Arborist.

2. Complete list of all materials to be provided showing the details identified herein.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the American Association of Nurserymen’s written recommendations.

B. The Contractor shall maintain all plant material and associated work until final acceptance by the Engineer. Maintenance shall include all pruning, spraying, watering, cultivation and weeding of all planted areas, and the repairing or replacement of all staking, wrapping, mulching and edging materials and any other operations necessary until final acceptance.

C. Water will be furnished by the Contractor. The Contractor shall furnish all necessary hoses and such other accessories as may be required.

**1.06 - DESIGN CRITERIA**

A. Plant material shall be installed by a competent Landscape Contractor or Arborist. Such company shall be certified, or licensed, or affiliated (by membership) with the American Association of Nurserymen or appropriate State organization. The Landscape Contractor or Arborist shall provide references of similar installations.

B. All planting materials shall comply with the American Association of Nurserymen's American Standard for Nursery Stock as last amended. All plant names shall be "Standardized Plant Names" as designated by the American Joint Committee on Horticultural Nomenclature (1942), as last amended.

C. All plant material shall be inspected and approved by the Engineer prior to planting. Any plant material which does not meet the criteria specified shall be replaced with approved plants at the Contractor's expense.

D. All plants shall meet the requirements specified on the planting plan.

E. All plant material shall be nursery grown and shall be shapely, well-grown, healthy, sound, and free of disease, insect pests, eggs or larvae, and shall have a well developed root system.

F. All trees and shrubs shall be freshly dug; no heeled-in plants or plants from cold storage will be accepted. All plants shall be hardy under climatic conditions similar to those in the locality of the project.

G. All plants shall be handled so that roots will be adequately protected at all times from drying out and from other injury. All plants shall be covered and braced during transportation.

H. Each tree or shrub shall be properly identified by name on legible, weatherproof labels securely attached thereto. Balled and burlapped plants shall have firm, natural balls of soil, the diameter and depth of which shall be sufficient to include the roots. The earth ball shall be adequately wrapped and secured with burlap. Container grown shrubs may be substituted for balled and burlapped shrubs.

I. Container grown plants shall have sufficient roots to hold planting mix in tact after removal from containers without being root bound.

J. When plants of kinds and sizes specified are not available within a reasonable distance, substitutions may be made upon written approval of the Engineer.

K. All plants shall conform to the measurements specified in the plant list and as set forth in American Association of Nurserymen's American Standard for Nursery Stock as last amended. Where a size range is given, at least 40 percent of those plants shall be at or above the average for that size range. Exceptions are as follows: Plants larger than specified in the plant list may be used if approved by the Owner, but use of such plants shall not increase the cost to the Owner.

L. Prior to planting, all planting pits will be inspected by the Engineer. Planting pits which do not meet the minimum requirements of the details indicated, shall be reshaped as necessary for approval by the Engineer.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS FOR GUYING, STAKING AND WRAPPING

A. Stakes - Stakes for supporting trees shall be of the sound wood of uniform size, reasonably free of knots and capable of standing in the ground at least two years. Stakes shall be 2 inches square and shall not be less than 8 feet in length.

B. Wire - Wire for tree bracing and guywire shall be pliable No. 12 gauge galvanized soft steel wire.

C. Hose - Cinch-tie or approved equal hose, if used, shall be two-ply fiber bearing garden hose, not less than 1 inch inside diameter.

D. Webbing - Web straps shall be three inches wide as manufactured by Duckbill, or equal and shall be provided with grommets. Hose shall not be allowed.

E. Wrapping Material - Wrapping material shall be first quality, heavy waterproof crepe paper manufactured for this purpose.

### 2.02 - PLANTING SOIL FOR PLANTING PITS AND PLANTING BEDS

A. Topsoil shall meet the specifications and shall be analyzed as described in SECTION 02485, LOAMING AND SEEDING.

B. Prepared planting mixture shall conform to standard planting practices and the following minimum requirements. Any deviations will be subject to the Engineer's approval.

1. Prepared planting mix shall be 1/3 peat and 2/3 topsoil plus fertilizer/additives as required by the Engineer based on recommendations from testing laboratory reports.

2. Ground cover and shrub planting beds shall have 1-inch layer of peat plus fertilizer/additives as required spread evenly over beds. Peat/additives shall then be cultivated into the top six inches of soil.

C. Peat shall be a commercial grade peat meeting the approval of the Engineer.

D. Fertilizer shall be furnished in manufacturer's standard containers clearly marked with the guaranteed chemical analysis of the product and shall be of the type and formulation specified by the Engineer. The fertilizer shall conform to local and federal regulations.

E. Limestone shall be standard agricultural ground limestone and shall be delivered in the manufacturer's standard containers with a guaranteed analysis appearing on each container.

F. Mulch shall be chip or chunk bark. Bark shall be fresh and undecayed, clean and free from weeds, leaves, moss, sticks and any other debris, and be of such a texture to resist washing or blowing. No long strips, decayed material nor sawdust will be permitted.

G. Wetting agent shall be non-ionic surfactant consisting of a 50 percent polyoxyethylene ether and 50 percent polyoxyethylene ether chemical type, preferably in a granular form for spreader application.

H. Anti-Transpirant shall be delivered in manufacturer's containers, unopened, with manufacturer's labels attached.

## PART 3 - EXECUTION

### 3.01 - SEASONS FOR PLANTING

A. Seasons for planting shall be as recommended to the Contractor by the nursery supplying the plant materials, relating to site conditions, plant species, and region where planting is to be done.

B. Planting shall be prohibited in frozen or muddy ground.

C. Approximate planting dates shall be furnished to the Engineer for approval. Material planted out-of-season shall be given extra care and attention by the Contractor. Any out-of-season planting shall be entirely at the Contractor's risk.

### 3.02 - PLANTING OPERATIONS

A. Locations for planting beds, trees and shrubs shall be staked out by the Contractor as shown on the drawings and approved by the Engineer.

B. Plant pits shall be excavated with vertical sides in accordance with the details on the drawings. Plant pits shall not be backfilled with prepared topsoil mixture until they have been approved by the Engineer. If pits are prepared and backfilled with topsoil to grade prior to planting, their location shall be marked and recorded on the plans so that when planting proceeds they can readily be located.

C. Prepared topsoil mixture for backfill in all planting areas shall have all fertilizer/additives, as specified herein, thoroughly incorporated before backfilling.

D. Plants shall be set in center of pits plumb and straight and at such a level that after settlement, the crown of the plant will be at the surrounding finished grade.

E. Backfilling and Watering

1. When balled and burlapped trees are set, topsoil shall be compacted around bases of balls to fill all voids. All burlap, ropes or wires shall be removed from the tops of balls.

2. Planting pit shall be backfilled to its depth. Backfill shall be compacted and pit then filled with water.

3. After two waterings have been completely absorbed, the top half of the pit shall be backfilled and compacted.

4. 1-3/4 pounds of granular wetting agent/100 square foot shall be applied to newly planted area. Wetting agent shall be raked lightly into top inch of soil and then soil raked smooth.

5. A shallow saucer larger than pit shall be formed with a 4-inch ridge of soil to facilitate and contain watering.

6. Immediately after planting, the plant shall be thoroughly watered by completely filling the saucer with water a minimum of two times.

7. Ground cover beds shall be watered to a minimum depth of 4 inches immediately after planting (after application of wetting agent).

F. Tree guying or staking shall be in accordance with the plan detail. Care shall be taken that stakes do not pierce rootballs.

**3.03 - OBSTRUCTIONS BELOW GROUND**

A. In the event that rock, underground construction work or obstructions are encountered in any plant pit excavation work to be done under this contract, alternative locations may be selected by the Engineer.

B. Where locations cannot be changed, the obstruction shall be removed to a depth of not more than 3 feet below grade and no less than 6 inches below bottom of ball or roots when plant is properly set at the required grade.

C. The Contractor shall be paid for the removal of such rock or underground obstructions encountered at the Contract rate per cubic yard, under the appropriate item in the proposal. Limits of payment for excavation in rock fill are 1 foot outside the plant or tree root ball as shown on the drawings.

**3.04 - UNDERGROUND UTILITIES**

A. The Contractor shall be responsible for obtaining plans and locations of utilities and existing underground structures.

**3.05 - WRAPPING**

A. Wrapping of all trees shall be done immediately after they are planted. The trunks of all trees shall be wrapped spirally from the bottom to top with material as specified and shall be adequately secured. The wrapping shall overlap and entirely cover the trunk from the ground to the height of the second branches and shall be neat and snug. Overlap shall be approximately 2 inches apart.

**3.06 - PRUNING, MULCHING AND WATERING**

A. Each tree and shrub shall be pruned in accordance with American Nurserymen Association Standards to preserve the natural character of the plant and in a manner to meet its particular requirements in the landscape plan.

B. All dead wood, suckers and all broken or badly bruised branches shall be removed. Leaders shall not be cut back. Container grown plants shall not be thinned.

C. Pruning shall be done with clean, sharp tools. All cuts are to be made flush and clean.

D. Cuts over 1 inch in diameter shall be painted with an approved tree wound paint. Paint shall cover all exposed cambium as well as other exposed living tissue.

E. Immediately after planting operations are completed, all tree and shrub pits and ground cover beds shall be covered with a uniform 4-inch layer of bark mulch as indicated on the drawings. All remaining planting beds and disturbed areas where no grass is specified shall be mulched with a uniform 4-inch layer of bark mulch which shall extend to edging strips, walks, walls, curbs or other hard surfaces or undisturbed areas.

F. All plant material shall be watered (by flooding) twice during the first 24-hour period after planting.

G. If a problem should arise with a planting, an anti-transparent shall be applied as directed by the Engineer.

**3.07 - INSPECTION AND ACCEPTANCE**

A. Inspection for Provisional Acceptance

1. Upon completion of work, the Contractor shall request an inspection for provisional acceptance by the Engineer. The request shall be received at least 10 days prior to the requested date for provisional inspection.

2. Upon completion of all repairs and replacements by the Contractor as requested by the Engineer, the Engineer shall issue a dated written order of provisional acceptance.

B. All plantings shall be guaranteed by the Contractor for one year. Provisional acceptance will be given by the Engineer following inspection to ensure compliance with the drawings, details and specifications.

C. At the end of the guarantee period, a final inspection of the work shall be made to determine the condition of plant materials. All plants not in a healthy growing condition as determined by the Engineer shall be removed from the site and promptly replaced with plants as specified for the original planting at no expense to the Owner.

D. Plantings replaced at final inspection shall be subject to all requirements in the specifications for the original work including planting, provisional acceptance, guarantee period and final inspection.

## 3.08 – CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02485**

**LOAMING AND SEEDING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, materials, tools and equipment required to furnish and install loam and seeding in areas as shown on the drawings, unpaved areas disturbed by the Contractor's operations and work, or any cross-country or lawn areas disturbed by the Contractor's operations during the course of construction.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Soil test results and recommendations for liming and fertilizing shall be submitted to the Engineer at least 45 days prior to loaming operations.
2. Certification of variety, proportions and percent germination of species in the seed mixture and percentage of crop seeds, weed seeds, noxious weeds and inert matter shall be submitted to the Engineer at least 45 days prior to loaming and seeding operations.
3. Brochures and samples for woven jute mesh netting and erosion control blanket.

**1.05 - PRODUCT HANDLING**

A. All materials shall be shipped, stored, handled and installed according to the American Association of Nurserymen’s written recommendations.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - SEASONS FOR PLANTING**

A. Seeding shall take place as soon as possible after each loam area has been prepared, in accordance with the recommendations of the seed supplier relating to the site conditions and region where seeding is to be done. Seeding shall be prohibited during windy or inclement weather, or in frozen or muddy ground; in general, conditions for seeding shall meet with the approval of the Engineer. This does not relieve the Contractor of the responsibility of providing a growth that is full and healthy, in the opinion of the Engineer.

**PART 2 - MATERIALS**

**2.01 - LOAM**

A. Testing

1. All loam used in the work of this section of the specifications will be tested and approved for use by the Engineer prior to being spread. Stripped material may be used if approved in accordance with the following requirements. Approved material shall be stockpiled so as not to interfere with the other work and other subgrade or fill materials.

2. All testing shall be done by an independent test laboratory approved by the Engineer. The Contractor shall provide the laboratory with representative soil samples for testing and send test reports directly to the Engineer.

3. Loam shall be tested for the following: pH, organics, buffer pH, soluble salts (expressed in millimhos), available Nitrogen, Phosphorous, exchangeable Potassium, Magnesium, Calcium and Sodium, Cation Exchange Capacity, percent H base saturation, percent Ca base saturation, percent M base saturation, and available Zinc, Manganese, Copper, Iron, humus content and soil type. All nutrient results shall be expressed in parts per million (ppm).

4. Test reports shall also contain specific recommendations as to the exact types and times and rates of application of soil additives and fertilizers based upon the soil test results. These recommendations shall be followed during lawn construction. All Contractors shall note that any and all materials and procedures, with respect to soil additives and fertilizers, contained herein are approximate and are given to assist bidding and that they will be adjusted to comply with test reports.

B. Loam shall be a "fine sandy loam", or a "sandy loam" determined by mechanical analysis and based on the "U.S.D.A. Classification System". It shall be of uniform composition, without mixture of subsoil. It shall be free of stones, lumps, plants and their roots, debris and other extraneous matter over 1/2 inches in diameter or excess quantities of smaller pieces of the same materials as determined by the Engineer. It shall not contain toxic substances harmful to plant growth. It shall be obtained from naturally well drained areas which have never been stripped before.

C. No more than 10 percent of loam shall be clay, with organic matter comprising not less than 4 percent, nor more than 20 percent of the total weight per load.

D. Loam shall not be delivered or worked in a frozen or muddy condition.

E. Soluble salts shall not be higher than 75 parts per million.

**2.02 - LIME**

A. Limestone shall be standard commercial ground limestone and shall be applied at a rate to be determined by the Engineer subsequent to the testing of loam; however, the rate shall not exceed 4,000 pounds per acre. Limestone shall not be installed during windy or inclement weather. Limestone in hydro-seeding operations shall be restricted in building areas. Any buildings or structures discolored or damaged from limestone spray shall be the Contractor's responsibility.

B. The Contractor shall take whatever precautions are deemed necessary to prevent damage by distribution of limestone. Any damage incurred by the Contractor's negligence shall be repaired at no additional cost to the Owner.

**2.03 - COMMERCIAL FERTILIZER**

A. Commercial fertilizer shall be a standard dry granular mixture, delivered in the manufacturer's containers and containing a guaranteed analysis by weight of Nitrogen, Phosphorous and Potash, applied at the rate to be determined by testing.

**2.04 - SEED**

A. Grass seed shall be fresh, clean new crop seed. It may be mixed by an approved method on the site or may be mixed by the dealer. If mixed on the site, each variety shall be delivered in the original containers which shall bear the dealers analysis. If the seed is mixed by the dealer, the Contractor shall furnish to the Engineer, the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety.

B. The seed shall be furnished and delivered premixed in the proportions specified below. All seed shall comply with the State and Federal seed laws.

C. Grass seed shall be the previous year's crop and in no case shall the weed seed content exceed 1 percent by weight.

D. The seed mixture specified for slopes are for use on slopes graded at the rate of 4:1 and steeper slopes.

E. A manufacture's certificate of compliance to the specifications shall be submitted to the Engineer by the manufacturers with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content and sown until the contractor has submitted the certificates to the Engineer.

F. Seed Mixture shall conform with MassDOT M6.03.0 and shall be used for all loamed areas (150 pounds/acre). Seed mixture shall be in accordance with the following:

| Seed Type | Proportion | Germination Minimum | Purity Minimum |
|---|---|---|---|
| For Grassplots & Islands | | | |
| Creeping Red Fescue | 50% | 85% | 95% |
| Kentucky Blue | 25% | 85% | 90% |
| Domestic Rye | 10% | 90% | 98% |
| Red Top | 10% | 85% | 92% |
| Ladino Clover | 5% | 85% | 96% |
| For Slopes & Shoulders | | | |
| Creeping Red Fescue | 50% | 85% | 95% |
| Kentucky 31 | 30% | 85% | 95% |
| Domestic Rye | 10% | 90% | 98% |
| Red Top | 5% | 85% | 92% |
| Ladino Clover | 5% | 85% | 96% |

G. Wildflower Seed Mixture (34 pounds/acre)

1. Wildflower seed mixture shall be eight pounds of Loft's "Pinto" Wildflower Mix, mixed with 26 pounds sheep or hard fescue per acre of seeding.

2. Northeast Mixture by Applewood Seed Co., Arvada, Co., or Northeastern U.S. Wild Flowers by Environmental Seed Producers, Inc., El Monte, CA will be considered at double the manufacturer's recommended rate of application, mixed with sheep or hard fescue as specified above.

3. Wildflower Seed Mixture shall only be allowed in locations approved by the Owner and Engineer.

H. Wetland Seed Mixture

1. Wetland Seed Mixture shall be applied at a rate of 35 pounds per acre. Wetland Seed Mixture shall consist of a mixture of plant species as described below. Unavailability of the specified seed types or mix shall be verified in writing to the Engineer. Substitutions for the above table will be permitted only upon approval of the Engineer. Seed which has become wet, moldy, or otherwise damaged shall not be used.

2. The seeds shall be delivered to the project in labeled and sealed containers. Official Seed tags and shipment invoices from the seed suppliers shall be furnished to the Engineer. Seed may be sampled and tested by the Owner to verify the seed tag information. The Engineer will inspect each shipment for acceptability, upon delivery to the project.

3. The weight of the pure live seed (PLS) is computed by the labeled purity percent times the labeled germination percent times the weight. For example: Requirement is for 20 pounds of pure live seed of a specified variety and the Seed Tag data indicates that the variety is 99.41 percent pure and with 92 percent germination. Then the conversion to PLS is: 20 pounds divided by the product of 0.9941 and 0.92 equals 21.8 pounds, which meets the 20 pounds PLS requirement.

4. The wetland seed mix shall consist of a mixture of at least 15 wetland plant species native to Rhode Island. Seed shall be produced in nurseries in the northeastern United States. The seed quality and mixtures are based on pure live seed, and variation is allowed in the species composition and proportions of seed for individual species provided that:

   a) 65 to 80 percent of the seed by weight belongs to the genera *Carex*, *Juncus*, *Scirpus*, *Cyperus*, and/or *Shoenoplectus* and Fox sedge (*Carex vulpinoidea*) makes up 25 to 40 percent of the seed mix by weight.

      At least three additional species belonging to the genus *Carex* make up 15 to 25 percent of the mix. Recommended species are *C. comosa*, *C. crinita*, *C. gynandra*, *C. intumescens*, *C. lupulina*, *C. lurida*, and *C. scoparia*.

      At least three species that belong to the genus *Scirpus* (now *Shoenoplectus* in part) make up 10 to 15 percent of the seed mix by weight. Recommended species include: *Scirpus cyperinus, S. atrovirens, S. acutus,* and *S. validus* (now *Shoenoplectus tabernaemontani*).

      At least one species of the genus *Juncus* provides five to 10 percent of the seed mix by weight. Recommended species: *Juncus acuminatus*, *J. articulatus*, *J. canadensis*, and J. *effusus*.

      An additional eight or more native grasses and forbs species make up the remaining fraction of the seed mixture (minimum 20 percent by weight). Recommended species include Mud plantain (*Alisma plantago-aquatica*), swamp milkweed (*Asclepias incarnate*), flat-top aster (*Asterumbellatus*), spotted Joe-Pye-Weed (*Eupatoriadelphus maculatus*), boneset (*Eupatorium perfoliatum*), grass-leaved goldenrod (*Euthamia graminifolia*), fowl manna-grass (*Glyceria striata*), blueflag iris (*Iris versicolor*), swamp candles (*Lysimachia terrestris*), monkey flower (*Mimulus ringens*), sensitive fern (Onoclea sensibilis) (spore), marsh St. John's-wort (*Triadenum virginicum*), blue vervain (*Verbena hastata*), ironweed (*Vernonia noveboracensis*).

   b) No woody plant species will be acceptable.

   c) Seed mixes containing species included in the list of Invasive and other Unacceptable Plant Species in the most recent version of the U. S. Army Corps of Engineers New England District's "Guidelines for Mitigation Plan Checklist" will not be accepted. (The document is available at: http://www.nae.usace.army.mil/reg/check3.pdf).

3. Wetland Seed Mixture shall only be allowed in locations approved by the Owner and Engineer.

I. All topsoil stockpiles shall be stabilized by seeding with annual ryegrass at the rate specified for mowable grass seed mixture. Stockpiles shall be reseeded as necessary to maintain good cover for enrichment and to prevent erosion.

**2.05 - EROSION CONTROL BLANKET**

A. Erosion control blanket shall be "Hi-Velocity Curlex Blanket", as manufactured by American Excelsior, Co., Arlington, TX, or an approved equal. Erosion control blanket shall be placed on all slopes greater than 3 to 1.

Erosion control blanket will be required for the protection of all seed areas or in any area where erosion is a problem.

**2.06 - WOVEN JUTE MESH NETTING**

A. Woven jute mesh netting shall be "Ludlow Soil Saver", as manufactured by the Ludlow Corp., Needham Heights, Massachusetts, or an equal manufactured by Advance Netting Company, Lodi, New Jersey, or "Jute - Net" by Bemis, Inc., St. Louis, Missouri, and shall be placed on all slopes greater than 3 to 1, and all slopes 3 to 1 which are higher than 10 feet. Woven Jute Mesh Netting will only be required for the protection of mowable grassed areas or in any other areas where erosion is a problem.

**2.07 - STRAW**

A. Straw for erosion control and moisture retention shall consist of stems or stalks after threshing. Straw shall be kept in place by stakes, netting, pins or liquid coatings as may be required and as approved by the Engineer.

**PART 3 - EXECUTION**

**3.01 - SEEDING OPERATIONS**

A. Personnel for lawn work shall be familiar with lawn construction and shall be under the constant supervision of a qualified foreman.

B. Preparation for Seeding

1. Preparation of Subgrade. After the Engineer has accepted the subgrade, the Contractor shall do whatever additional grading is necessary to bring the subgrade to a true smooth slope, parallel to finish grade or to the level of adjacent existing loam areas. Subgrade depth for Lawn Areas shall be 6 inches while Subgrade depth for Cross Country Areas shall be 4 inches.

2. The top 3 inches of the subgrade immediately prior to being covered with loam shall be raked or otherwise loosened and shall be free from stones, rock and other foreign materials 3 inches or greater in dimension.

3. Sufficient grade stakes as determined by the Engineer shall be provided to insure correct line and grade of subgrade and of finished grade.

4. Subgrade shall be inspected and approved by Engineer before placing of loam.

5. Loam shall be as specified herein and shall be placed and spread over approved areas to a sufficient depth so that after natural settlement and light rolling for lawn areas, the completed work will conform to the lines, grades and elevations indicated.

6. Finish grading. After loam has been spread, it shall be prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over 1 inch in diameter shall be removed from the loam which shall also be free of smaller stones in excessive quantities.

7. The surface for lawn areas shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width.

8. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade.

9. Subsequent to or during raking of the loam and at least 4 days prior to seeding, lime shall be applied and raked into the soil over all loam areas.

10. After the lime has been applied and worked into the loam, the entire area shall receive an application of commercial fertilizer. Fertilizer shall be spread in advance of seeding by approved mechanical spreading devices and lightly taken into the top of the soil.

C. Placement of Seed

1. Seed shall be spread at least 4 days after fertilization of the soil by an approved mechanical method and at the rate of 5 pounds per thousand square feet or as noted with seed mix. Seed shall be lightly raked into the soil to a depth of approximately 1/8 inch and no greater than 1/4 inch and the entire seeded area shall be rolled with a lightweight roller.
2. Seeding shall not be done during windy weather.
3. For lawn areas, seeding shall be done in 3 directions, 2 at right angles to each other, and one diagonally.
4. Culti-packer or approved similar equipment may be used to cover the seed and to form the seed bed in one operation. Due to the small size of the seed in the cross-country mix, the Contractor shall increase the bulk prior to seeding by the addition and thorough mixing of sand, Milorganite or other approved materials.
5. Immediately after seeding, all seeded areas shall be watered to a depth of approximately 4 inches and shall be covered with a loose, uniform layer of straw or hay.

**3.02 - INSTALLATION OF EROSION CONTROL BLANKET**

A. Erosion control blanket shall be installed in accordance with the accepted practices and the manufacturer's instructions and recommendations by personnel experienced with similar installations. All products and/or fastenings shall be as supplied by or recommended by the manufacturer, subject to approval by the Engineer.

B. Erosion control blanket shall lay loose on the grade and shall not be stretched or tightened in any direction. The blanket shall conform naturally to the contour and grade of the proposed topography.

C. Anchor slots, butts with structures, walls, curbs, etc., side and junction overlaps and terminal folds shall be made and fastened in accordance with the manufacturer's recommendations or as directed by the Engineer.

**3.03 - INSTALLATION OF MESH NETTING**

A. Mesh netting shall be installed in accordance with accepted practices and the manufacturer's instructions and recommendations by personnel experienced with similar installations. All products and/or fastenings shall be as supplied by or recommended by the manufacturer, subject to approval by the Engineer.

B. Netting shall lay loose on the grade and shall not be stretched or tightened in any direction. The netting shall conform naturally to the contour and grade of the proposed topography.

C. Anchor slots, butts with structures, walls, curbs, etc., side and junction overlaps and terminal folds shall be made and fastened in accordance with the manufacturer's recommendations or as directed by the Engineer.

**3.04 - MAINTENANCE AND PROTECTION**

A. Maintenance shall begin immediately after each portion of the lawn is installed.

B. Lawns shall be maintained for at least 60 days or as much longer as necessary to establish a uniform stand of the specified grasses.

C. Maintenance and protection of seeded areas shall consist of temporary protective fences, barriers, signs, watering, weeding, cutting, and reseeding as necessary, as well as maintaining the straw or mesh cover in a uniform layer.

D. The surface layer of soil shall be kept damp at all times during the germination period. In the absence of adequate rainfall, watering shall be performed two or three times daily or as often as necessary during the germination period and in sufficient quantities to maintain moist soil to a depth of at least 4 inches. Watering shall be done during the heat of the day to prevent the soil from drying out.

E. After first cutting, watering shall be once per week as necessary to supplement natural rain, to the equivalent of 1 inch per week, or to 4 inches in depth. Weekly inspection shall be made to determine the moisture content of the soil and the approved schedule shall be adjusted to fit conditions.

F. At the time of the first cutting, when grass is 4 inches high, mower blades shall be set at 2-l/2 inches high. In subsequent mowings, lawn areas shall be cut to a 2-l/2 inches height with not more than 40 percent of the grass leaf being removed. Naturalized seed mixture shall be cut only once per year during dormant periods as recommended by the manufacturer.

G. All clippings shall be removed after each mowing. Mowing shall be done only in dry weather.

H. The Contractor shall be responsible for providing a second application of commercial fertilizer should lawn work not be accepted within a 90-day period following the first application of fertilizer.

I. Excessive weeds shall be removed by methods approved by the Engineer.

J. The Contractor shall, at his own expense, repair bare spots and/or damage resulting from erosion, gulleys, washouts, or other causes by filling with topsoil and reseeding.

K. In the event that lawn operations are completed too late in the fall for adequate germination and/or growth of grass, maintenance shall continue into the following spring.

**3.05 - INSPECTION AND ACCEPTANCE**

A. The Engineer will inspect the seeded areas upon written request by the Contractor. The request shall be received at least 10 days before the anticipated date of inspection.

B. Inspection and acceptance of seeded areas may be requested and granted in part, provided the area for which acceptance is requested is relatively substantial in size and reasonably regular in shape with clearly definable boundaries.

C. An acceptable seeded area shall be one that has a dense, uniform stand of the specified species. It shall be free of ruts, gullies, bare spots, and the grass areas shall be healthy and free of weeds.

D. Upon acceptance of the work, the Contractor shall be relieved of further responsibility for care or maintenance of accepted lawns.

**3.06 - DAMAGE AFTER ACCEPTANCE**

A. Any lawns damaged after final acceptance of seeded areas and before project acceptance shall be repaired, reseeded, and maintained as specified above with an inspection and formal acceptance required.

**3.07 - CLEANING UP**

A. When any of this work is done while buildings are occupied, pavements shall be kept clear at all times, and broomed clean to prevent tracking dirt into buildings.

B. After completion of all landscaping work, all debris and excess material shall be disposed of to the satisfaction of the Engineer. All pavements shall be broomed and hosed clean.

## 3.18 – CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02503**

**PAVING, CURBING, SIDEWALKS AND ROADWAYS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work covered by this section of the specifications includes furnishing all labor, equipment, tools, and materials, and in performing all operations in connection with roadway pavement overlay, and the replacement of existing paved surfaces, tack coat, installation of bituminous concrete curb, brick sidewalks, cement concrete sidewalks, bituminous concrete sidewalks, pavement markings, and all incidental work pertaining thereto as indicated on the drawings and as specified herein.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Prior to the start of construction, the Contractor shall prepare, submit and obtain written approval from the Owner for the various proposed methods of site restoration work. As part of this approval process and prior to the start of grading and paving operations, the Contractor and the Contractor's paving subcontractor shall meet with the Owner and Engineer to review the requirements for Project Site restoration. No payment shall be made for any work on this project unless these requirements have been met.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Material reports for bituminous concrete pavement job mix formula and tack coat.
2. Material report (job mix formula) for cement concrete.
3. Survey of establishment of roadway grades along the entire length of each roadway.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Environmental Conditions

1. Permanent paving shall be placed only when the underlying surface is dry, when the atmospheric temperature in the shade is above 40 degrees F, and when the weather is not foggy or rainy, provided, however, that the Engineer may permit, in case of sudden rain, the placing of mixture then in transit from the plant, if laid at proper temperature and if the roadbed is free from pools of water. Such permission shall in no way relax the requirements for quality of the pavement and smoothness of surface.
2. No material shall be laid upon a frozen base course or when wind conditions are such that rapid cooling will prevent satisfactory compaction. No load shall be sent out so late in the day that spreading and compaction cannot be completed during daylight.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. All materials shall conform to the requirements of "The Commonwealth of Massachusetts Highway Department (MHD), Standard Specifications for Highways and Bridges", latest edition (hereinafter referred to as the "State Specifications") and as specified herein.

**2.02 - CALCIUM CHLORIDE – Not Used**

**2.03 - BASE COURSE**

A. Gravel base course shall conform to the requirements for gravel fill in SECTION 02220, EARTHWORK, except that the maximum size of stone in the gravel shall be 3 inches.

B. Dense graded crushed stone base course shall conform to the requirements of Section M2.01.7 of the State Specifications.

**2.04 - BITUMINOUS CONCRETE PAVEMENT**

A. The binder and top courses for Class I, Type I-1, bituminous concrete pavement shall conform to the requirements of Section M3.11.00 of the State Specifications.

B. The general composition limits of materials, which make up the Job Mix Formula, shall conform to columns entitled "Binder Course" and "Top Course" as listed in Section M3.11.03 of the State Specifications. No bituminous concrete pavement shall be placed until the Engineer approves the Job Mix Formula.

**2.05 - BITUMINOUS CONCRETE FOR TEMPORARY SURFACING**

A. Hot mixed bituminous concrete shall be as specified hereinbefore for binder course or top course unless otherwise authorized by the Engineer.

B. Cold mixed bituminous concrete shall be a suitable type as approved by the Engineer. Cold mix may only be used when hot mixed bituminous concrete is not available and when authorized by the Engineer.

**2.06 - TACK COAT**

A. Tack Coat shall conform to the requirements of Section M3.03.0 of the State Specifications.

**2.07 - CONCRETE SIDEWALKS**

A. Cement concrete for walks shall be of 5,000 psi compressive strength at 28 days and shall conform to Section M4.02.00 (air entrained) of the State Specifications.

B. Welded steel wire fabric shall conform to the requirements of Section M8.01.2 of the State Specifications and shall meet AASHTO-M55 and shall have a minimum end-lap of six inches except where expansion joints occur. Mesh shall be 6 inches by 6 inches, W2.9 by W2.9 welded wire fabric.

C. Pre-molded expansion joint filler shall conform to Section M9.14.0 of the State Specifications and shall meet AASHTO-M153 thickness and widths required for the expansion joint widths.

**2.08 - TEXTURED CONCRETE SIDEWALKS – Not Used**

**2.09 - GRANITE CURBING**

A. Curbing shall be of a hard and durable granite, light gray in color, free from seams which would impair its structural integrity, and of a smooth splitting character. Natural color variations characteristic of the deposit will be permitted. Curbing shall be of the sizes indicated on the drawings.

B. Vertical Curbing shall be type VA-4 and shall conform to Section M9.04.1 of the State Specifications. Stone set on a radius of 100 feet or less shall be cut to the curve required.

C. Sloped Curbing shall be Type SA and shall conform to Section M9.04.2 of the State Specifications.

D. Transition Stones shall be as manufactured by Fletcher Co., Baretto Granite Corp., North Carolina Granite Corp. or equal. Stone shall match curb Type VA-4 at one end and SA at the other and shall conform in all other respects to the State Specifications.

E. Curb Inlets shall conform to Section M9.04.5 of the State Specifications.

F. Curb Corners shall be Type A (2-foot radius) and shall conform to Section M9.04.6 of the State Specifications.

**2.10 - MORTAR – Not Used**

A. Mortar for pointing joints in granite curbing shall be composed of equal parts of cement and sand with sufficient water to form a workable mixture. The materials shall conform to the requirements of Section M4.02.15 of the State Specifications.

**2.11 – GUARDRAIL**

A. Steel guardrail shall conform to the requirements of Section M8.07.0 of the State Specifications for wood [steel] posts and Type SS single face guardrail elements and terminal sections, except that all steel elements and hardware shall be of corrosion resistant steel in conformance with AASHTO M 180, Class A, Type 4. Wood shall be treated with chromated copper arsenate to retention of 0.40 lbs./cu. ft.

B. Wood guardrails and posts shall be Douglas fir (coast region) or long leaf southern yellow pine, select structural grade or better, and shall be sound, well-seasoned, and straight grained, free from shakes and large or loose knots and shall have no decayed wood, worm holes, or any defects which, impair its' strength or durability for the purpose intended. Timber shall be treated with an oil-borne preservative conforming to the requirements of AASHTO-M133, Type C, to a retention of 6 pounds cubic foot of wood.

**2.12 - PARKING AND ROADWAY MARKINGS**

A. Paint for parking and roadway markings shall be a white and/or yellow reflectorized, fast drying paint, conforming to Section M7.01.0 of the State Specification with glass beads conforming to Section M7.01.07.

B. Temporary markings for parking and/or roadways shall conform to Section M7.01.16 for reflective glass spheres.

**2.13 - VEHICLE LOOP DETECTORS – Not Used**

**2.14 – PAVEMENT MARKINGS**

A. State Roadways

1. Thermoplastic Road Paint shall be utilized for Pavement Markings located in State roadways. Thermoplastic Road Paint shall conform to MassDOT requirements.

2. Glass beads shall be added to the Thermoplastic Road Paint for extra reflectivity.

3. The colors of the marking materials shall be the standard highway colors of white or yellow and as outlined in the Manual on Uniform Traffic Control Devices.

B. Town Roadways

4. Acetone Road Paint shall be utilized for Pavement Markings located in Town roadways. Acetone Road Paint shall meet Federal Specification AA 2886 Type II.

5. Glass beads shall be added to the Acetone Road Paint for extra reflectivity.

C. Glass beads, tapes and paints used for pavement markings shall be lead free, conform to MassDOT requirements and meet the retro-reflectivity requirements of the Manual on Uniform Traffic Control Devices.

**PART 3 - EXECUTION**

**3.01 - DUST CONTROL**

A. Water shall be applied to control dust. The use of calcium chloride is not allowed.

B. Water shall be uniformly applied at least once a week or as directed by the Owner and/or Engineer.

C. Water for dust control shall be metered and paid for by the Contractor.

**3.02 - PREPARATIONS FOR BITUMINOUS CONCRETE PAVING**

A. Subgrade Preparation

1. All trenches shall be backfilled and compacted as required under the SECTION 02220, EARTHWORK. The edges of all pavements along the line of the trench shall be cut back from exposed edges thereof, a sufficient distance to form a clean, sharp straight edge essentially parallel to the centerline of the trench. The minimum lateral cut back to be allowed will be 12 inches. Cut back pavement shall be carefully removed to minimize any disturbance to foundation materials. The exposed surface of the foundation material shall then be rolled, wetting the surface as necessary to obtain a firm, even surface. Any depressions or uneven areas shall be regraded and re-rolled until the surface is smooth and satisfactorily compacted.

2. The edges of all other pavements (driveways and intersecting roadways) along shall be cut back from exposed edges thereof, a sufficient distance (as determined in the field by the Engineer) to form a clean, sharp straight edge essentially parallel to the centerline of the trench.

3. The Contractor shall rough grade and fine grade all roadways. In order to facilitate grading of the roadways, the Contractor shall establish grades along the entire length of each roadway. Grades shall be established along the centerline of each roadway as well as each side of the roadways. Grading shall be adjusted for driveways aprons and sidewalks. The Contractor shall engage an independent Registered Land Surveyor in the state of Massachusetts with experience with establishing roadways grades. The survey shall be submitted as a shop drawing for review and approval. The Owner has the right to adjust existing roadways grades as part of the final rough grading and fine grading at no cost to the Owner.

4. All surfaces to receive pavements shall be examined by the paving subcontractor to see that they are in proper condition to receive paving. Starting work in any area shall constitute acceptance of that surface. Sub-grade shall be maintained in satisfactory condition and properly drained until surface improvement is placed. All defects resulting from use of unaccepted surfaces shall be corrected by the Contractor at no cost to the Owner.

B. The Contractor shall raise all Owner drain and sewer manhole frames and covers, catch basin frames and grates and gate boxes to the established grades as shown on the Contract Drawings before paving is applied.

C. Prior to submitting its bid, the Contractor shall contact the other utilities so as to gain their requirements concerning any possible adjustment of gate boxes and other such structures. If the utility wishes the Contractor to raise these boxes it shall be in accordance with the utilities requirements. If the utility wishes to adjust their own gate boxes the Contractor shall give the utility adequate notice of his paving schedule.

D. If the gravel base course is disturbed by the adjustment of utilities, the disturbed base material shall be carefully removed and replaced with Portland cement concrete. For additional requirements see DIVISION 3 - CONCRETE.

**3.03 - DRIVEWAYS**

A. All driveways shall be adjusted as required to meet the final grades of the roadway.

B. Bituminous Driveways - Where trenches are excavated through existing bituminous concrete paved driveways, the trench shall be resurfaced to match the existing depth or 2-inch binder course of bituminous concrete (whichever is greater) followed by a 1-1/2-inch top course over the full width of the existing paved driveway. The limits of the overlay course shall be as defined by the Engineer.

C. Brick and Cobblestone Driveways - Where trenches are excavated through existing brick and/or cobblestone driveways, the trench shall be restored with similar materials utilizing existing materials and/or new materials meeting the requirements specified herein. The limits of the restoration shall be as defined by the Engineer

D. Other Types of Driveways - Where trenches are excavated through existing driveway materials not included above, the trench shall be restored with similar materials, including but not limited to color, type, and size, utilizing existing materials and/or new materials. The limits of the restoration shall be as defined by the Engineer.

**3.04 - LEVELING COURSE**

A. Where specified or directed by the Engineer, the Contractor shall install a leveling course of bituminous concrete to the depths as required and as approved by the Engineer.

B. The leveling course shall be installed utilizing bituminous material as specified above for a top course.

**3.05 - TEMPORARY SURFACING**

A. Contractor shall place temporary surfacing as directed by the Engineer. Temporary surfacing shall be placed over trenches in hard surfaced streets and roads, and other areas where directed. Temporary surfacing shall be of bituminous concrete base course as specified herein before, laid in one courses, 3-inches thick. Backfill at top of trench shall be removed to allow for placing temporary surfacing.

B. Contractor shall maintain temporary surfacing in good condition. Trenches shall be inspected at least once a week and also immediately after each storm. Holes and settlements shall be promptly refilled with bituminous mixture.

**3.06 - PERMANENT SURFACING OF STATE STREETS AND MUNICIPAL STREETS**

A. Permanent resurfacing shall occur as specified in SECTION 01030, SPECIAL REQUIREMENTS.

B. Construction requirements for bituminous concrete pavement shall conform to Section 460 of the State Specifications.

C. Construction requirements for hot mix asphalt pavement milling shall conform to the Asphalt Institute Publication MS-22, "Construction of Hot Mix Asphalt Pavements.

D. After the trenches have been completely consolidated and when directed by the Engineer the Contractor shall place full width bituminous concrete pavement. If there has been an appreciable lag in time between installing bituminous concrete courses, or if the binder course has been used extensively during construction, the Engineer shall determine whether tack coat and/or cleaning will be required at no cost to the Owner.

E. Prior to placing bituminous concrete resurfacing over existing pavement, the Contractor shall thoroughly clean and repair the existing pavement to the satisfaction of the Engineer. Upon securing approval, the Contractor shall apply a tack coat as specified and shall place a bituminous concrete mix in an approved manner.

F. Prior to placing bituminous concrete resurfacing, the Contractor shall remove and replace existing curbing in the locations as determined by the Engineer.

**3.07 - BASE COURSE**

A. Construction requirements for gravel base course shall conform to the requirements for gravel fill in SECTION 02220, EARTHWORK.

B. Material as previously specified shall be placed and compacted to the required thickness for the particular application. The moisture content of material may have to be adjusted to obtain the specified compaction. Refer to the SECTION 02220, EARTHWORK for specific compaction requirements. After compaction, all base course for pavements shall be as indicated on the drawings.

**3.08 - CEMENT CONCRETE SIDEWALKS**

A. Construction requirements for cement concrete walks shall conform to the requirement of Section 476 of the State Specifications.

B. Walks shall be sloped as indicated on drawings and slightly adjust grades at intersections as required.

C. Concrete walk sections shall be one-course construction and of thickness, widths, and lengths shown on drawings.

D. The concrete shall be tamped and screened true to grade and section.

E. Expansion joints shall be ½-inch expansion joints, with pre-molded fillers here shown on the drawings and at walk junctions and intersections, at top and bottom of steps, and where walks abut building, platforms, or other fixed structures. Expansion joints shall extend full depth of concrete. Pre-molded filler shall extend to within 3/8 inch of the walk surfaces.

F. Control joints shall be located as shown on the drawings, depth and width as required.

G. Finish cement concrete walks shall be finished according to Section 476.67 of the State Specifications. A final medium broom finish shall be applied as indicated on the drawings.

**3.09 - BITUMINOUS CONCRETE SIDEWALKS – Not Used**

**3.10 - TEXTURED CONCRETE SIDEWALKS – Not Used**

**3.11 - INSTALLATION OF GRANITE CURBING AND CURB CORNERS**

A. In general, all work shall conform to Section 500 of the State Specifications.

B. The trench for the curb shall be excavated to a width of 18 inches. The subgrade of the trench shall be a depth below the proposed finish grade of the curb equal to six inches in depth, plus the depth of curbstone.

C. Upon the foundation additional gravel shall be spread and compacted as required and granite curb shall be set thereon. All spaces under the curbstones shall be completely supported throughout their length. The curb shall be set at the line and grade required. Gravel shall be carried up evenly on both sides of curb until curb is firmly anchored.

D. Joints between granite curbstones shall be at least 1/4 inch and no greater than 5/8 inch and shall be carefully filled with mortar for a depth of three inches in from the top front and back faces and shall be neatly pointed on the exposed faces.

E. Curb shall be protected from bituminous concrete during paving operations and shall be cleaned if bituminous concrete does adhere to exposed curb surfaces.

**3.12 – GUARDRAIL**

A. Installation of guardrail shall be conformance with Section 601 of the State Specifications. Post spacing shall be 6 feet 3 inches on center.

B. Installation shall include all excavation including the removal of any type of material encountered. Posts shall be installed plumb and true to line and grade. Backfill shall be thoroughly compacted in layers not exceeding 6 inches in thickness. Surplus material shall be reused on site or removed to a legal disposal area.

**3.13 – PAVEMENT MARKINGS**

A. Pavement marking shall be painted on non-windy days using whatever methods are necessary to prevent overspray from discoloring pavement. The locations, dimensions, color, etc. shall match existing/preconstruction conditions.

B. The Contractor is responsible for replacing all existing pavement markings including center lines, edge line, stop lines, crosswalks and lettering following temporary and permanent restoration of pavement.

**3.14 - REPLACEMENT OF CURBS, WALKS, FENCES, STONE WALLS AND OTHER SIMILAR ITEMS**

A. All existing curbs, walks, fences, stone walls and other similar items removed for the construction of the sanitary sewer, services, connections, water and/or storm drain lines shall be replaced in a manner equal or better than their original condition.

**3.15 - REPLACEMENT OF BRICK AND COBBLESTONE ROADWAYS, SIDEWALKS, AND DRIVEWAYS**

A. Existing brick and cobblestones used for roadways, sidewalks, driveways and/or cross walks, as applicable, shall be removed and place in a protected area.

B. Remove and place in a protected area all edging used for existing roadways, sidewalks, driveways and/or cross walks. It should be noted that existing edging consists of but not limited to steel, aluminum, granite and brick. Reset edging and/or replace any edging broken during removal at no additional cost to the Owner.

C. Remove sufficient depth of existing base materials replace with 6-inches of compacted stone dust for bricks and 6-inches of compacted stone dust and sand mixture at a 50/50 ratio for cobblestone. Rough and fine grade stone dust and compact to the required thickness for the particular application. Reset bricks and/or cobblestones with the smooth (worn and “weathered”) side up. Replace any bricks and/or cobblestones broken during removal at no additional cost to the Owner. Spread stone dust between the bricks and/or cobblestones to lock bricks and/or cobblestones in place.

D. Adjust all existing and newly installed utility boxes, frames and covers.

E. Sidewalks shall be sloped away from buildings to no more the ¼-inch per foot maximum toward the roadway. All existing structures including but not limited to tree grades, window wells, curbing, benches, utility boxes, and manholes shall match the elevation of the reset sidewalk.

**3.16 - VEHICLE LOOP DETECTORS – Not Used**

**3.17 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02520**

**WICK CONSTRUCTION AND TESTING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, tools, materials and equipment; and performing all operations in connection with the construction of five wicks, which includes, but is not limited to: clearing an preparation of site for access and wick installation, soil borings; excavation and legal disposal of soils; grain-size analysis of the natural soil formations; installation and removal of temporary wick casings; providing permanent wick casings; providing access well screens; transporting and installation of artificial filter pack; performing testing for plumbness and alignment throughout wick installation; performing 24-hour loading tests on each wick; performing video inspections of each wick and providing; and installing protective vaults with locking covers as specified herein and/or as shown on the Contract Drawings.

B. Permanent casings are designed as part of the wick and shall remain in place after wick is completed. Temporary casings shall be installed to facilitate wick construction and removed during or after construction.

C. The Contractor is responsible for the implementation of the specified test program including the selection of the final acceptance criteria for the wicks.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

E. Specialty Contractors provided for consideration:

Hub Foundation Co., Inc.
139 Billerica Road
Chelmsford, MA 01824
Phone: 978-456-2387
http://hubfoundation.com/

Maher Services, Inc.
71 Concord Street
North Reading, MA 01864
Phone: 978-664-9355
https://maherserv.com/

F.G. Sullivan Drilling, Co.
394 Parker Road
Lancaster, MA 01523
978-365-2932
https://fgsullivandrill.com/

New England Foundation Co., Inc.
One Westinghouse Plaza, Bldg. D
Boston, MA 02136
617-361-9750
http://www.nefco.com/

Atlas Drilling
85 Constitution Lane, Suite 100F
Danvers, MA 01923
978-304-0812
https://atlasdrillingllc.com/

Helical Geotechnical Design/Build
639 Granite Street, Suite 101
Braintree, MA 02184
781-848-2110
https://helicaldrilling.com

O. E. Dube & Son, Inc
769 Daniel Webster Highway
Merrimack, NH 03054
Phone: 603-669-4810

F. Specialty Contractor utilized for the installation of the existing Wick is:

Desmond Well Drilling, Inc.
5 Rayber Road
Orleans, MA 02653
Phone: 508-240-1000
https://desmondwelldrilling.com/

G. Wick Design

1) The Wick design is different from a typical water-well design. The Wicks are not intended for the extraction of water for drinking water supply. In fact, the bottom of the Wicks are located in unsaturated soils above the water table. MassDEP does not allow a Wick to be designed like a typical water supply well using a well screen. Therefore, the typical water-well design does not apply.

2) The gravel within the Wick must be installed against the natural formation. The bottom of the Wicks will be installed above the water table. The WWTF effluent will be discharged above the center of the Wick and will flow to the base of the Wick, where it will discharge out of the Wick, flowing into the natural formation. Flow from the Wick should always flow into the formation.

3) Similarly designed Wicks have been online since 2004 with no apparent plugging from surrounding soils.

4) The stainless-steel well screen referenced in the specifications applies to the three 6-inch diameter Wick access wells that will be installed in each Wick. These access wells will be used to observe Wick performance, once the Wicks become operational and for maintenance purposes.

H. Wick Drilling

1) The proposed drilling method is to be submitted by the Contractor for review and approval by the ENGINEER. Preferred methods of drilling are caisson drilling and dual rotary drilling, or other means suitable to the Engineer.

2) The specified plumbness criterion for the Wicks is a critical component for proper operation and maintenance.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

**1.04 - SUBMITTALS**

A. Submittals required under this section include, but are not limited to the following:

B. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

C. The following submittals are required four weeks prior to mobilization and construction.

1. The following Contractor qualifications:

a. Qualifications of the Cable Tool and/or Drilled Shaft Contractor, as specified herein.

b. Qualifications of the Soil Boring/Monitoring Well Contractor, as specified herein.

c. Qualifications of the Contractor's Cable Tool and/or Drilled Shaft Constructor, as specified herein.

d. Qualifications of the Contractor's Soil Boring/Monitoring Well Constructor, as specified herein.

2. A Drilled Borehole/Shaft Installation Plan containing, at a minimum, the following:

a. A proposed wick-construction diagram for each proposed wick. The diagram shall be a profile, having a vertical scale showing, at a minimum, the following:

1) All temporary and permanent casings, artificial filter pack design, and wick access well design including centralizers.

2) Proposed finished elevations including ground surface, top and bottom of artificial filter packs, top and bottom of wick access wells, top and bottom permanent casings, wick vaults, etc.

b. A detailed list of equipment and accessories proposed for use. The equipment list shall include drilling equipment, cranes, augers, bailing buckets, casing oscillators, casing twisters, vibratory hammers, final cleaning equipment, tremies, casing, etc.

c. Details of shaft excavation methods in soils and methods of removing any obstructions such as boulders or cobbles, including a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavations.

d. Details of the methods and materials used to properly space and install the stainless steel wick access wells, artificial filter pack and permanent casings.

e. Details of the proposed method(s) for ensuring drilled shaft stability during excavation.

f. Method of measuring plumbness and location of the drill shaft during construction using the methodology described in American Water Works (AWWA) Standard A100-15 (Appendix D) or Engineer approved equivalent.

g. Detailed procedures for temporary and permanent wick casing installation and removal, including casing dimensions.

h. A detailed description of the proposed drilling approach, sequence of operations and schedule.

D. Two weeks prior to construction, the Contractor shall attend a Preconstruction Meeting and submit the following for approval:

1. A shop drawing for the proposed stainless steel wick access wells, permanent casing and centralizers.

2. A shop drawing for the proposed artificial filter pack type, size, and source.

3. Contractor shall describe in detail his proposed drilling approach, sequence of operations, and proposed wick installation schedule.

E. The following submittals are required during construction including mobilization and demobilization.

1. Daily Activity Log which shall include the following information:

a. Project name and date.

b. Drilled shaft installation Contractor.

c. Soil boring logs.

d. Drilled borehole/shaft installation equipment.

e. Drilled shaft installation method and special advancement procedures.

f. Shaft location and number.

g. Shaft dimensions.

h. Steel reinforcement materials used.

i. Drilled shaft shell material.

j. Drilled shaft accessories.

k. Calculated drilled shaft volume.

l. Volume of artificial filter pack placed in each shaft.

m. Dimensions and slot-size of wick access wells installed.

n. Depth of wick access wells centralizers.

o. Drilled shaft vertical deviations and horizontal offsets.

p. Finished elevations (including ground surface, top and bottom of artificial filter pack, top and bottom of wick access wells, permanent casing and top of vault).

q. Copies of each wick video inspection.

r. Effective drilled shaft lengths.

s. Unusual occurrences and conditions.

2. Upon completion of the soil boring excavation, Contractor shall provide Soil Boring Logs which shall contain the following information:

a. Soil boring number, project identification including Engineer's project number, date boring was commenced and completed, and the driller's name.

b. Elevation of the ground surface at the soil boring location, if available.

c. Depth below ground surface or true elevation of each stratum of soil or rock encountered.

d. Description of each sample of soil obtained using the Unified Classification System (ASTM D2487), including the character of the material and its degree of compactness.

e. Depth below ground surface the water table was encountered and the length of the time after completion of the boring the measurement was taken.

f. Depth at which drilling fluid was lost in either soil, if such loss occurs, amount of loss and range of depth over which loss occurred.

g. Sample identification and depth range at which soil samples were collected for laboratory analysis.

h. Where samples are taken by ramming, the standard penetration resistance for each sample taken.

i. Comment by the drilling or field foreman covering any special conditions that were encountered.

j. The Contractor's form or the blank form provided by Engineer at the end of this Section may be used.

3. Upon completion of the soil boring excavation, Contractor shall provide summary grain-size analysis data sheets, grain-size distribution curves, and samples for all native-formation materials collected and laboratory analyzed.

k. Engineer shall consider the grain-size distribution curves and select the appropriate artificial filter packs and wick access well's screen slot size.

l. Once the screen for the wick access wells is selected, Contractor shall submit to Engineer for review and approval:

1) Manufacturer's data sheet for well screen that indicates the material of construction, strength, slot size, and open area per foot of screen.

2) Manufacturer's data sheet for the proposed artificial filter pack type, size, and source.

3) Samples of proposed artificial filter pack.

4) Shop drawing of the welding rod to be used to join stainless steel well screen.

5) Shop drawing of the welding rod to be used to join and secure the permanent steel casing.

4. Upon completion of each plumbness and alignment test, Contractor shall provide plumbness or "caging" logs properly filled out, for review and approval by Engineer. The Contractor's form or the blank "caging" form provided by Engineer at the end of this may be used.

F. Within one week of completion of each wick, Contractor shall provide a Wick Construction Record to the Engineer. At a minimum, the completed Wick Construction Record shall include the following:

1. Wick "RECORD DRAWING" Diagrams.

2. Wick Loading Test Records.

3. Wick Caging Logs.

4. Two copies of each wick access well video inspection on a USB flash drive.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and so as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable companies. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements are specified herein and or shown on the Contract Drawings.

C. Drilling of the borehole/shaft shall be in accordance with AWWA A100 standards and as approved by Engineer.

D. A typical wick diagram is provided on the Contract Drawings.

E. Each wick shall be a minimum diameter of 36-inches and installed to a depth of 100 feet below the ground surface unless otherwise approved by Engineer. Excavations for permanent wicks shall extend approximately 1 foot deeper than the design wick-depth. Therefore, the excavations shall extend to a depth of about 101 feet below ground surface for each wick.

F. Coarse gravel (approximately 3/4-inch diameter) shall be used as artificial filter pack and shall be placed in the annulus between the 6-inch diameter permanent stainless-steel access wells and the 24-inch diameter temporary casing to the limits specified and approved by Engineer.

G. Fine gravel (approximately 3/8-inch diameter) shall be used as artificial filter pack and shall be placed in the annulus between the 24-inch diameter temporary casing and the drill casing to the limits specified and approved by Engineer.

H. All wick materials, including wick access wells, access well centralizers, permanent casings, and artificial filter packs, shall be staged neatly at each wick site on wooden blocking or by other suitable means.

I. Cable Tool and Drilled Shaft Installer Qualifications shall be as follows:

1. Not less than three years of experience in the installation of cable tool and/or drilled shafts in similar conditions and of equal complexity as the proposed system;
2. Completed not less than five successful wells and/or drilled shaft installation projects of similar scope and magnitude (at least 24-inch diameter) as the proposed system within the past ten years;
3. Well drilling and/or shaft installation equipment operators and on-site supervisors shall have at least three years of experience installing drilled shafts; and
4. The name and experience record of each well driller/operator shall be submitted in writing to Engineer upon request.

**1.07 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Wicks will be installed as part of the construction of a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, the Contractor shall be provide an warranty of the Wicks warranting that all of the materials is new and of recent manufacture, all materials and workmanship and installation are of good quality, free from faults or defects in accordance with the requirements specified herein. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**1.08 - REFERENCES**

A. American Welding Society (AWS)
   1. D1.1/D1.1M: Structural Welding Code
   2. D1.4/D1.4M: Structural Welding Code, Reinforcing Steel

B. AMERICAN WATER WORKS ASSOCIATION (AWWA)
   1. AWWA A100: (2006; Errata 2007) Water Wells
   2. AWWA B300: (2010; Addenda 2011) Hypochlorites
   3. AWWA B301: (2010) Liquid Chlorine
   4. AWWA C654: (2013) Disinfection of Wells

C. ASTM INTERNATIONAL (ASTM)
   1. ASTM A312/A312M: (2015) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
   2. ASTM C136/C136M (2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
   3. ASTM D2487: (2011) Soils for Engineering Purposes (Unified Soil Classification System)
   4. ASTM D2488: (2009a) Description and Identification of Soils (Visual-Manual Procedure)
   5. ASTM D4750: (1987; R 2001) Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PROJECT DESCRIPTION**

A. Site preparation, including the clearing, grading, soils compaction, etc., shall take place for the access road, wick, vault, distributions box, and WWTF force main. The site preparation shall include the leveling and preparation of the ground surface at each wick location to allow for the proper installation of the soil borings and wicks.

B. The drilling of a minimum of 5 soil borings will be necessary to collect continuous soil samples between the ground surface and a depth of 120 feet belowground. A soil boring is to be drilled a maximum of 10 feet from each of the 5 proposed wick locations. A total of 25 soil samples, approximately 5 samples at each boring location, are to be collected and submitted to a laboratory for grain-size analysis. Soil boring logs and grain-size analyses results from soil boring previously drilled at the site are provided at the end of this section.

C. Each wick shall be located where directed by Engineer and constructed in accordance with these specifications. The approximate locations of the wicks are shown on the Contract Drawings.

D. A 36-inch diameter or larger borehole is to be drilled to a depth of 101 feet below ground surface at each wick location. Once drilled, 24-inch diameter temporary steel casing will be centered in the wick borehole to a depth of 100-feet below ground surface.

E. Three 6-inch diameter wick access wells will be installed and properly spaced inside within the 24-inch diameter temporary casing. Each access well will consist of 97 feet of 250-slot continuously wound stainless steel well screen installed from 3 to 100 feet below the ground surface.

F. Once the access wells are installed, course gravel shall be installed inside the 24-inch diameter temporary casing from the bottom of the borehole to a depth of approximately3.5 feet below ground. The gravel shall be installed using a tremie, taking care not to damage the gravel during installation.

G. A fine-gravel shall also be installed between the 24-inch and minimum 36-inch diameter temporary casings extending from the bottom of the borehole to approximately 3.5 feet below ground.

H. Once the fine- and course-gravel has been installed, the 24-inch diameter temporary casing shall be removed. The gravel can be installed in lifts as the 24-inch diameter casing is removed, if necessary.

I. Once the 24-inch diameter temporary casing has been removed, the minimum 36-inch diameter temporary casing shall be removed leaving a minimum of 8 feet of permanent casing (minimum 36-inch diameter) from approximately 3 to 11 feet below the ground surface. The permanent casing will need to be secured to the wick vault. A wick detail is provided on the Contract Drawings.

J. A vibratory hammer will not be allowed to assist in the installation or removal of temporary casings to minimize disturbance to the natural soils.

K. Drilling challenges may include cobbles and boulders which need to be anticipated during wick installation. Copies of the soils data are provided at the end of this section as part of the specification package.

L. Once the installations of all wicks and wick vaults have been completed, a 24-hour loading test shall be performed on each wick to obtain infiltration and wick efficiency rates. Each loading test shall be performed as directed by Engineer and in accordance with these specifications.

M. Once the installation of all wicks has been completed, a video inspection of each wick access well shall be performed.

**1.10 - EXPERIENCE AND QUALIFICATIONS**

A. If cable-tool drilling or drilled shaft methods are employed, contractor shall have a Certification to engage in the business of digging or drilling wells in the Commonwealth of Massachusetts, in accordance with 310 CMR 46.00, “Certification of Well Drillers and Filing of Well Completion Reports”, or its predecessor regulations in 313 CMR 3.00, “Water Well Diggers and Drillers Registration”.

## PART 2 – PRODUCTS

### 2.01 - SOIL BORINGS

A. General

1. The purpose of the soil borings is to determine the physical properties, arrangement and thickness of the various soil strata, as they exist in the ground. As the soil boring is advanced, special care shall be taken to note and record the depth at which groundwater is encountered and the depth at which drilling water is lost if this occurs. Soil borings shall be advanced using suitable casing and/or bits subject to the approval by Engineer.
2. Each soil boring through unconsolidated material shall be excavated with one of the following two techniques: rotary drilling with a hollow stem auger or direct push.
3. Soil borings shall be made with drilling equipment of a size and type designed to drill holes of the required sizes and depths as follows:

| Location | Soil Boring Number | Depth (vf) |
|---|---|---|
| 32 Lots Hollow Road | WB - 1 | 120 |
| | WB - 2 | 120 |
| | WB - 3 | 120 |
| | WB - 4 | 120 |
| | WB - 5 | 120 |

4. Soil boring shall be located within five (5) feet of the proposed Wick Wells shown on the drawings. The Contractor may relocate soils borings up to a distance of an additional five (5) feet to avoid obstructions or under-ground utilities and structures. The Contractor shall notify the ENGINEER of any changed locations and associated ground surface elevations. Such notification shall be in writing and approved by Engineer prior to proceeding with the borings.
5. All soil borings can be allowed to collapse or shall be backfilled with native material for their full depth.

B. Soil Samples

1. Soil samples shall be taken using a Split-Barrel Sampler approximately one and three-eighths (1 3/8) inches ID by twenty-four (24) inches long. The bottom of the sampler shall be sharpened to form a cutting edge at its inside circumference. The cutting edge shall be maintained in good conditions. The sampler shall be fastened to its drive pipe by a connection embodying a check valve which will permit the ready escape of water trapped above the sample as the sampler is driven down into the soil, but which will close as the soil sample and sampler are withdrawn, thus preventing the development of hydrostatic pressure on top of the soil during recovery. Any washing shall be done with water of drinking water quality so as not to add to or initiate any contamination of the soil and groundwater.
2. Soil samples shall be taken at every change of strata and within a continuous stratum at intervals not exceeding five (5) feet in depth.
3. Before sampling, the soil boring shall be thoroughly cleaned out to the sampling elevation using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts the drill bit shall be withdrawn slowly to prevent loosening of the soil around the hole. The water level in the soil boring shall be kept at, or slightly above, the natural groundwater level at all times. Where casing is used it shall not be driven below sampling elevation.
4. Upon retrieval of the sampler from the borehole, two representative samples (one for Contractor's use and one for Engineer's use), four (4) inches in length (16-ounce minimum volume), shall be selected and inserted into a suitable container (e.g. one-gallon plastic re-sealable bag). Each container shall then be labeled with the project identification including the Engineer's job number, the date, number of soil boring, number of sample, its depth

below ground surface at the soil boring and the standard penetration resistance. If more than one (1) type of soil is found in the sampler (for instance, part sand and part clay or alternating layers of such soils) the thickness and description of the individual layers shall be recorded in the log and samples of each type soil taken. If a sample is not recovered or is found unsatisfactory as to size or condition, a second attempt shall be made to obtain a satisfactory sample before sinking the casing to a lower depth.

**2.02 - TEMPORARY CASINGS**

A. Temporary separator casings shall be steel with a minimum wall thickness of 1/4-inch, and suitable for butt welding. Temporary separator casings that are damaged, dented, out-of-round, crimped, or otherwise unsuitable shall be rejected by Engineer.

B. Steel guides of a design approved by Engineer shall be used to maintain proper spacing between the walls of all temporary steel casings.

**2.03 - WELL SCREEN AND SCREEN PLATE**

A. Well screen shall be Type 304 stainless steel of the continuous slot, wire wound design. Screen shall be fabricated by circumferentially wrapping a 3/16-inch, triangularly shaped wire around a circular array of internal rods. The wire configuration must produce inlet slots with sharp outer edges. The slots shall widen inward so as to minimize clogging. Each juncture between the horizontal wire and the vertical rods shall be fusion welded under water by the electrical resistance method. Well screen shall be as manufactured by Aqseptence Group (Johnson Screens) or Engineer approved equal.

B. Engineer may elect Standard Flow or High Flow well-screen construction.

C. Perforated, louvered and mill-slot type well screens are not acceptable.

D. Well screen plate shall be 1/4-inch thick Type 304 stainless steel welded continuously to the bottom of the well screen.

E. Welding rod used to join stainless steel well screen shall be suitable for joining Type 304 stainless steel.

F. Threaded or coupled well screen may be allowed if approved by Engineer.

G. Centralizers shall be Type 304 stainless steel.

**2.04 - PERMANENT WICK CASING**

A. Permanent 36-inch minimum diameter wick casing shall be new pipe ASTM A53and ASTM A252, Grade 2, and shall have a minimum yield strength of 36,000 psi and minimum wall thickness of 3/8-inch. The casing pipe shall conform to ASTM A139 for electric fusion welded steel pipe. Joints shall be fully welded completely around the circumference of the casing pipe. Each joint in the casing pipe shall be welded and approved prior to subjecting the joint to installation stresses. Casing pipe shall conform to the latest revisions of the requirements of AWA Standards for fabricating electrically welded steel water pipes and AWS welding code, or its equivalent.

B. All permanent wick casing shall be butt ended. Threaded or coupled casing may be allowed if approved by Engineer.

C. All permanent wick casing shall be secured to the wick vault.

D. Welding rod used to join wick casings shall be suitable for joining the steel casings.

**2.05 - ARTIFICIAL FILTER PACK**

A. Gravel pack material shall have an average specific gravity of not less than 2.5. Not more than 1% by weight of the material shall have a specific gravity of 2.25 or less.

B. Non-round pieces shall not exceed 2 percent of the total weight of the gravel-pack material. Non-round pieces are defined as thin, flat and/or elongated grains, the maximum dimension of which exceeds three (3) times the minimum.

C. Not more than 5 percent of the gravel-pack material shall be soluble in hydrochloric acid.

D. Gravel-pack material shall be washed and free of shale, mica, clay, dirt, loam and organic impurities of any kind. It shall not contain iron, manganese, copper, lead and/or other heavy metals in a form or quantity that will adversely affect the quality of the well water.

E. Gradation tests shall be in accordance with ASTM C136.

F. For formation sands having a uniformity coefficient less than 2.5, the grain size distribution curve for each gravel-pack material shall parallel the grain size distribution curve of the formation.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - WICK INSTALLATION**

A. Preconstruction Meeting

1. Prior to mobilization to the Project site(s), Contractor shall meet on-site with Engineer to discuss the project and its requirements. Contractor and his crews shall be thoroughly familiar with the Contract Documents (specifications and drawings) before the meeting.

2. Contractor shall present his generalized approach for excavating boreholes/shafts, sampling soils, staging and handling of materials, installing wick materials, testing for plumbness, load testing the wicks, and video inspecting wick access wells.

3. Contractor shall present a generalized construction schedule designed to complete all wick-construction and testing operations within the prescribed period of performance.

4. Contractor shall present a Health and Safety Plan for the project and describe his plans for maintaining worker health and safety throughout drilling and testing operations.

5. Contractor shall describe his plans for preparing drilling equipment and maintaining no release of oil or hazardous materials to the environment throughout drilling and testing operations.

6. Contractor’s drilling foreman shall be present at the pre-construction meeting.

7. Engineer may call for additional meetings with Contractor at various stages of construction.

B. Drilling Preparation

1. Contractor shall steam-clean all drilling and pumping equipment at its shop before mobilizing to the site to remove residual oil and grease, mud and soil cuttings. Engineer will inspect drilling equipment upon its arrival at the Project site(s), and if it is inadequately cleaned, Engineer shall order that the equipment be returned to the Contractor’s shop until the equipment is adequately cleaned.

2. Contractor shall trim trees and remove brush and vegetation around each wick site sufficient to allow wick construction as approved by Engineer.

3. Do not discharge fuel oil, sewage, septic waste or other deleterious substances into streams, groundwater supplies or wetlands areas. The storage of fuel oil, refueling of equipment and lubrication of equipment shall be restricted to area(s) designated by Engineer. Report any spillage of deleterious substance (fuel oil, lubricants, septic waste, etc.) to the Owner and appropriate regulatory agency and appropriate measures taken, as determined by the regulatory agency, to contain and to clean up the affected areas.

C. Excavation

1. Excavations for permanent wick construction shall be made using steel casings with a minimum diameter of 36 inches extending from the ground surface to 101 feet below ground surface as shown on the attached Typical Wick Diagrams shown at the end of this section.
2. Excavation shall be completed using conventional cable-tool or caisson drilling methods, dual rotary or other means suitable to the Engineer. Mud rotary drilling will not be allowed.
3. Contractor is advised that the soils encountered at the Project site(s) consist largely of fine to coarse sands. Three to four thin layers, generally less than 1-foot in thickness, of very fine sands and silts have been noted at the site. Cobbles and boulders have been noted at the surface and may be present at depth. In general, the soils expected are fairly loose and above the water table. Soils at certain drilling locations have been found to become denser with depth.
4. Appropriate means, such as a cleanout bucket or air lift, shall be employed to clean the bottom of the drilled shaft excavations.
5. The drilled shaft dimensions and alignment shall be verified with approved methods. Final shaft depths shall be measured with a suitable weighted tape or other approved method after final cleaning.
6. If caving occurs outside of the drill shaft or temporary casing(s) during any construction procedure, the construction operation shall be stopped, the Engineer shall be notified, and the shaft excavation shall be stabilized by approved methods.
7. Begin drilled shaft installations only after the completion of site grading work in the area of the wick locations. Drilled shaft installation work shall be performed using the materials and equipment indicated in the accepted Wick Design and Installation Plans.
8. Should an impenetrable obstruction be encountered during drilling that prevents wick placement at the required depth or within the specified tolerances, perform the following procedures after notifying and with the permission of the Engineer:
    a) Excavate to remove obstruction and backfill with Select Fill/Granular Fill per SECTION 02220, EARTHWORK.
    b) Abandon the shaft by cutting down the shaft to one foot below the shaft cap elevation and filling above the shaft with Select Fill/Granular Fill per SECTION 02220, EARTHWORK and drill and install replacement shaft at location and depth indicated by Engineer.
    c) The obstructions located within five feet of the top level of the ground surface during drilling shall be removed at the expense of the Contractor.
9. The bottom of the shaft shall be sounded immediately before placement of the artificial filter pack.
10. During excavation, Contactor shall mark the running depth on the outside of each temporary casing using crayon or soapstone to facilitate Engineer’s periodic inspections.
11. If cable-tool drilling is employed, to ensure that the natural soil outside of all temporary casings remains undisturbed, excavation shall not extend beyond the bottom of any temporary casing by greater than 24 inches.
12. “Drilling”, i.e., repeated pounding with heavy drill bits, is prohibited unless all other methods of removing material from inside of temporary casings have failed, and Engineer approves of drilling activity.
13. If cable-tool drilling is employed, temporary casings shall be "pulled" into the ground using pulley blocks, cable, and/or I-beams. Conventional hydraulic, air operated, or mechanical orange peel buckets or a standard sand pump shall be used for proper removal of soils from inside temporary casings.
14. If cable-tool drilling is employed, driving of casing is prohibited unless all attempts to “pull down” casings have failed and Engineer approves the driving of casings.
15. If cable-tool drilling is employed, temporary casings shall not have more than 30-feet of skin friction applied to them. Excavation shall be made so as to minimize disturbance to the natural soils outside the temporary casing(s). Excavations shall be made so as to avoid compaction of the formation.

16. Vibratory hammers shall not be used to install or remove temporary casings so to minimize disturbance to the natural soils.
17. Extreme care shall be exercised when temporary outer casings are installed. The vertical plumb of the temporary outer casings shall be checked periodically using a “well cage” or other approved method, as necessary to maintain vertical plumb. Should temporary casings drift out-of-plumb, Contractor shall take measures to correct this condition. See AWWA A100-15 (Appendix D) for plumbness testing methods.
18. Wick excavation equipment shall remain at each wick site at all times during wick excavations.

**3.03 - TEMPORARY STEEL COVER**

A. A temporary steel cover, as approved by Engineer, shall be placed over all temporary casings during "No Work" periods to prevent accidents and vandalism.

B. At the conclusion of wick installation, a temporary cover shall be tack-welded to the top of the permanent wick for security until the permanent vault with locked access has been installed and approved by Engineer.

**3.04 - SOIL BORING SAMPLES AND SIEVE ANALYSIS**

A. Proper collection of soil boring samples is fundamental to the design of the permanent wicks. To this end, Contractor shall discuss in advance with Engineer a means of obtaining representative soil samples and avoid mixing of soils from various depths.

B. Soil boring samples shall be obtained continuously from 10 feet below the ground surface to the bottom of the excavation in no greater than 5-foot increments. Samples shall be placed on heavy plastic sheeting provided by Contractor near each wick site excavation for periodic examination by Engineer. Soil-sample depths (or depth ranges) shall be marked on the plastic sheeting using permanent marker. Samples shall be covered at night with heavy plastic sheeting to protect the samples from wind, rain and the elements.

C. Representative samples of the natural soil formations shall be obtained at no greater than 5-foot intervals from a depth of 10-feet to the bottom of the excavation. Samples shall be sieved and analyzed in accordance with ASTM (ASTM C136) standards. Grain-size distribution curves shall be provided for each soil sample. The grain-size distribution curves shall be displayed on graphs showing cumulative percent retained versus grain size in inches.

D. Contractor shall take care during excavation to obtain representative samples of the natural soil formations. Contractor shall not discount the volume of coarse soil material (i.e., 1/4-inch diameter and greater) excavated, but instead shall weigh the coarse fraction and report the weight on the grain-size distribution curves.

E. The following VISUAL identification system will be used to identify soil samples:

1. GRAIN SIZE (According to the Unified Soil Classification System) - on the basis of grain size, soils are divided into the following classes:

| | Sizes | |
|---|---|---|
| **Description** | **From** | **To** |
| Boulders | Greater than | 12-inch |
| Cobbles | 3-inch | 12-inch |

| | Sieve Size | | Grain Size (millimeters | |
|---|---|---|---|---|
| **Description** | **Passing** | **Retained** | **Passing** | **Retained** |
| Gravel – Coarse | 3-inch | ¾-inch | 76.20 | 19.00 |
| Gravel – Fine | ¾-inch | #4 | 19.00 | 4.75 |
| Sand – Coarse | #4 | #10 | 4.75 | 2.00 |
| Sand - Medium | #10 | #40 | 2.00 | 0.25 |
| Sand – Fine | #200 | #230 | 0.25 | 0.125 |
| Sand – Very Fine | #230 | | 0.125 | 0.074 |

Several entries are made to describe a soil according to its grain size:

a. The first entry represents the predominant type of soil in the sample. This should be capitalized in each case, such as COARSE SAND, FINE GRAVEL, SILT, ETC.

b. The second entry indicates the second-most abundant soil component, the third entry, the third-most, etc. The amounts should be indicated by the following terms:

- "and" 35% to 50%
- "some" 20% to 35%
- "little" 10% to 20%
- "trace" 10% or less

Examples:

- brown, SILT, some fine Sand, trace of Clay
- gray FINE SAND, some Silt and Clay
- gray SILT, trace of fine Sand and Clay
- brown SILT, some coarse Sand and Gravel

c. Fine Grained Soils are predominantly Silt and/or Clay.

d. Coarse Grained Soils are predominantly Gravel and/or Sand.

2. Consistency: The consistency of the soil sample shall be described as follows:

a. Fine Grained Soils - "hard", "medium", or "soft", as well as a designation of whether the soil is "plastic" or "non-plastic".

b. Coarse Grained Soils - "loose" or "compact" and a designation as to whether or not the soil is "cemented".

c. Hardpan - Some soil mixtures have been subjected to extremely heavy pressures and have formed so-called “Hardpan”. This term should be used to amplify the soil description but, should not take the place of the grain-size classification.

d. Color - The predominant color of the soil sample in the natural state shall be designated: "White", "Yellow", "Red", "Gray", "Blue", "Brown", or "Black".

e. Other Soil Characteristics - In coarse-grained soils, the shape of the grain shall be described as: "flat", "sharp", and/or "round". The overall grading of the material shall be termed "well-graded", "poorly-graded", or if the material is noticeably of one size, it should be termed "uniform".

f. Vegetable Muck and Peat - Vegetable muck and peat are soil mixtures with varying percentages of organic and soil matter formed by decomposition of leaves, grasses and other fibrous materials. The color ranges from light brown to black. When the mixture contains a high percentage of vegetable material, it is called peat. The soil and organic content should be estimated in percent.

g. Silt or Clay - Silt shall be distinguished from clay using the dilatancy test, in the following manner: Silt- water disappears from surface; Clay- water stays on surface.

h. Loss of Wash Water - At the end of each wash, a determination shall be made as to the amount of the loss of wash water when the wash/jetting pipe exits the drive shoe. The loss of wash water shall be described on the well log as none, fair, good, excellent.

i. Other Descriptions - Additional descriptive terms may be used, but they should not replace the basic description. These terms could include: “rock fragments”, “stones”, and/or “rock flour”.

**3.05 - WELL SCREEN AND SCREEN PLATE**

A. All well screens shall be joined together by means of welding, using methods and welding materials as approved by Engineer.

B. Once excavation is complete, the 6-inch diameter wick access wells shall be lowered and properly spaced inside the wick. The entire wick access well assembly shall include the screen, centralizers, and the 6-inch diameter base plate.

C. Stainless steel centralizers may be required to properly space the wick access wells inside the temporary casing(s) during construction. The exact dimensions and depth of the centralizers shall be dictated by field conditions to properly plumb and center the wick access wells inside the temporary casing(s) and wick.

D. Stainless steel centralizers shall be welded to the base of the well screen, to properly space the well screen in the 24-inch diameter temporary casing. If necessary, a set of stainless steel guides may also be welded to the wick access wells at varying depths to properly space the access wells. Guides will not be used if there is any risk of jamming the screen or the casing in the 36-inch, or larger, diameter temporary casing(s).

E. All wick access wells shall be secured to the wick vault. A wick detail is provided on the Contract Drawings.

F. Each well screen shall have a screen plate at the base and be capped with a threaded cover.

**3.06 - ARTIFICIAL FILTER PACK**

A. Contractor shall install approximately 6 to 12 inches of artificial filter pack at the bottom of the excavation before installation of the wick access wells and artificial filter pack. The well screens shall rest on the processed sand.

B. Artificial Filter Pack

1. Contractor shall place artificial filter pack as specified and approved by Engineer as artificial filter pack in the annulus between the wick access wells and the temporary casing and between the temporary casing and the borehole/shaft wall, as approved by Engineer.

2. Engineer and Contractor shall, in consultation, select the size of the artificial filter pack.

3. The well screens shall be designed to retain 100 percent of the artificial filter pack.

**3.07 - PERMANENT WICK CASING**

A. Permanent wick casing shall be joined together by means of welding, using methods and welding materials as approved by Engineer.

B. All permanent wick casing shall be secured to the wick vault. A wick detail is provided on the Contract Drawings.

C. Permanent wick casing shall be capped with a 1/4-inch thick steel plate continuously welded to the casing.

**3.08 - PLUMBNESS TESTING**

A. Prior to installation of the 6-inch diameter wick access wells, Contractor shall "cage" the temporary casings every 10 feet to determine that they are sufficiently plumb, using methods described in Appendix D of AWWA A100-15, or other approved method.

B. Contractor shall be responsible for maintaining vertical plumb throughout the construction of each wick. The caging log included at the end of this section of the Specifications shall be completed each time a casing or wick access well plumbness test is performed.

C. The plumbness criterion for the wick is a maximum 1-inch deflection per 10 vertical feet, or 10-inchs deflection per 100 feet.

**3.09 - WICK LOADING TEST**

A. Once the installations of all wicks and wick vaults have been completed, a 24-hour loading test shall be performed on each wick to obtain infiltration and wick efficiency rates. Each loading test shall be performed as directed by Engineer and in accordance with these specifications.

B. Each permanent wick shall be thoroughly tested by discharging potable water into each wick. It is intended that each permanent wick be load tested at the rates and duration noted below, or as directed by Engineer. Water discharged to the wick shall be potable water. The potable water will be supplied by the Town of Orleans Water Department through an onsite fire hydrant. The water shall be discharged through a water meter and hose provided by Town of Orleans Water Department.

| Step No. | Loading Rate (gallons/minute) | Loading Rate (gallons/day) | Duration of Step (hours) | Elapsed Time (hours) |
|---|---|---|---|---|
| 1 | 50 | 72,000 | 2 | 2 |
| 2 | 100 | 144,000 | 2 | 4 |
| 3 | 150 | 216,000 | 2 | 6 |
| 4 | 200 | 288,000 | 2 | 8 |
| 5 | 300 | 432,000 | 16 | 24 |

C. Contractor shall have coarse artificial filter pack on site should the artificial filter pack settle during the wick loading test. Contractor shall maintain a minimum of 10 percent of the total wick volume of coarse artificial pack for each loading test. Contractor shall have proper equipment on site to add the artificial filter pack when necessary.

D. Contractor shall maintain a record of each loading test on a form provided by the Contractor or Engineer throughout the development process. The record shall contain the following information:

1. In the heading: Wick ID, Client name and location, Contractor name and address, wick diameter, wick depth and wick access wells-screen intervals, flow-measurement equipment.

2. and, in chart form: date, time, elapsed time since the beginning of the test static water level, wick loading rate, wick water level, and water levels of observation wells within 100 feet of the wick being loaded.

E. During each wick loading test, the Contractor shall keep records of the discharge rates, weather conditions, rainfall, water level rise and drop in the wick and all observation wells selected by Engineer during the respective loading and recovery periods. All water-level readings shall be measured using electronic probes and recorded to the nearest hundredth of a foot (measuring tape is to read directly in feet, tenths and hundredths of a foot). In addition to the actual time of each water level reading, the Contractor shall record the number of minutes that have elapsed from the start of a test. Water level readings shall be taken according to the following timetable:

1. Prior to start up of test (static water level)

2. Ten minutes to two hours: once every 10 minutes

3. One hundred twenty minutes to 12 hours: once every hour

4. Prior to shutdown of test.

5. Ten minutes to two hours after shutdown: once every 10 minutes
6. One hundred twenty minutes to 8 hours after shutdown: once every hour

F. At the beginning of each loading test and during each two (2) hour reading, the Contractor shall measure and record the flow rate in gallons per minute on the water meter provided by the Orleans Water Department.

G. For the start of any loading test (first 100 minutes) and shutdown (first 100 minutes), the Contractor shall provide one (1) qualified individuals to measure and record the water level in the wick.

H. Contractor shall provide Engineer with a complete record of the loading test within two days of completion of the test.

**3.10 - VIDEO INSPECTION**

A. At the conclusion of the loading test, Contractor shall perform a video inspection of each wick access well to establish its as-built condition. The inspection shall be done in the presence of Engineer. Engineer will examine the wick access wells well screen and joints between the well screen sections.

B. The video camera and equipment shall have a color monitor for field viewing and shall be capable of recording color images on DVD. In addition, the camera shall be capable of being articulated to view in the downward and sideward directions. The camera shall have a built-in depth counter to monitor depth in the field and record depth on the DVD image.

C. The video inspection shall be conducted slowly and carefully so that features in the wick access well interior, such as the joints and well screen, are clear to the viewer. The Contractor shall periodically bring the camera to a full-stop to allow examination of particular points of interest.

D. Two copies of the video on a flash drive or DVD shall be provided to the Engineer.

**3.11 - WICK CONSTRUCTION RECORD (RECORD DRAWING)**

A. Contractor shall submit a "Record Drawing", for each permanent wick, vertically scaled, having at least the following information:

1. Project identification, installation Contractor, Engineer’s project number, wick location number, date installation was commenced and completed, and the driller's name.
2. Original ground elevation.
3. Finished elevations including; ground surface, top of the wick vault, top and bottom of artificial filter pack, top and bottom of wick access wells, top and bottom of permanent casing).
4. Construction details for the full length of the wick, including the depths, and diameters of the temporary and permanent wick casings, wick access wells and screens, wick access well centralizers, and artificial filter pack.
5. Volume and diameter of artificial filter pack placed in each shaft.
6. Well screen slot-size.
7. Artificial filter pack sizes.
8. Static water level and final water level at the end of the loading tests for all wick access wells monitored during the test. Contractor shall indicate the water level depth measured from the top of the access wells.
9. Contractor shall use the Wick Construction Record form included at the end of this Section of the specifications.
10. On a separate form, Contractor shall provide a detailed log of native soils drilled along with the depth, designation and description of each soil sample collected.
11. Comment by the drilling or field foreman covering any special conditions that were encountered.
12. Incomplete or inaccurate “Record Drawing” and soil logs will be returned to Contractor for revisions and corrections.

**3.12 - PAINTING – Not Used**

**3.13 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the wick well system.

B. Spillage of lubricants used in servicing the system shall be cleaned from all wick well system including equipment and concrete surfaces.

## 3.14 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF TEXT**

SEE ATTACHMENTS

Attachment 1 – Wick and Groundwater Monitoring Well Locations

Attachement 2 - Existing Montoring Well Logs

Attachment 3 - Soil Analyses

Attachment 4 - Blank Log

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**Attachment 1 – Wick and Groundwater Monitoring Well Locations**

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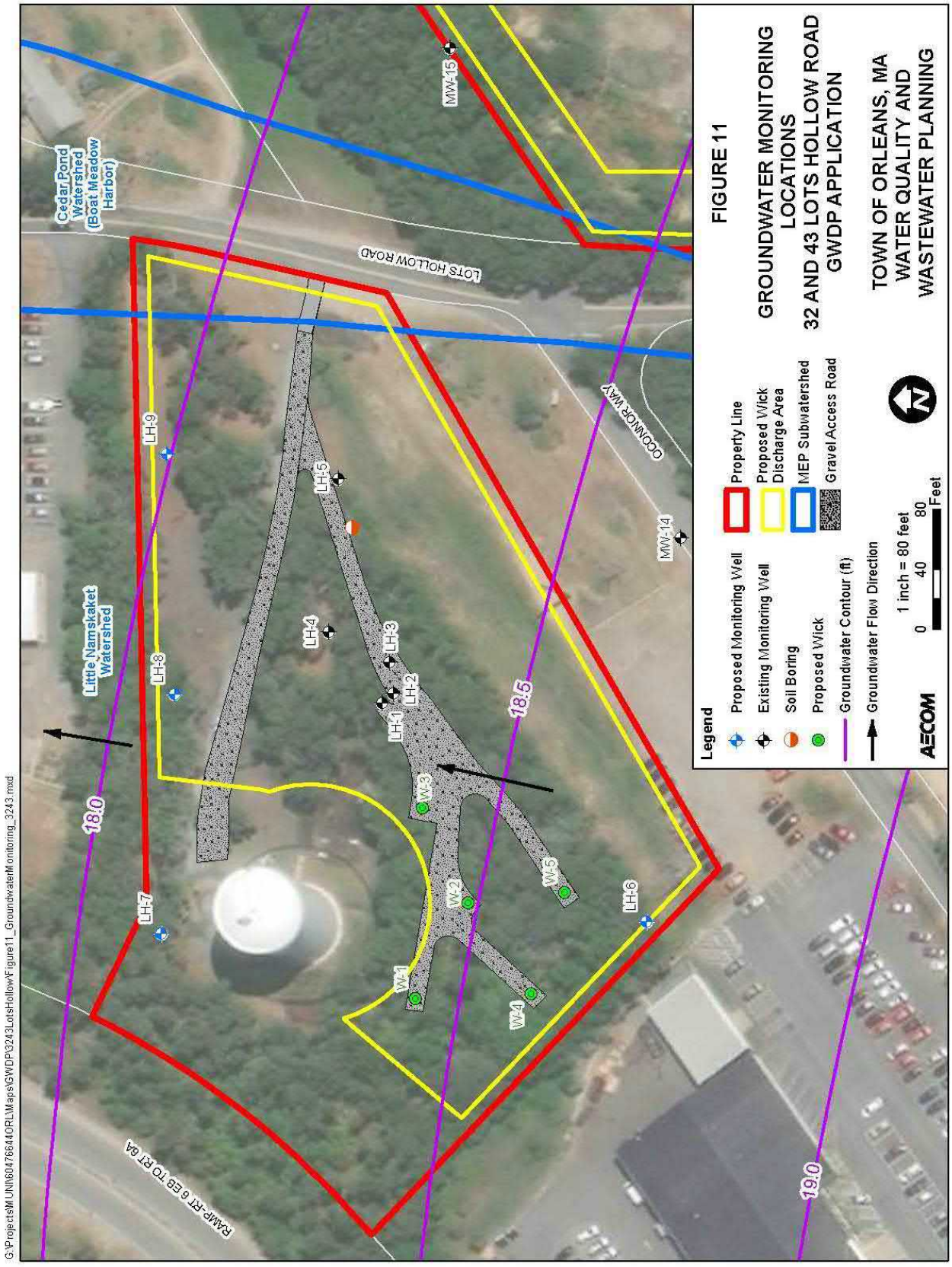
FIGURE 11
GROUNDWATER MONITORING LOCATIONS
32 AND 43 LOTS HOLLOW ROAD
GWDP APPLICATION
TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING
Legend
Proposed Monitoring Well
Existing Monitoring Well
Soil Boring
Proposed Wick
Groundwater Contour (ft)
Groundwater Flow Direction
Property Line
Proposed Wick Discharge Area
MEP Subwatershed
Gravel Access Road
1 inch = 80 feet
0
40
80
Feet
AECOM
Cedar Pond Watershed (Boat Meadow Harbor)
Little Namskaket Watershed
LOTS HOLLOW ROAD
COCONNOR WAY
RAMP-RT 6 EB TO RT 6A
LH-1
LH-2
LH-3
LH-4
LH-5
LH-6
LH-7
LH-8
LH-9
MW-14
MW-15
W-1
W-2
W-3
W-4
W-5
18.0
18.5
19.0
G:\Projects\MUNI\60476644\GRL\Maps\GWDP\3243LotsHollowFigure11_GroundwaterMonitoring_3243.mxd

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**Attachement 2 - Existing Montoring Well Logs**

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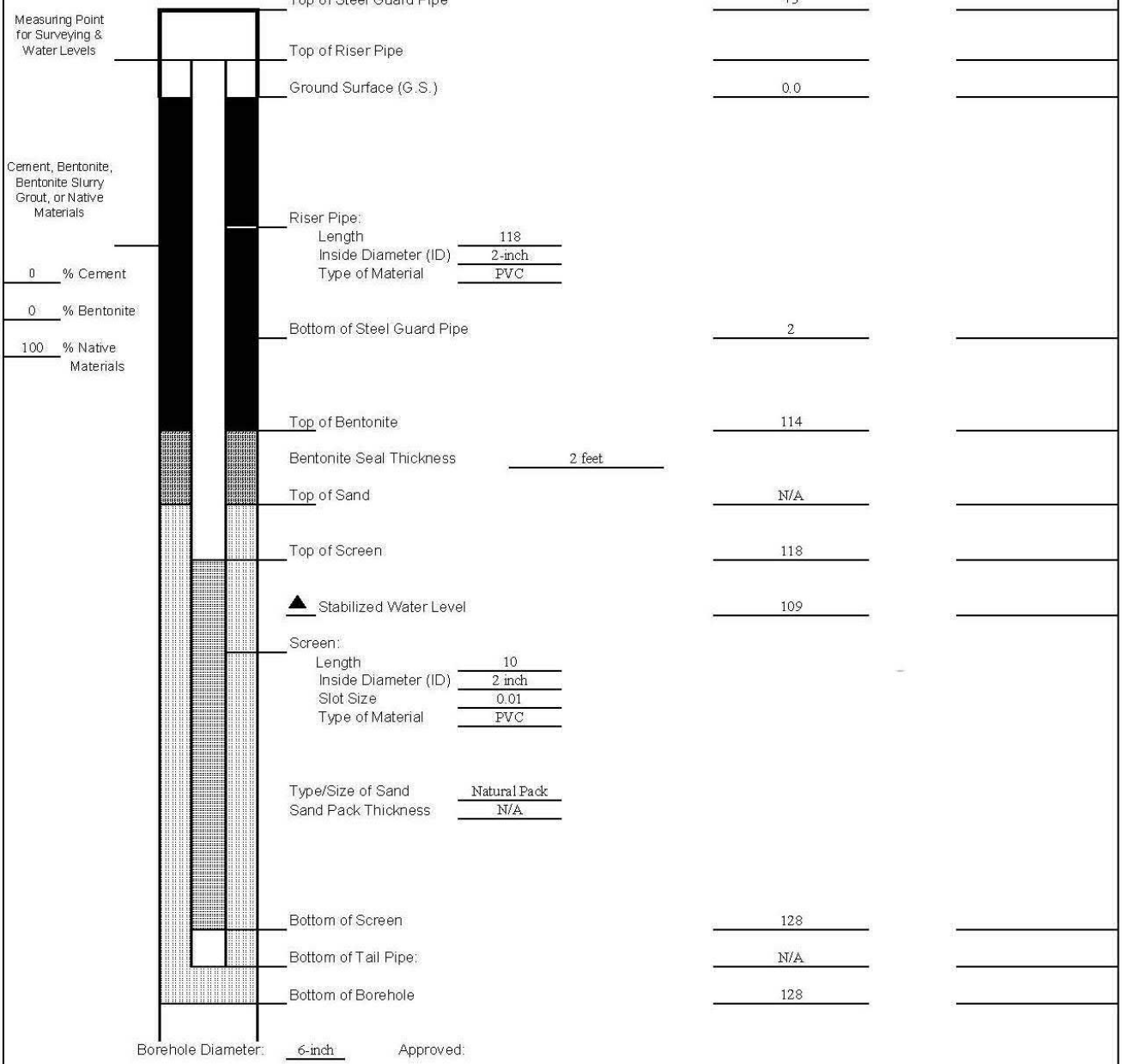
| AECOM | Client: Town of Orleans | WELL ID: LH-1 |
|---|---|---|
| | Project Number: 60476644 | |
| | Site Location: Orleans, MA | Date Installed: 01/03/2018 |
| | Well Location: 32 Lots Hollow Coords: | Inspector: Erika Amir-Lin |
| | Method: CME truck mounted hollow-stem auger | Contractor: Desmond Drilling |

## MONITORING WELL CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Steel Guard Pipe | +3 | |
| Top of Riser Pipe | | |
| Ground Surface (G.S.) | 0.0 | |
| Riser Pipe: Length 118; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Steel Guard Pipe | 2 | |
| Top of Bentonite | 114 | |
| Bentonite Seal Thickness 2 feet | | |
| Top of Sand | N/A | |
| Top of Screen | 118 | |
| ▲ Stabilized Water Level | 109 | |
| Screen: Length 10; Inside Diameter (ID) 2 inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand Natural Pack; Sand Pack Thickness N/A | | |
| Bottom of Screen | 128 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 128 | |

Approved: _____ Signature _____ Date

Describe Measuring Point:
Top of PVC.

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

## *Boring Log LH-2*

*Boring Number:* 2
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME

*Project Manager:* M. Owen | *Field Tech:* E. Amir-Lin | *Date Started:* 12/13/2017
*Drilling Contractor:* Desmond | *Driller:* Tommy/Josh | *Date Completed:* 12/22/2017
*Inside Diameter:*

### *Well Data*

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | Well completed with 3 foot metal standpipe and concrete pad | | | | 1 |
| 2 | | | | | | 27 | dry | 2" Dark brown loam/topsoil<br>3" Grey M SAND, little C sand, trace F sand.<br>22" Dark tan M SAND, little F sand, trace C sand. | | | | | 2 |
| 3 | | | | | | | | | | | | | 3 |
| 4 | | | | | | | | | | | | | 4 |
| 5 | | | | | | | | | | | | | 5 |
| 6 | | | | | | 47 | dry | 24" Tan F SAND, little M sand, trace C sand.<br>23" Light tan M SAND, some F sand, trace C sand. | | | | | 6 |
| 7 | | | | | | | | | | | | | 7 |
| 8 | | | | | | | | | | | | | 8 |
| 9 | | | | | | | | | | | | | 9 |
| 10 | | | | | | 26 | dry | 15" Tan M SAND, little F sand, trace C sand.<br>6" Brown F SAND.<br>5" Tan M SAND, little F sand, trace C sand. | | | | | 10 |
| 11 | | | | | | | | | | | | | 11 |
| 12 | | | | | | | | | | | | | 12 |
| 13 | | | | | | | | | | | | | 13 |
| 14 | | | | | | 41 | moist | 41" Orange-tan M SAND, little F sand, little C sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 14 |
| 15 | | | | | | | | | | | | | 15 |
| 16 | | | | | | | | | | | | | 16 |
| 17 | | No Blow Counts Collected - Drilled Direct Push to 88 feet | | | | | | | | | | | 17 |
| 18 | | | | | | 40 | moist | Same as above; increasingly orange/Fe stained. | | | | | 18 |
| 19 | | | | | | | | | | | | | 19 |
| 20 | | | | | | | | | | | | | 20 |
| 21 | | | | | | | | | | | | | 21 |
| 22 | | | | | | 32 | moist | 28" Tan M SAND, little F sand, trace C sand.<br>4" Orange M SAND, little F sand, trace C sand. | | | | | 22 |
| 23 | | | | | | | | | | | | | 23 |
| 24 | | | | | | | | | | | | | 24 |
| 25 | | | | | | | | | | | | | 25 |
| 26 | | | | | | 26 | moist | 26" Light tan-buff M SAND, little C sand, trace F sand. | | | | | 26 |
| 27 | | | | | | | | | | | | | 27 |
| 28 | | | | | | | | | | | | | 28 |
| 29 | | | | | | | | | | | | | 29 |
| 30 | | | | | | 37 | moist | 16" Tan/brown mottled M SAND, occasional stringers of dark brown, F sand.<br>21" Tan-orange C SAND, little M sand, trace F sand. | | | | | 30 |
| 31 | | | | | | | | | | | | | 31 |
| 32 | | | | | | | | | | | | | 32 |
| 33 | | | | | | | | | | | | | 33 |

Notes: F=Fine, M=Medium, C=Coarse

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen | *Field Tech:* E. Amir-Lin | *Date Started:* 12/13/2017
*Drilling Contractor:* Desmond | *Driller:* Tommy/Josh | *Date Completed:* 12/22/2017

## Boring Log LH-2

*Boring Number:* 2
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### Well Data

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | | No Blow Counts Collected - Drilled Direct Push to 88 feet | | | | 41 | moist | 41" Tan M SAND, little F sand, trace C sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 34 |
| 35 | | | | | | | | | | | | | 35 |
| 36 | | | | | | 42 | moist | 42" Tan M SAND, little F sand, one 2" piece of subrounded C gravel. | | | | | 36 |
| 37 | | | | | | | | | | | | | 37 |
| 38 | | | | | | | | | | | | | 38 |
| 39 | | | | | | | | | | | | | 39 |
| 40 | | | | | | 37 | moist | 26" Tan M and C SAND, little F sand, trace F subrounded gravel.<br>11" Tan M SAND, some F sand, trace C sand. | | | | | 40 |
| 41 | | | | | | | | | | | | | 41 |
| 42 | | | | | | | | | | | | | 42 |
| 43 | | | | | | | | | | | | | 43 |
| 44 | | | | | | 36 | moist | 36" Light brown M SAND, clean. | | | | | 44 |
| 45 | | | | | | | | | | | | | 45 |
| 46 | | | | | | | | | | | | | 46 |
| 47 | | | | | | | | | | | | | 47 |
| 48 | | | | | | 36 | moist | 6" Orange-brown M SAND, some C sand, little F sand, trace F rounded gravel.<br>30" Tan M SAND, little F sand, coarse lens at 50.5 feet, at 50 feet a lens of F rounded gravel. | | | | | 48 |
| 49 | | | | | | | | | | | | | 49 |
| 50 | | | | | | | | | | | | | 50 |
| 51 | | | | | | | | | | | | | 51 |
| 52 | | | | | | 36 | moist | 8" Tan M SAND, some C sand, little F sand, trace F gravel.<br>2" Brown/grey mottled SILT.<br>26" Tan F SAND, one lens F gravel/C sand. | | | | | 52 |
| 53 | | | | | | | | | | | | | 53 |
| 54 | | | | | | | | | | | | | 54 |
| 55 | | | | | | | | | | | | | 55 |
| 56 | | | | | | 48 | moist | 14" Orange-tan-brown C SAND, little M sand, little F sand, little F subrounded to subangular gravel.<br>34" Tan F SAND, clean. | | | | | 56 |
| 57 | | | | | | | | | | | | | 57 |
| 58 | | | | | | | | | | | | | 58 |
| 59 | | | | | | | | | | | | | 59 |
| 60 | | | | | | 37 | moist | 8" Orange/tan mottled M SAND, some C sand, little F sand, trace F subrounded gravel.<br>23" Tan/orange mottled M SAND.<br>6" Tan F SAND, clean. | | | | | 60 |
| 61 | | | | | | | | | | | | | 61 |
| 62 | | | | | | | | | | | | | 62 |
| 63 | | | | | | | | | | | | | 63 |
| 64 | | | | | | 39 | moist | 39" Tan F SAND, clean. Orange to dark brown lens at 65.5 feet. | | | | | 64 |
| 65 | | | | | | | | | | | | | 65 |
| 66 | | | | | | | | | | | | | 66 |

Notes: F=Fine, M=Medium, C=Coarse

Project Number: 60476644
Client:
City of Orleans
Orleans, MA
Site Location:
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Project Manager: M. Owen | Field Tech: E. Amir-Lin | Date Started: 12/13/2017
Drilling Contractor: Desmond | Driller: Tommy/Josh | Date Completed: 12/22/2017

## Boring Log LH-2

Boring Number: 2
Sheet: 1 of 4
Surface Elevation (ft-asl):
Equipment: CME
Inside Diameter:

### Well Data

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | | No Blow Counts Collected - Drilled Direct Push to 88 feet, then downhole hammer employed | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 67 |
| 68 | | | | | | 29 | moist | 29" Tan-light brown F SAND. Orange mottling. Two lenses of brown SILT, 2" thick each, at 71 and 72 feet. | | | | | 68 |
| 69 | | | | | | | | | | | | | 69 |
| 70 | | | | | | | | | | | | | 70 |
| 71 | | | | | | | | | | | | | 71 |
| 72 | | | | | | 31 | moist | 6" Light brown F SAND.<br>25" Tan M SAND, slight Fe stain and mottling. | | | | | 72 |
| 73 | | | | | | | | | | | | | 73 |
| 74 | | | | | | | | | | | | | 74 |
| 75 | | | | | | | | | | | | | 75 |
| 76 | | | | | | 42 | moist | 42 " Tan M SAND, trace F sand. Orange Fe mottling. | | | | | 76 |
| 77 | | | | | | | | | | | | | 77 |
| 78 | | | | | | | | | | | | | 78 |
| 79 | | | | | | | | | | | | | 79 |
| 80 | | | | | | 47 | moist | 47" Light brown M SAND; little F sand. | | | | | 80 |
| 81 | | | | | | | | | | | | | 81 |
| 82 | | | | | | | | | | | | | 82 |
| 83 | | | | | | | | | | | | | 83 |
| 84 | | | | | | 41 | moist | Same as above. | | | | | 84 |
| 85 | | | | | | | | | | | | | 85 |
| 86 | | | | | | | | | | | | | 86 |
| 87 | | | | | | | | | | | | | 87 |
| 88 | | | | | | 12 | | 12" Tan-buff M SAND, some F sand. | | | | | 88 |
| 89 | | | | | | | | | | | | | 89 |
| 90 | | | | | | 15 | | 15" Buff F SAND, clean. | | | | | 90 |
| 91 | | | | | | | | | | | | | 91 |
| 92 | | | | | | 19 | | 19" Tan F SAND, clean. | | | | | 92 |
| 93 | | | | | | | | | | | | | 93 |
| 94 | | | | | | 22 | | 22" Tan F SAND, clean. | | | | | 94 |
| 95 | | | | | | | | | | | | | 95 |
| 96 | | | | | | 21 | | 16" Tan F SAND, clean, slight Fe mottling.<br>5" Buff M SAND, little F sand. | | | | | 96 |
| 97 | | | | | | | | | | | | | 97 |
| 98 | | | | | | 22 | moist | 22" Tan F SAND, little M sand, slight Fe mottling. | | | | | 98 |
| 99 | | | | | | | | | | | | | 99 |

Notes: F=Fine, M=Medium, C=Coarse

| | | |
|---|---|---|
| *Project Number:* 60476644<br>*Client:*<br>City of Orleans<br>Orleans, MA<br>*Site Location:*<br>32 Lots Hollow Road; Water Tower<br>Orleans, MA | AECOM<br>250 Apollo Drive<br>Chelmsford, Massachusetts<br>(978) 905-2100 | ***Boring Log LH-2***<br>*Boring Number:* 2<br>*Sheet:* 1 of 4<br>*Surface Elevation (ft-asl):*<br>*Equipment:* CME<br>*Inside Diameter:* |
| *Project Manager:* M. Owen<br>*Drilling Contractor:* Desmond | *Field Tech:* E. Amir-Lin<br>*Driller:* Tommy/Josh | *Date Started:* 12/13/2017<br>*Date Completed:* 12/22/2017 |

***Well Data***

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | | | | | | | | | | | | | 100 |
| 101 | | | | | | 22 | moist | 19" Light brown F SAND, little M sand.<br>3" Grey SILT, trace clay, little F-M sand. | | | | | 101 |
| 102 | | | | | | | | | | | | | 102 |
| 103 | | | | | | 19 | moist | 19" Tan-light brown F SAND. | | | | | 103 |
| 104 | | | | | | 18 | moist | 11" Light brown F SAND.<br>4" Brown SILTY SAND, F sand.<br>3" Grey/brown mottled SILT, medium stiff. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 104 |
| 105 | | | | | | | | | | | | | 105 |
| 106 | | | | | | | | | | | | | 106 |
| 107 | | | | | | 24 | moist-wet | 3" Same as above; SILT.<br>21" Brown F SAND, some silt. | | | | | 107 |
| 108 | | | | | | | | | | | | | 108 |
| 109 | | | | | | 24 | wet | 24" Brown F SAND, little silt, Fe mottling, stiff. | | | | | 109 |
| 110 | | | | | | | | | | | | | 110 |
| 111 | | | | | | 18 | wet | 18" Brown F and M SAND, Fe staining, dense. | | | | | 111 |
| 112 | | | | | | | | | | | | | 112 |
| 113 | | No Blow Counts Collected - Drilled Direct Push to 88 feet, then downhole hammer employed | | | | 22 | wet | 22" Brown F and M SAND, dense. | Time-release bentonite chip seal. | | | | 113 |
| 114 | | | | | | | | | | | | | 114 |
| 115 | | | | | | 18 | wet | 18" Brown F and M SAND, micaceous, dense. | | | | | 115 |
| 116 | | | | | | | | | | | | | 116 |
| 117 | | | | | | 17 | wet | 17" Brown M SAND, some F sand, lenses of reddish-brown M sand, dense. | | | | | 117 |
| 118 | | | | | | | | | | | | | 118 |
| 119 | | | | | | 14 | wet | 14" Brown M and F SAND, dense. | | | | | 119 |
| 120 | | | | | | | | | | | | | 120 |
| 121 | | | | | | 24 | wet | 25" Brown M SAND, little F sand, dense. 2" lens grey/brown mottled SILT at 121.5 feet. | | | | | 121 |
| 122 | | | | | | | | | | | | | 122 |
| 123 | | | | | | 24 | wet | 24" Brown M SAND, little F sand, dense. | | | | | 123 |
| 124 | | | | | | | | | .010 slot PVC screen | | | | 124 |
| 125 | | | | | | 21 | wet | 18" Brown M SAND, little F sand, dense.<br>3" Grey/brown mottled SILT, little clay, stiff. | | | | | 125 |
| 126 | | | | | | | | | | | | | 126 |
| 127 | | | | | | 24 | wet | Brown M SAND, little F sand, dense. | | | | | 127 |
| 128 | | | | | | | | | | | | | 128 |
| 129 | | | | | | **Bottom of Boring at 129 feet** | | | | | | | | 129 |
| 130 | | | | | | | | | | | | | 130 |
| 131 | | | | | | | | | | | | | 131 |
| 132 | | | | | | | | | | | | | 132 |

Notes: F=Fine, M=Medium, C=Coarse

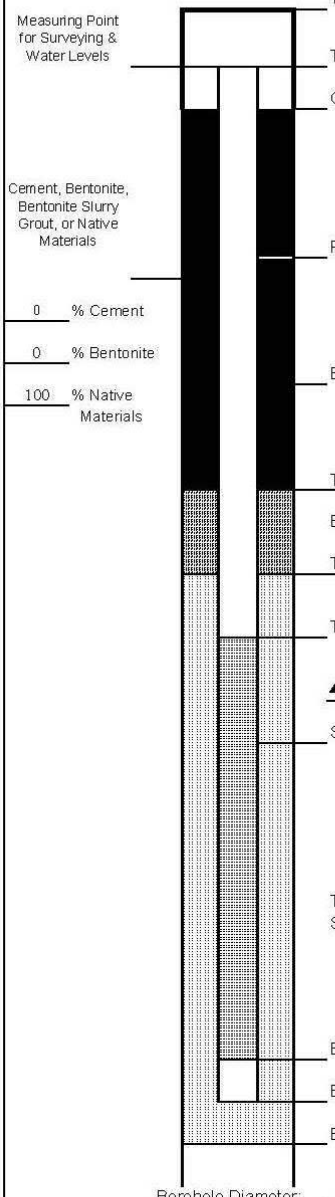
AECOM

Client: Town of Orleans
Project Number: 60476644
Site Location: Orleans, MA
Well Location: 32 Lots Hollow Coords:
Method: CME truck mounted hollow-stem auger

**WELL ID: LH-3**

Date Installed: 02/06/2018
Inspector: Erika Amir-Lin
Contractor: Desmond Drilling

## MONITORING WELL CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Steel Guard Pipe | +3 | |
| Top of Riser Pipe | | |
| Ground Surface (G.S.) | 0.0 | |
| Riser Pipe: Length 119; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Steel Guard Pipe | 2 | |
| Top of Bentonite | 114 | |
| Bentonite Seal Thickness 2 feet | | |
| Top of Sand | N/A | |
| Top of Screen | 119.0 | |
| ▲ Stabilized Water Level | 104 | |
| Screen: Length 10; Inside Diameter (ID) 2-inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand native pack; Sand Pack Thickness N/A | | |
| Bottom of Screen | 129 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 129 | |

Borehole Diameter: 6-inch

Approved:

Signature

Date

Describe Measuring Point:

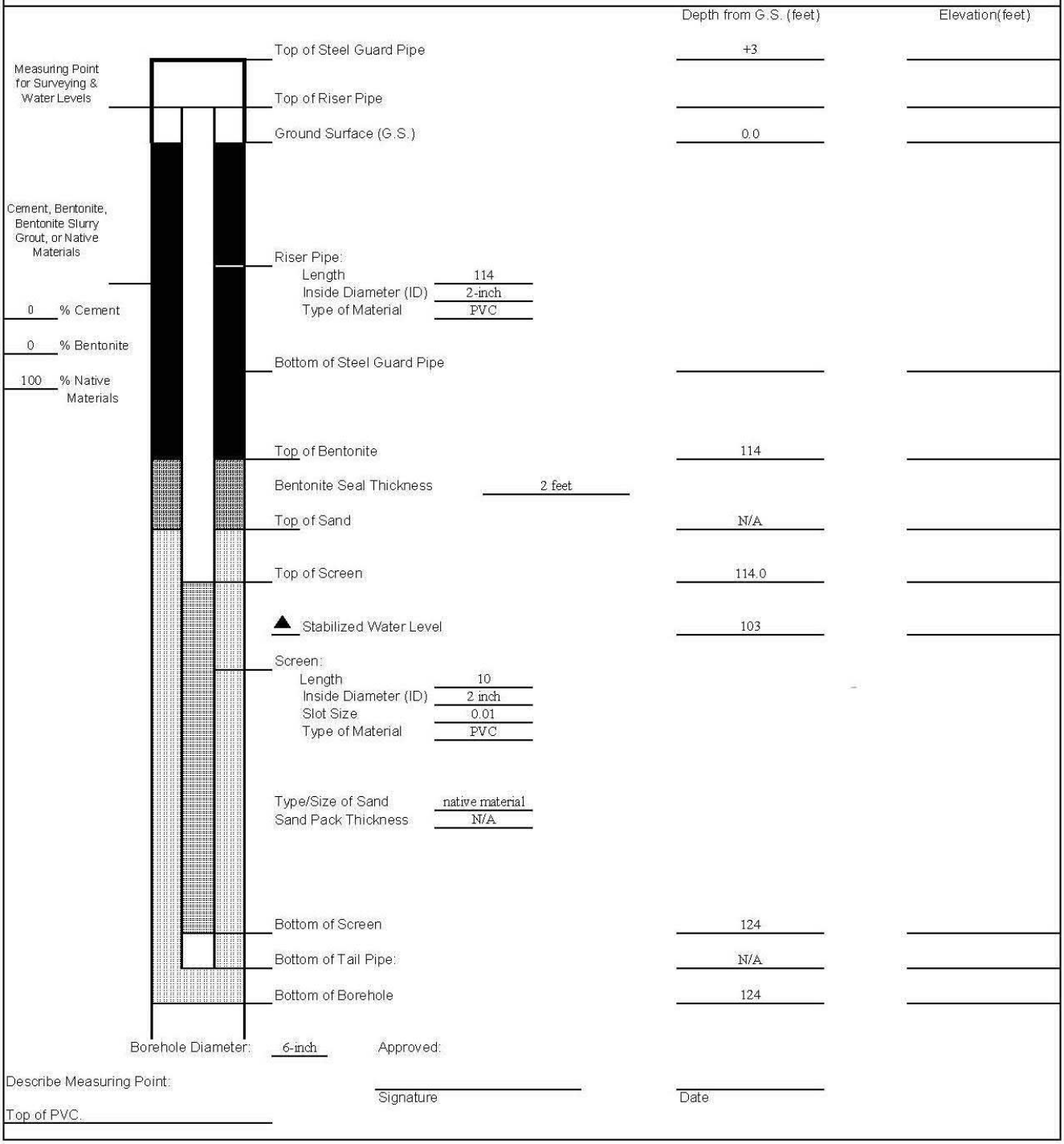
Top of PVC.

AECOM

Client: Town of Orleans
Project Number: 60476644
Site Location: Orleans, MA
Well Location: 32 Lots Hollow Coords:
Method: CME truck mounted hollow-stem auger

**WELL ID: LH-4**
Date Installed: 01/04/2018
Inspector: Erika Amir-Lin
Contractor: Desmond Drilling

## MONITORING WELL CONSTRUCTION DETAIL



*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen
*Drilling Contractor:* Desmond
*Field Tech:* E. Amir-Lin
*Driller:* Tommy/Josh
*Date Started:* 12/15/2017
*Date Completed:* 12/19/2017

## *Boring Log LH-5*

*Boring Number:* 5
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### *Well Data*

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat | Tube | Fill Mat | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | No Blow Counts Collected - Drilled Direct Push to 80 feet | | | | | | | Well completed with 3 foot metal standpipe and concrete pad | | | | 1 |
| 2 | | | | | | 25 | dry | 2" Brown loam. 24" Yellow-brown M SAND, little F sand, trace C sand, trace F rounded gravel. | | | | | 2 |
| 3 | | | | | | | | | | | | | 3 |
| 4 | | | | | | | | | | | | | 4 |
| 5 | | | | | | | | | | | | | 5 |
| 6 | | | | | | 21 | dry | 21" Light brown M SAND, intermittent Fe stained bands. | | | | | 6 |
| 7 | | | | | | | | | | | | | 7 |
| 8 | | | | | | | | | | | | | 8 |
| 9 | | | | | | | | | | | | | 9 |
| 10 | | | | | | 40 | dry | 18" Light brown M SAND, little C sand, Fe staining. 6" Light brown F SAND. 16" Light brown M SAND, little C sand, Fe staining. | | | | | 10 |
| 11 | | | | | | | | | | | | | 11 |
| 12 | | | | | | | | | | | | | 12 |
| 13 | | | | | | | | | | | | | 13 |
| 14 | | | | | | 22 | dry | 22" Light brown to orange-brown M SAND, some C sand, little F sand, trace F rounded gravel. | | | | | 14 |
| 15 | | | | | | | | | Schedule 40 PVC riser to surface Natural formation pack | | | | 15 |
| 16 | | | | | | | | | | | | | 16 |
| 17 | | | | | | | | | | | | | 17 |
| 18 | | | | | | 23 | dry | 23" Light brown M SAND, little F sand, trace C sand, trace F rounded gravel, mottled Fe stain. | | | | | 18 |
| 19 | | | | | | | | | | | | | 19 |
| 20 | | | | | | | | | | | | | 20 |
| 21 | | | | | | | | | | | | | 21 |
| 22 | | | | | | 28 | dry | 28" Light brown M SAND, some C sand, little F sand, trace F subrounded gravel, Fe staining. | | | | | 22 |
| 23 | | | | | | | | | | | | | 23 |
| 24 | | | | | | | | | | | | | 24 |
| 25 | | | | | | | | | | | | | 25 |
| 26 | | | | | | 34 | dry | 26" Tan M SAND, little C sand, trace F sand, trace F rounded gravel, occasional Fe stain. 8" Reddish brown C SAND, little F gravel, one piece C angular gravel, little M sand, trace F sand. | | | | | 26 |
| 27 | | | | | | | | | | | | | 27 |
| 28 | | | | | | | | | | | | | 28 |
| 29 | | | | | | | | | | | | | 29 |
| 30 | | | | | | 30 | moist | 30" Light brown M SAND, some C sand, little F sand, little F-C gravel. | | | | | 30 |
| 31 | | | | | | | | | | | | | 31 |
| 32 | | | | | | | | | | | | | 32 |
| 33 | | | | | | | | | | | | | 33 |

Notes: F=Fine, M=Medium, C=Coarse

| | | |
|---|---|---|
| *Project Number:* 60476644<br>*Client:*<br>City of Orleans<br>Orleans, MA<br>*Site Location:*<br>32 Lots Hollow Road; Water Tower<br>Orleans, MA | AECOM<br>250 Apollo Drive<br>Chelmsford, Massachusetts<br>(978) 905-2100 | ***Boring Log LH-5***<br>*Boring Number:* **5**<br>*Sheet:* 1 of 4<br>*Surface Elevation (ft-asl):*<br>*Equipment:* CME<br>*Inside Diameter:* |
| *Project Manager:* M. Owen<br>*Drilling Contractor:* Desmond | *Field Tech:* E. Amir-Lin<br>*Driller:* Tommy/Josh | *Date Started:* 12/15/2017<br>*Date Completed:* 12/19/2017 |

***Well Data***

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | | No Blow Counts Collected - Drilled Direct Push to 80 feet | | | | 30 | moist | 8" Light brown M SAND, some C sand, little F sand, little F-C gravel.<br>22" Brown/tan mottled M SAND, little fine sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 34 |
| 35 | | | | | | | | | | | | | 35 |
| 36 | | | | | | 29" | moist | 29" Brown-tan M SAND, little F sand, trace C sand. | | | | | 36 |
| 37 | | | | | | | | | | | | | 37 |
| 38 | | | | | | | | | | | | | 38 |
| 39 | | | | | | | | | | | | | 39 |
| 40 | | | | | | 42 | moist | 42" Light brown-tan M SAND, little F sand, little C sand, lens of brown M and C sand at 43.3 feet. | | | | | 40 |
| 41 | | | | | | | | | | | | | 41 |
| 42 | | | | | | | | | | | | | 42 |
| 43 | | | | | | | | | | | | | 43 |
| 44 | | | | | | 40 | moist | 40" Light brown-tan M SAND, little F, trace C, Fe staining. | | | | | 44 |
| 45 | | | | | | | | | | | | | 45 |
| 46 | | | | | | | | | | | | | 46 |
| 47 | | | | | | | | | | | | | 47 |
| 48 | | | | | | 32 | moist | Same as above, decreasing Fe staining. | | | | | 48 |
| 49 | | | | | | | | | | | | | 49 |
| 50 | | | | | | | | | | | | | 50 |
| 51 | | | | | | | | | | | | | 51 |
| 52 | | | | | | 26 | moist | 26" Tan M SAND, little F sand, little C sand, trace F subangular gravel. | | | | | 52 |
| 53 | | | | | | | | | | | | | 53 |
| 54 | | | | | | | | | | | | | 54 |
| 55 | | | | | | | | | | | | | 55 |
| 56 | | | | | | 30 | moist | 10" Tan M SAND, occasional Fe staining.<br>3" Grey/brown mottled SILT.<br>5" Tan F SAND, Fe stain.<br>12" Tan M SAND, some F sand, occasional Fe staining. | | | | | 56 |
| 57 | | | | | | | | | | | | | 57 |
| 58 | | | | | | | | | | | | | 58 |
| 59 | | | | | | | | | | | | | 59 |
| 60 | | | | | | 31 | moist | 31" Tan M SAND, little F sand, occasional dark brown bands. | | | | | 60 |
| 61 | | | | | | | | | | | | | 61 |
| 62 | | | | | | | | | | | | | 62 |
| 63 | | | | | | | | | | | | | 63 |
| 64 | | | | | | 36 | moist | 36" Tan-light brown M SAND, little F sand, occasional Fe stain. | | | | | 64 |
| 65 | | | | | | | | | | | | | 65 |
| 66 | | | | | | | | | | | | | 66 |

Notes: F=Fine, M=Medium, C=Coarse

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen
*Field Tech:* E. Amir-Lin
*Date Started:* 12/15/2017
*Drilling Contractor:* Desmond
*Driller:* Tommy/Josh
*Date Completed:* 12/19/2017

## *Boring Log LH-5*

*Boring Number:* 5
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### *Well Data*

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | | No Blow Counts Collected - Drilled Direct Push to 80 feet, then downhole hammer employed | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 67 |
| 68 | | | | | | | | | | | | | 68 |
| 69 | | | | | | | | | | | | | 69 |
| 70 | | | | | | 38 | moist | 38" Tan-light brown M SAND, little F sand, trace Fe stain. | | | | | 70 |
| 71 | | | | | | | | | | | | | 71 |
| 72 | | | | | | | | | | | | | 72 |
| 73 | | | | | | | | | | | | | 73 |
| 74 | | | | | | 25 | moist | 21" Same as above, two C gravel pieces.<br>4" Brown F SAND with SILT. | | | | | 74 |
| 75 | | | | | | | | | | | | | 75 |
| 76 | | | | | | | | | | | | | 76 |
| 77 | | | | | | | | | | | | | 77 |
| 78 | | | | | | 24 | moist | 24" Tan-light brown M SAND, little F sand, Fe staining. | | | | | 78 |
| 79 | | | | | | | | | | | | | 79 |
| 80 | | | | | | | | | | | | | 80 |
| 81 | | | | | | 22 | moist | 22" Tan M SAND, little F sand, clean. | | | | | 81 |
| 82 | | | | | | | | | | | | | 82 |
| 83 | | | | | | 22 | moist | 22" Light brown M SAND, little F sand, clean. | | | | | 83 |
| 84 | | | | | | | | | | | | | 84 |
| 85 | | | | | | 21 | moist | 21" Same as above. | | | | | 85 |
| 86 | | | | | | | | | | | | | 86 |
| 87 | | | | | | 19 | moist | 19" Tan M SAND, little F sand, clean. | | | | | 87 |
| 88 | | | | | | | | | | | | | 88 |
| 89 | | | | | | 20 | moist | 20" Light brown to tan M SAND, little F sand. | | | | | 89 |
| 90 | | | | | | | | | | | | | 90 |
| 91 | | | | | | 21 | moist | 21" Light brown M SAND, little F sand. | | | | | 91 |
| 92 | | | | | | | | | | | | | 92 |
| 93 | | | | | | 24 | moist | 24" Same as above. | | | | | 93 |
| 94 | | | | | | | | | | | | | 94 |
| 95 | | | | | | 24 | moist | 24" Same as above. | | | | | 95 |
| 96 | | | | | | | | | | | | | 96 |
| 97 | | | | | | 11 | moist | 11" Tan M SAND, little F sand. | | | | | 97 |
| 98 | | | | | | | | | | | | | 98 |
| 99 | | | | | | 24 | moist | 24" Light brown M SAND, little F sand, faint Fe staining. | | | | | 99 |

Notes: F=Fine, M=Medium, C=Coarse

| | | |
|---|---|---|
| *Project Number:* 60476644<br>*Client:*<br>City of Orleans<br>Orleans, MA<br>*Site Location:*<br>32 Lots Hollow Road; Water Tower<br>Orleans, MA | AECOM<br>250 Apollo Drive<br>Chelmsford, Massachusetts<br>(978) 905-2100 | ***Boring Log LH-5***<br>*Boring Number:* 5<br>*Sheet:* 1 of 4<br>*Surface Elevation (ft-asl):*<br>*Equipment:* CME<br>*Inside Diameter:* |
| *Project Manager:* M. Owen<br>*Drilling Contractor:* Desmond | *Field Tech:* E. Amir-Lin<br>*Driller:* Tommy/Josh | *Date Started:* 12/15/2017<br>*Date Completed:* 12/19/2017 |

***Well Data***

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

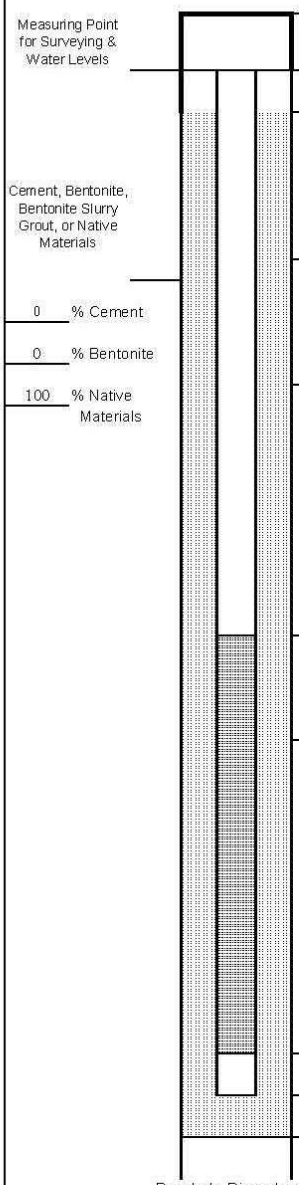
| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat | Tube | Fill Mat | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | | No Blow Counts Collected - Drilled Direct Push to 80 feet, then downhole hammer employed | | | | | | | | | | | 100 |
| 101 | | | | | | 19 | moist | 19" Tan M SAND, some F sand, faint Fe staining. | | | | | 101 |
| 102 | | | | | | | | | | | | | 102 |
| 103 | | | | | | 24 | moist | 24" Light brown M SAND, little F sand. | | | | | 103 |
| 104 | | | | | | | | | | | | | 104 |
| 105 | | | | | | 24 | moist - wet | 24" Brown M sand, some F sand. | Time-release bentonite chip seal. | | | | 105 |
| 106 | | | | | | | | | | | | | 106 |
| 107 | | | | | | 19 | wet | 19" Same as above. | | | | | 107 |
| 108 | | | | | | | | | | | | | 108 |
| 109 | | | | | | 22 | wet | 22" Brown M and F SAND. | | | | | 109 |
| 110 | | | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 110 |
| 111 | | | | | | 24 | wet | 24" Same as above. | | | | | 111 |
| 112 | | | | | | | | | | | | | 112 |
| 113 | | | | | | 18 | wet | 24" Same as above. | | | | | 113 |
| 114 | | | | | | | | | | | | | 114 |
| 115 | | | | | | 22 | wet | 22" Brown M SAND, some F sand. | | | | | 115 |
| 116 | | | | | | | | | | | | | 116 |
| 117 | | | | | | 24 | wet | 19" Brown M SAND, some F sand.<br>5" Brown SANDY SILT. | | | | | 117 |
| 118 | | | | | | | | | | | | | 118 |
| 119 | | | | | | 24 | wet | 24" Brown M and F SAND, becoming M with some F at bottom of spoon. | 0.010 slot PVC screen | | | | 119 |
| 120 | | | | | | | | | | | | | 120 |
| 121 | | | | | | 24 | wet | 5" Brown M and F SAND.<br>1" Brown SILT.<br>18" Light brown M SAND, little F sand. | | | | | 121 |
| 122 | | | | | | | | | | | | | 122 |
| 123 | | | | | | 24 | wet | 3" Same as above.<br>21" Brown F and M SAND. | | | | | 123 |
| 124 | | | | | | | | | | | | | 124 |
| 125 | | | | | | 24 | wet | 24" Brown F SAND, little M sand. | | | | | 125 |
| 126 | | | | | | | | | | | | | 126 |
| 127 | | | | | | 21 | wet | 21" Same as above. | | | | | 127 |
| 128 | | | | | | | | | | | | | 128 |
| 129 | | | | | | 24 | wet | 24" Brown F SAND, trace M sand, clean. | | | | | 129 |
| 130 | | | | | | | | | | | | | 130 |
| 131 | | | | | | 20 | wet | 20" Same as above. | | | | | 131 |
| 132 | | | | | | | | | | | | | 132 |
| 133 | | | | | | 18 | wet | 18" Brown M SAND, some F sand. | | | | | 133 |
| 134 | | | | | | | | **Bottom of Boring at 134 feet** | | | | | 134 |
| 135 | | | | | | | | | | | | | 135 |

Notes: F=Fine, M=Medium, C=Coarse

AECOM

| | |
|---|---|
| *Client: Town of Orleans* | ***Test Wick - 32 Lots Hollow*** |
| *Project Number: 60476644* | |
| *Site Location: Orleans, MA* | *Date Installed: 02/06/2018* |
| *Well Location: 32 Lots Hollow Coords:* | *Inspector: Erika Amir-Lin* |
| *Method: CME truck mounted hollow-stem auger* | *Contractor: Desmond Drilling* |

## WICK DISCHARGE CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Plastic Culvert Pipe (6-foot diameter) | +2 | |
| Top of PVC well | +1 | |
| Ground Surface (G.S.) | 0.0 | |
| Well Riser Pipe: Length 25; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Plastic Culvert Pipe | 4 | |
| Note: PVC well set in center of the wick. | N/A | |
| | N/A | |
| Top of Screen | 25 | |
| ▲ Stabilized Water Level | above water table | |
| Screen: Length 80; Inside Diameter (ID) 2 inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand 3/8" gravel - Sand Pack Thickness 5 inches | | |
| Bottom of Screen | 105 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 105 | |

Approved:

Signature

Date

Describe Measuring Point:

Top of PVC.

**Attachment 3 – Soil Analyses**

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THIELSCH ENGINEERING

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http://www.thielsch.com
*Let's Build a Solid Foundation*

Client Information:
AECOM / Town Of Orleans
Boston, MA
PM: Tom Parece
Collected By: Mark Owen
Client Project #: 60476644.01.01

Project Information:
**Orleans - GWDP**
**Orleans, MA**
TEI Project Number: 60476644.01.01
Summary Page: 1 of 1
Report Date: 02.23.18

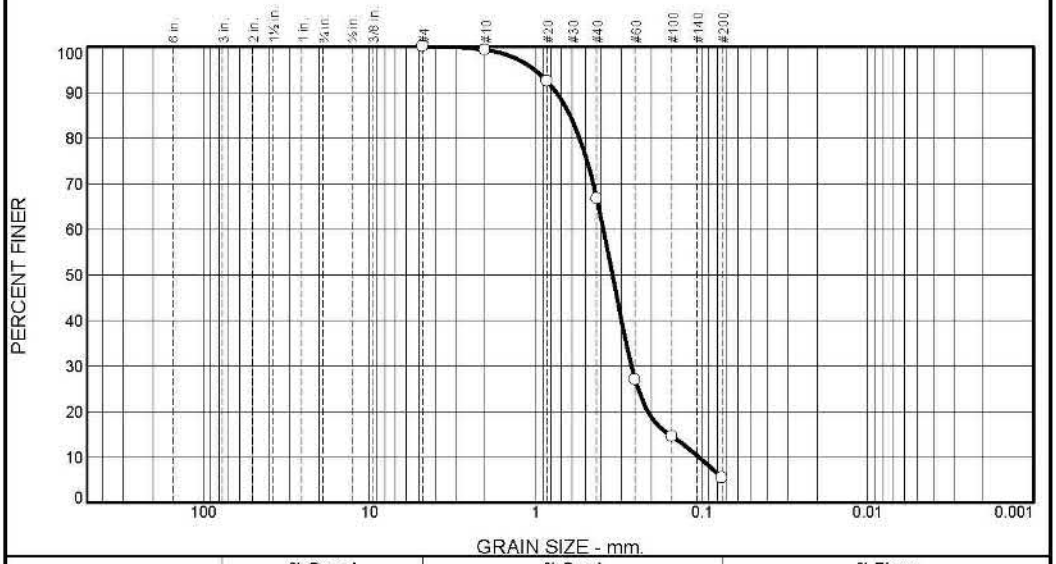
## LABORATORY TESTING DATA SHEET

| Boring ID / Source | Sample No. / Material | | Depth (ft) | CTS Laboratory No. | Identification Tests | | | | | | Corrosivity Tests | | | | | | | | Laboratory Log and Soil Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Water Content % | LL % | PL % | Gravel % | Sand % | Fines % | pH | Sulfate (mg/kg) | Chloride (mg/kg) | Sulfide (mg/kg) | Redox Potential (mv) | Electrical Resist. As Received Ohm-cm | Electrial Resist. Saturated Ohm-cm | Other | |
| LH-2 | 1 | | 30-40 | 18-S-163 | | | | 0.0 | 94.6 | 5.4 | | | | | | | | | Brown poorly graded sand with silt (SP - SM) |
| LH-5 | 1 | | 80-96 | 18-S-164 | | | | 0.0 | 97.2 | 2.8 | | | | | | | | | Brown poorly graded sand (SP) |
| LH-2 | 2 | | 106 | 18-S-165 | | | | 0.0 | 20.4 | 79.6 | | | | | | | | | Grey-brown silt with sand (ML) |
| LH-5 | 2 | | 118 | 18-S-166 | | | | 0.0 | 22.0 | 78.0 | | | | | | | | | Brown silt with sand (ML) |
| LH-5 | 3 | | 124-132 | 18-S-167 | | | | 0.0 | 96.7 | 3.3 | | | | | | | | | Brown poorly graded sand (SP) |
| LH-2 | 3 | | 106-108 | 18-S-168 | | | | 0.0 | 76.6 | 23.4 | | | | | | | | | Brown silty sand (SM) |
| MW-2 (235-245) | 1 | | 36 | 18-S-169 | | | | 0.0 | 78.6 | 21.4 | | | | | | | | | Brown silty sand (SM) |
| MW-2 (235-245) | 2 | | 66 | 18-S-170 | | | | 0.0 | 97.0 | 3.0 | | | | | | | | | Brown poorly graded sand (SP) |
| MW-2 (235-245) | 3 | | 101 | 18-S-171 | | | | 0.0 | 7.2 | 92.8 | | | | | | | | | Brown silt (ML) |
| MW-2 (235-245) | 4 | | 165 | 18-S-172 | | | | 0.0 | 58.3 | 41.7 | | | | | | | | | Grey sandy silt (SM) |
| MW-2 (235-245) | 5 | | 186-196 | 18-S-173 | | | | 0.0 | 94.4 | 5.6 | | | | | | | | | Gray poorly graded sand with silt (SP - SM) |
| MW-2 (235-245) | 6 | | 226 | 18-S-174 | | | | 0.0 | 95.0 | 5.0 | | | | | | | | | Gray poorly graded sand with silt (SP - SM) |

Reviewed By _____

Date Reviewed *02.26.18*

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.8 | 32.6 | 61.2 | 5.4 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.2 | | |
| #20 | 92.4 | | |
| #40 | 66.6 | | |
| #60 | 26.9 | | |
| #100 | 14.5 | | |
| #200 | 5.4 | | |

* (no specification provided)

**Material Description**

Brown poorly graded sand with silt (SP - SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

**Coefficients**

$D_{90}$= 0.7483 $D_{85}$= 0.6191 $D_{60}$= 0.3887
$D_{50}$= 0.3433 $D_{30}$= 0.2636 $D_{15}$= 0.1577
$D_{10}$= 0.1044 $C_u$= 3.72 $C_c$= 1.71

**Remarks**

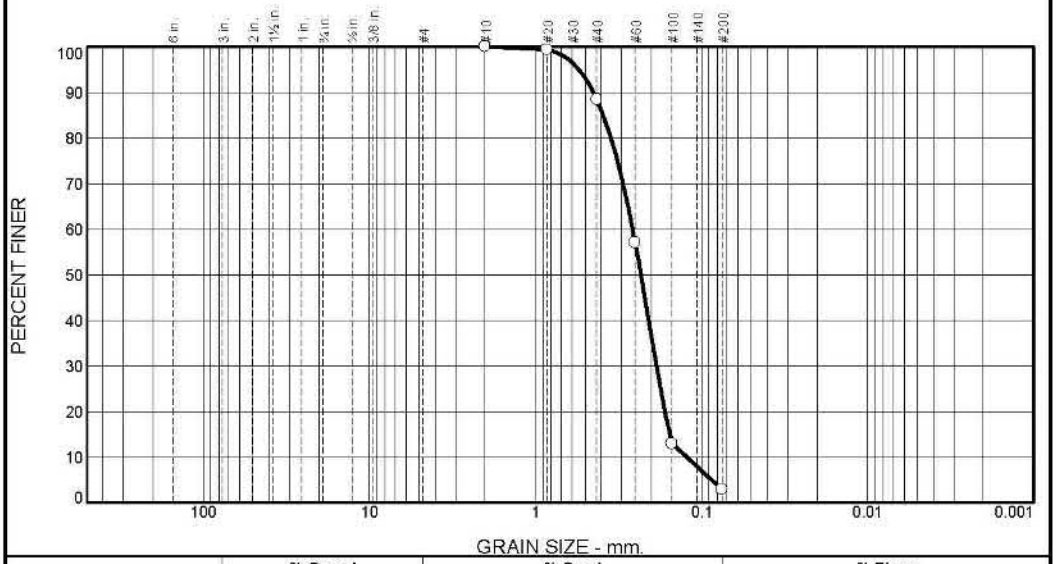
**Date Received:** 02.20.18 **Date Tested:** 02.22.18
**Tested By:** MN
**Checked By:** Matthew Colman P.E.
**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 30-40' **Date Sampled:** 12.14.17
**Sample Number:** LH-2 / S-1

**Thielsch Engineering Inc.**
**Cranston, RI**

**Client:** AECOM / Town Of Orleans
**Project:** Orleans-GWDP
Orleans, MA
**Project No:** 06476644.01.01 **Figure** 18-S-163

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 11.7 | 85.5 | 2.8 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 99.3 | | |
| #40 | 88.3 | | |
| #60 | 57.0 | | |
| #100 | 12.9 | | |
| #200 | 2.8 | | |

* (no specification provided)

**Material Description**

Brown poorly graded sand (SP)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SP AASHTO (M 145)= A-3

**Coefficients**

$D_{90}$= 0.4468 $D_{85}$= 0.3902 $D_{60}$= 0.2592
$D_{50}$= 0.2310 $D_{30}$= 0.1866 $D_{15}$= 0.1550
$D_{10}$= 0.1231 $C_u$= 2.11 $C_c$= 1.09

**Remarks**

**Date Received:** 02.20.18 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 80-96' **Date Sampled:** 12.18.17

**Sample Number:** LH-5 / S-1

**Thielsch Engineering Inc.**

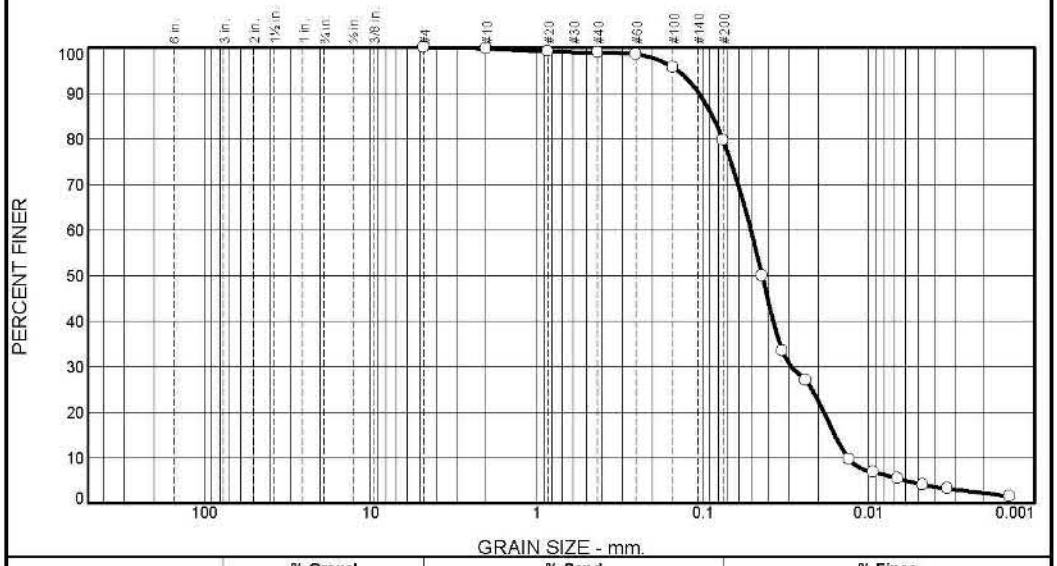
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-164

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.3 | 0.8 | 19.3 | 77.5 | 2.1 |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.7 | | |
| #20 | 99.1 | | |
| #40 | 98.9 | | |
| #60 | 98.4 | | |
| #100 | 95.6 | | |
| #200 | 79.6 | | |
| 0.0436 mm. | 49.9 | | |
| 0.0330 mm. | 33.4 | | |
| 0.0239 mm. | 26.9 | | |
| 0.0131 mm. | 9.6 | | |
| 0.0093 mm. | 6.8 | | |
| 0.0066 mm. | 5.3 | | |
| 0.0047 mm. | 4.0 | | |
| 0.0033 mm. | 3.1 | | |
| 0.0014 mm. | 1.4 | | |

* (no specification provided)

**Material Description**

Grey-brown silt with sand (ML)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

**Coefficients**

$D_{90}$= 0.1051 $D_{85}$= 0.0872 $D_{60}$= 0.0511
$D_{50}$= 0.0437 $D_{30}$= 0.0292 $D_{15}$= 0.0160
$D_{10}$= 0.0133 $C_u$= 3.84 $C_c$= 1.25

**Remarks**

Material was visually checked for plasticity and rolled to approximatley 3/16" thread diameter.

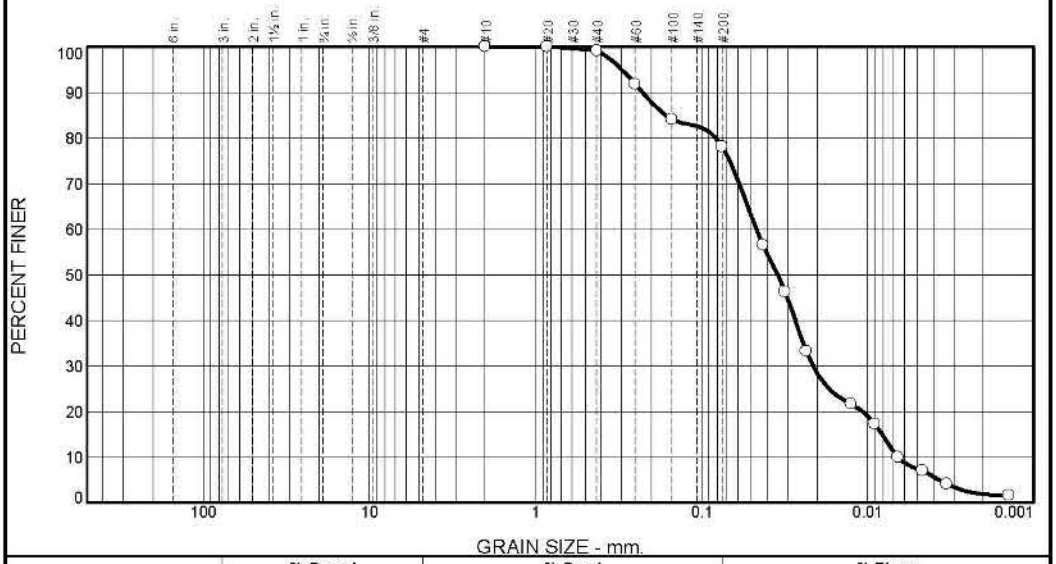
**Date Received:** 02.20.18 **Date Tested:** 02.23.18
**Tested By:** MN
**Checked By:** Matthew Colman P.E.
**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 106' **Date Sampled:** 12.20.17
**Sample Number:** LH-2 / S-2

**Thielsch Engineering Inc.**
**Cranston, RI**

**Client:** AECOM / Town Of Orleans
**Project:** Orleans-GWDP
Orleans, MA
**Project No:** 06476644.01.01 **Figure** 18-S-165

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 21.1 | 76.2 | 1.8 |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 100.0 | | |
| #40 | 99.1 | | |
| #60 | 91.8 | | |
| #100 | 84.0 | | |
| #200 | 78.0 | | |
| 0.0425 mm. | 56.4 | | |
| 0.0314 mm. | 46.2 | | |
| 0.0234 mm. | 33.1 | | |
| 0.0126 mm. | 21.5 | | |
| 0.0090 mm. | 17.2 | | |
| 0.0065 mm. | 9.9 | | |
| 0.0047 mm. | 6.9 | | |
| 0.0033 mm. | 4.0 | | |
| 0.0014 mm. | 1.5 | | |

* (no specification provided)

**Material Description**

Brown silt with sand (ML)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

**Coefficients**

$D_{90}$= 0.2269 $D_{85}$= 0.1658 $D_{60}$= 0.0467
$D_{50}$= 0.0348 $D_{30}$= 0.0213 $D_{15}$= 0.0082
$D_{10}$= 0.0066 $C_u$= 7.10 $C_c$= 1.48

**Remarks**

Material was visually checked for plasticity and rolled to 3/16 thread diameter.

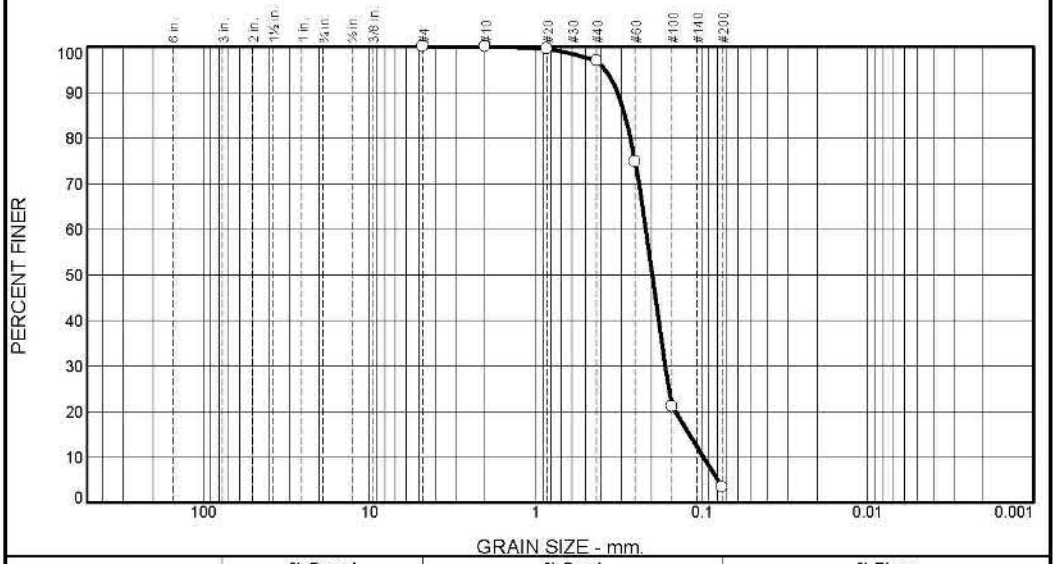
**Date Received:** 02.20.18 **Date Tested:** 02.23.18
**Tested By:** MN
**Checked By:** Matthew Colman P.E.
**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 118' **Date Sampled:** 12.19.17
**Sample Number:** LH-5 / S-2

**Thielsch Engineering Inc.**
**Cranston, RI**

**Client:** AECOM / Town Of Orleans
**Project:** Orleans-GWDP
Orleans, MA
**Project No:** 06476644.01.01 **Figure** 18-S-166

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 3.2 | 93.5 | 3.3 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 100.0 | | |
| #20 | 99.5 | | |
| #40 | 96.8 | | |
| #60 | 74.7 | | |
| #100 | 21.0 | | |
| #200 | 3.3 | | |

* (no specification provided)

**Material Description**

Brown poorly graded sand (SP)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SP AASHTO (M 145)= A-3

**Coefficients**

$D_{90}$= 0.3207 $D_{85}$= 0.2889 $D_{60}$= 0.2159
$D_{50}$= 0.1977 $D_{30}$= 0.1652 $D_{15}$= 0.1185
$D_{10}$= 0.0974 $C_u$= 2.22 $C_c$= 1.30

**Remarks**

**Date Received:** 02.20.18 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 124-132' **Date Sampled:** 12.19.18

**Sample Number:** LH-5 / S-3

**Thielsch Engineering Inc.**

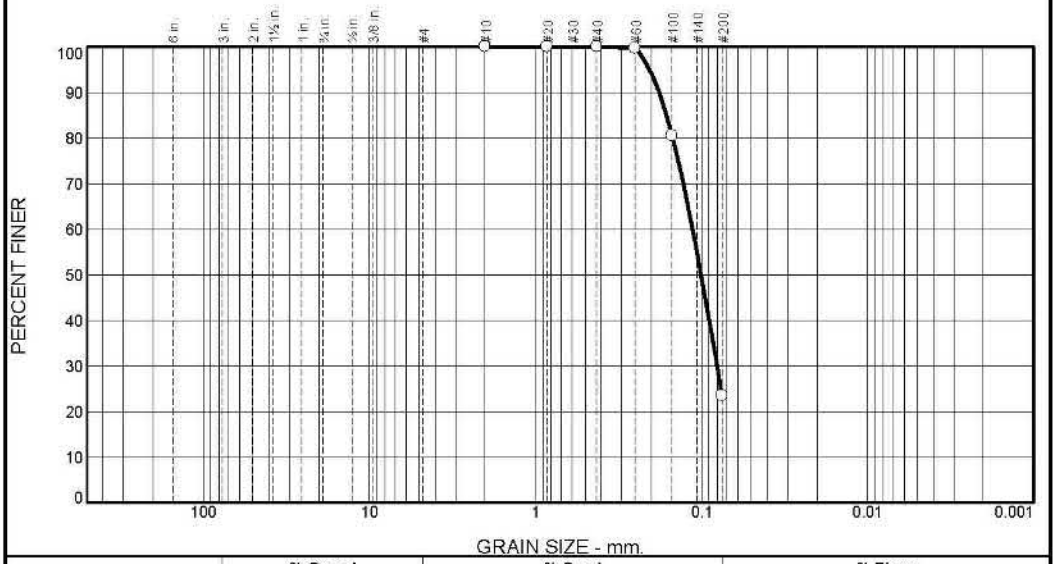
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-167

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.6 | 23.4 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 100.0 | | |
| #40 | 100.0 | | |
| #60 | 99.6 | | |
| #100 | 80.4 | | |
| #200 | 23.4 | | |

* (no specification provided)

**Material Description**

Brown silty sand (SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

**Coefficients**

$D_{90}$= 0.1801 $D_{85}$= 0.1625 $D_{60}$= 0.1130
$D_{50}$= 0.1004 $D_{30}$= 0.0805 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Remarks**

Material was visually checked for plasticity and appeared non-plastic.

**Date Received:** 02.20.18 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 106-108' **Date Sampled:** 12.20.17

**Sample Number:** LH-2 / S-3

**Thielsch Engineering Inc.**

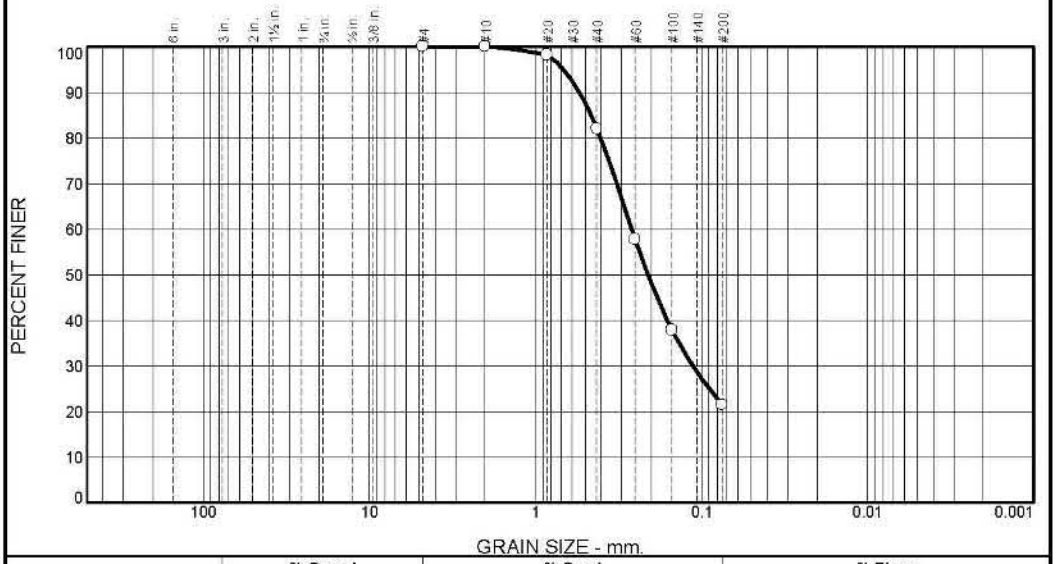
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-168

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 18.1 | 60.5 | 21.4 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 100.0 | | |
| #20 | 98.2 | | |
| #40 | 81.9 | | |
| #60 | 57.7 | | |
| #100 | 37.8 | | |
| #200 | 21.4 | | |

* (no specification provided)

**Material Description**

Brown silty sand (SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

**Coefficients**

$D_{90}$= 0.5430 $D_{85}$= 0.4618 $D_{60}$= 0.2628
$D_{50}$= 0.2097 $D_{30}$= 0.1126 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Remarks**

Material was visually checked for plasticity and appeared non-plastic.

**Date Received:** 02.20.18 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 36' **Date Sampled:** 07.20.17

**Sample Number:** MW-2 / S-1

**Thielsch Engineering Inc.**

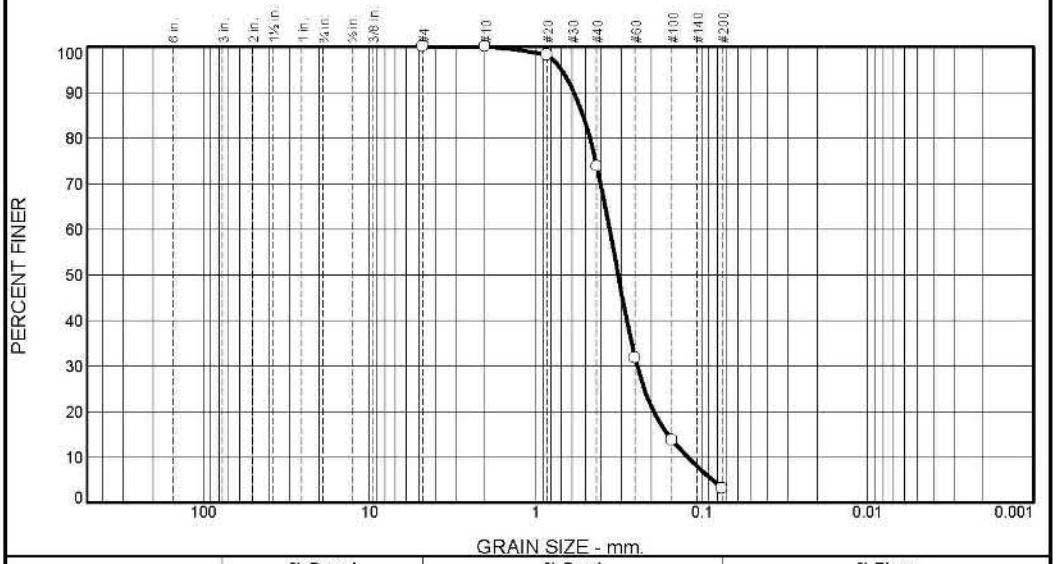
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-169

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.1 | 26.2 | 70.7 | 3.0 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.9 | | |
| #20 | 98.2 | | |
| #40 | 73.7 | | |
| #60 | 31.7 | | |
| #100 | 13.7 | | |
| #200 | 3.0 | | |

* (no specification provided)

**Material Description**

Brown poorly graded sand (SP)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI=

**Classification**

USCS (D 2487)= SP AASHTO (M 145)=

**Coefficients**

$D_{90}$= 0.5840 $D_{85}$= 0.5166 $D_{60}$= 0.3570
$D_{50}$= 0.3175 $D_{30}$= 0.2433 $D_{15}$= 0.1602
$D_{10}$= 0.1215 $C_u$= 2.94 $C_c$= 1.36

**Remarks**

**Date Received:** 02.20.17 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman, P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 66' **Date Sampled:** 07.20.17

**Sample Number:** MW-2 / S-2

**Thielsch Engineering Inc.**

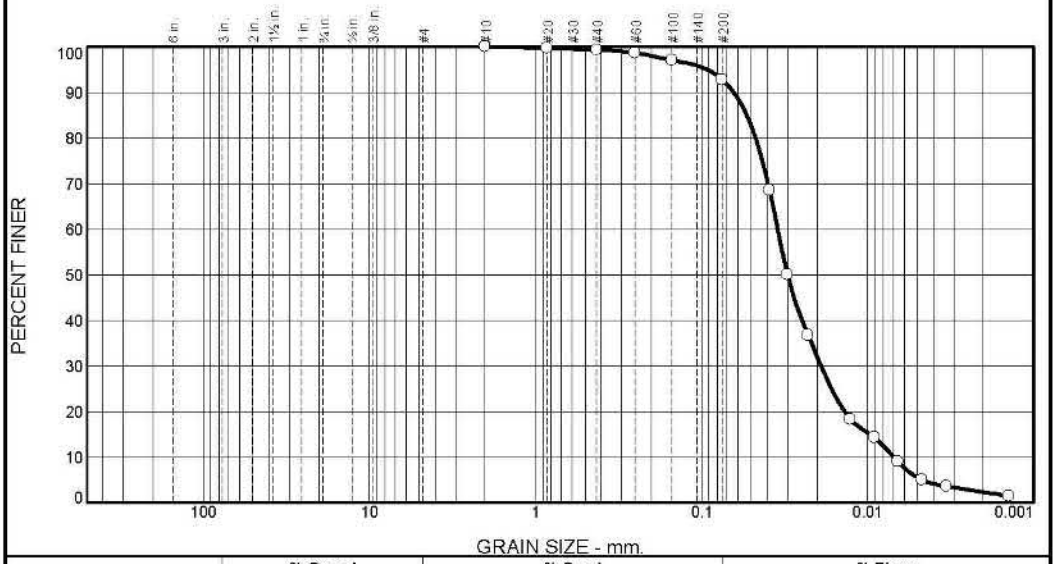
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-170

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 6.5 | 90.5 | 2.3 |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 99.7 | | |
| #40 | 99.3 | | |
| #60 | 98.6 | | |
| #100 | 97.0 | | |
| #200 | 92.8 | | |
| 0.0388 mm. | 68.4 | | |
| 0.0303 mm. | 49.9 | | |
| 0.0228 mm. | 36.7 | | |
| 0.0126 mm. | 18.2 | | |
| 0.0091 mm. | 14.2 | | |
| 0.0065 mm. | 8.9 | | |
| 0.0047 mm. | 4.9 | | |
| 0.0033 mm. | 3.5 | | |
| 0.0014 mm. | 1.4 | | |

* (no specification provided)

**Material Description**

Brown silt (ML)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

**Coefficients**

$D_{90}$= 0.0638 $D_{85}$= 0.0533 $D_{60}$= 0.0347
$D_{50}$= 0.0303 $D_{30}$= 0.0190 $D_{15}$= 0.0097
$D_{10}$= 0.0070 $C_u$= 4.98 $C_c$= 1.50

**Remarks**

Material was visually checked for plasticity and appeared non-plastic.

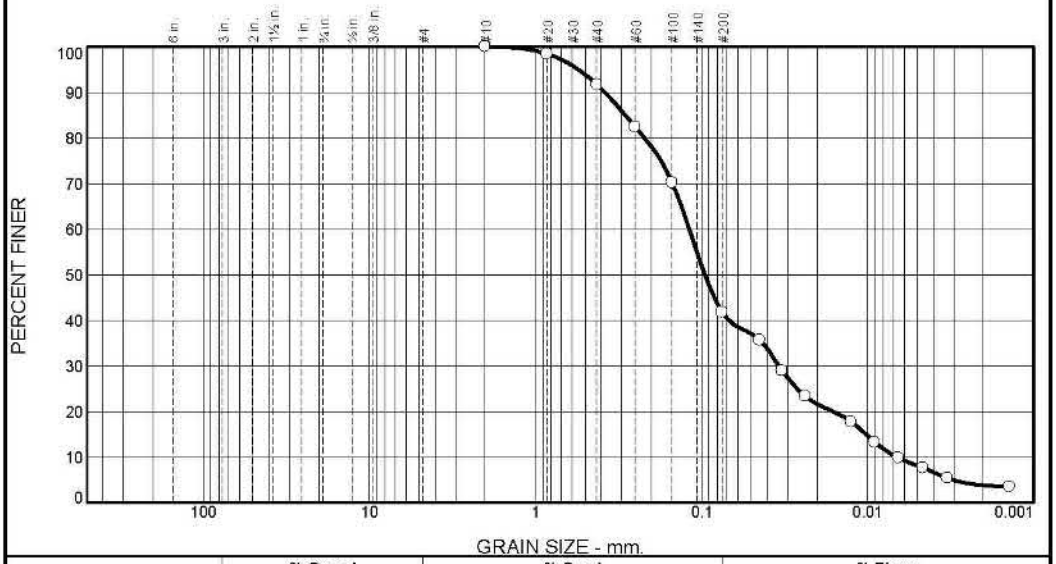
**Date Received:** 02.20.18 **Date Tested:** 02.23.18
**Tested By:** MN
**Checked By:** Matthew Colman P.E.
**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 101' **Date Sampled:** 07.20.17
**Sample Number:** MW-2 / S-3

**Thielsch Engineering Inc.**
**Cranston, RI**

**Client:** AECOM / Town Of Orleans
**Project:** Orleans-GWDP
Orleans, MA
**Project No:** 06476644.01.01 **Figure** 18-S-171

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 8.4 | 49.9 | 38.0 | 3.7 |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 98.3 | | |
| #40 | 91.6 | | |
| #60 | 82.4 | | |
| #100 | 70.1 | | |
| #200 | 41.7 | | |
| 0.0445 mm. | 35.6 | | |
| 0.0326 mm. | 28.9 | | |
| 0.0237 mm. | 23.3 | | |
| 0.0125 mm. | 17.7 | | |
| 0.0090 mm. | 13.2 | | |
| 0.0065 mm. | 9.8 | | |
| 0.0046 mm. | 7.6 | | |
| 0.0033 mm. | 5.3 | | |
| 0.0014 mm. | 3.4 | | |

* (no specification provided)

**Material Description**

Grey silty sand (SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

**Coefficients**

$D_{90}$= 0.3830 $D_{85}$= 0.2886 $D_{60}$= 0.1185
$D_{50}$= 0.0952 $D_{30}$= 0.0342 $D_{15}$= 0.0103
$D_{10}$= 0.0067 $C_u$= 17.72 $C_c$= 1.48

**Remarks**

Material was visually checked for plasticity and appeared non-plasitc.

**Date Received:** 02.20.18 **Date Tested:** 02.23.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 165' **Date Sampled:** 07.20.17

**Sample Number:** MW-2 / S-4

**Thielsch Engineering Inc.**

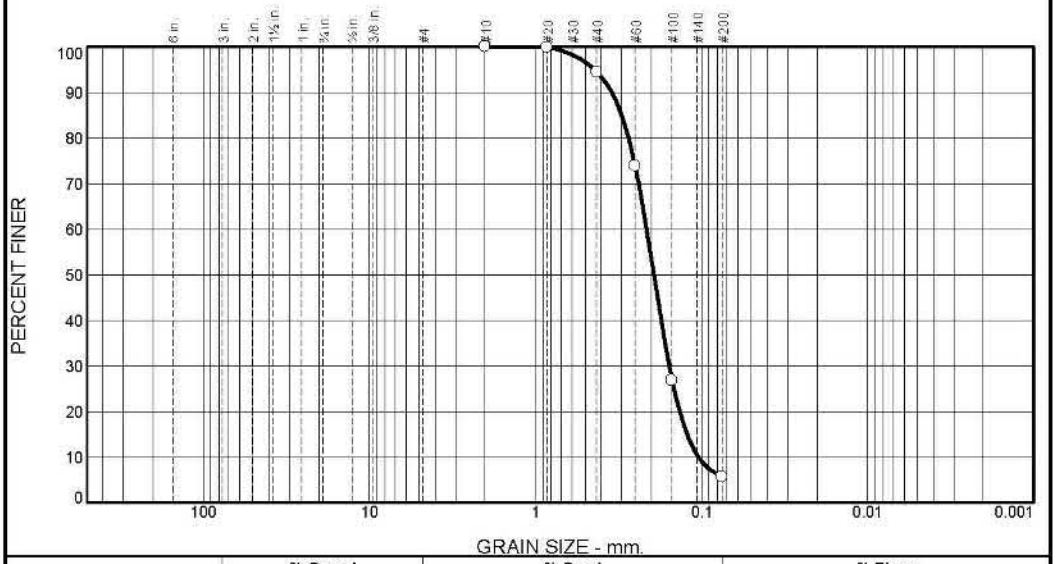
**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-172

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 88.7 | 5.6 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 99.8 | | |
| #40 | 94.3 | | |
| #60 | 73.8 | | |
| #100 | 26.8 | | |
| #200 | 5.6 | | |

* (no specification provided)

**Material Description**

Gray poorly graded sand with silt (SP - SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SP-SM AASHTO (M 145)= A-3

**Coefficients**

$D_{90}$= 0.3469 $D_{85}$= 0.3022 $D_{60}$= 0.2137
$D_{50}$= 0.1932 $D_{30}$= 0.1563 $D_{15}$= 0.1222
$D_{10}$= 0.1045 $C_u$= 2.04 $C_c$= 1.09

**Remarks**

Date Received: 02.20.18 Date Tested: 02.22.18

Tested By: MN

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Exploratory Samples Depth: 186-196' Date Sampled: 07.21.18

Sample Number: MW-2 / S-5

**Thielsch Engineering Inc.**

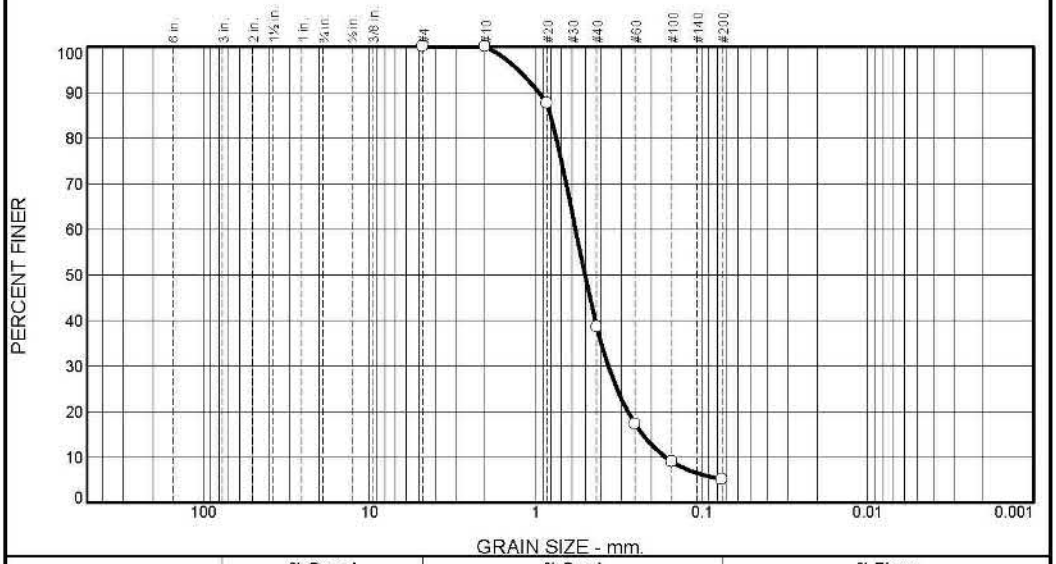
**Cranston, RI**

Client: AECOM / Town Of Orleans

Project: Orleans-GWDP
Orleans, MA

Project No: 06476644.01.01 Figure 18-S-173

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.1 | 61.5 | 33.4 | 5.0 | |

**Test Results (D6913 & ASTM D 1140)**

| Opening Size | Percent Finer | Spec.* (Percent) | Pass? (X=Fail) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.9 | | |
| #20 | 87.5 | | |
| #40 | 38.4 | | |
| #60 | 17.2 | | |
| #100 | 8.9 | | |
| #200 | 5.0 | | |

* (no specification provided)

**Material Description**

Gray poorly graded sand with silt (SP - SM)

**Atterberg Limits (ASTM D 4318)**

PL= NP LL= NV PI= NP

**Classification**

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

**Coefficients**

$D_{90}$= 0.9576 $D_{85}$= 0.8116 $D_{60}$= 0.5720
$D_{50}$= 0.5023 $D_{30}$= 0.3639 $D_{15}$= 0.2267
$D_{10}$= 0.1660 $C_u$= 3.45 $C_c$= 1.39

**Remarks**

**Date Received:** 02.20.18 **Date Tested:** 02.22.18

**Tested By:** MN

**Checked By:** Matthew Colman P.E.

**Title:** Laboratory Manager

**Source of Sample:** Exploratory Samples **Depth:** 226' **Date Sampled:** 07.21.17

**Sample Number:** MW-2 / S-6

**Thielsch Engineering Inc.**

**Cranston, RI**

**Client:** AECOM / Town Of Orleans

**Project:** Orleans-GWDP
Orleans, MA

**Project No:** 06476644.01.01 **Figure** 18-S-174

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**Attachment 4 - Blank Log**

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|---|---|---|
| COMPANY:_____<br>ADDRESS: _____ | PROJECT: _____ | BORING NUMBER<br>SHEET 1 OF<br>DATE FILE NO |
| DRILLING COMPANY<br>FOREMAN<br>GEOLOGIST | | BORING LOCATION<br>CASING ELEVATION<br>DATE STARTED DATE ENDED |

| DRILLING SUMMARY | WELL DETAILS | Shallow | Deep | GROUNDWATER READINGS |
|---|---|---|---|---|
| Method<br>Casing Diameter<br>Sampler<br>Hammer Weight | Casing Diameter<br>Material<br>Stick up<br>Screen Interval<br>Slot Size | | | Well ID / Date / Time / Depth / Elevation |

| SAMPLE | | | | STRATA CHANGE/ | EQUIPMENT/ |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | SAMPLE DESCRIPTION | GENERAL DESCRIPTION | WELL INSTALLED |
| 10 | | | | | |
| 20 | | | | | |
| 30 | | | | | |
| 40 | | | | | |
| 50 | | | | | |

PROPORTIONS SED

| | |
|---|---|
| TRACE | 0 TO 10% |
| LITTLE | 10 TO 20% |
| SOME | 20 TO 35% |
| AND | 35 TO 50% |

WELL CONSTRUCTION LEGEND

CASING | CONCRETE (XXXXXX) | BENTONITE (//////////) | GROUT (+++++++)

SCREEN (=======) | SILICA SAND | NATURAL BACKFILL | BEDROCK (**********)

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| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 52 | | | | | |
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| 112 | | | | | |
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| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 122 | | | | | |
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| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 192 | | | | | |
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**SECTION 02600**

**WATER MAINS AND APPURTENANCES**

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1.07 - REFERENCE STANDARDS ..... 3
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, tools, equipment and materials necessary to perform all operations required for the construction of the replacement of the existing water mains, fittings, valves, hydrants and other related items necessary to complete the Work as specified.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Pipe and fittings.
2. Gaskets.
3. Couplings and solid sleeves.
4. Hydrants.
5. Valves.
6. Tapping Sleeves and Valves.
7. Water Service and Blowoff Materials.

8. Manufacturer's Certificates of Compliance with these Specifications and certification that the ductile iron pipe and fittings have been manufactured and tested in accordance with AWWA/ANSI specifications.
9. Manufacturer's documentation demonstrating at least 10 years of successful experience in manufacturing ductile iron pipe and fittings.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. All pipe when shipped shall be packed and separated by wood separators such that pipe-to-pipe contact is prevented during transit and/or storage.

D. Take appropriate measures during the loading, trucking, unloading, and handling of pipe and appurtenant materials so as not to damage them or the roadway surface. Dropping of materials directly from the trucks upon the ground will not be permitted. Suitable effective buffers or runners shall be provided. Metal chain shall not be used for lifting materials.

E. Distribution of pipeline materials along the line of Work is not permitted without written approval of the Owner. Do not obstruct driveways, sidewalks and/or walkways or place materials on private property.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. All products and materials shall conform to the applicable standards of ANSI and AWWA and/or as specified herein.

D. All materials supplied shall be manufactured in the United States.

**1.07 - REFERENCE STANDARDS**

A. American Society for Testing and Materials (ASTM)

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pressure Pipe and Fittings
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings for Water
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges
6. AWWA C150 - Thickness Design of Ductile-Iron Pipe
7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids
8. AWWA C153 - Ductile-Iron Compact Fittings, 3-in through 16-in for Water and Other Liquids
9. AWWA C500 - Gate Valves for Water and Sewerage System.

10. AWWA C502 - Dry-Barrel Fire Hydrants
11. AWWA C504 - Standard for Rubber-Seated Butterfly Valves
12. AWWA C600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
13. AWWA C651 - Disinfecting Water Mains
14. AWWA C800 - Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

D. Underwriters Laboratory (UL)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - PIPE**

A. All ductile iron pipe shall be designed and manufactured in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 and the following class:

| Pipe Diameter (inches) | Thickness (inches) | Special Thickness Class |
|---|---|---|
| 6 | 0.31 | 52 |
| 8 | 0.33 | 52 |
| 10 | 0.35 | 52 |
| 12 | 0.37 | 52 |
| 16 | 0.37 | 51 |
| 20 | 0.39 | 51 |

B. Pipe shall be designed for the rated working pressure in pounds per square inch shown below and for laying condition Type 2 (Flat bottom trench, backfill consolidated to centerline of pipe) and for eight (8) feet of earth cover.

C. The pipe shall be in nominal laying lengths of eighteen (18) to twenty (20) feet. The grade of iron from which the pipe is made shall be 60-42-10; having 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength and ten (10) percent minimum elongation.

D. Ductile iron pipe shall have either push-on or restrained joints. Restrained joint pipe shall be used in lieu of thrust blocks to resist the movement of the pipe. The “Minimum Restrained Joint Pipe Length” shall be in accordance with the manufacturer’s requirements and operating conditions. All other pipe shall have push-on joints.

E. Gaskets shall meet the material requirements of ANSI/AWWA C111 for mechanical joint gaskets.

F. The interior of the pipe shall be cement-mortar lined to twice the thickness specified in ANSI/AWWA C104/A21.4. The pipe manufacturer under controlled factory conditions shall apply the cement-mortar lining and field application is strictly prohibited. The cement-mortar lining shall be seal coated with an asphaltic material in accordance with ANSI/AWWA C150/A21.50 and NSF Standard 61. Asphaltic seal coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphaltic seal coat shall be a product acceptable to the NSF for use in potable water and shall be so listed in the NSF summary of approved products. The asphaltic seal coat shall be applied and cured in strict conformance with the coating manufacturer's instructions. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

G. The outside of the pipe shall be asphaltic coated to a minimum 1 mil thickness in accordance with ANSI/AWWA C150/A21.50. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited

H. Restrained joint pipe shall be TR FLEX® as manufactured by the United States Pipe and Foundry Company or equal.

**2.02 - FITTINGS**

A. All ductile iron fittings including plugs, caps and blank flanges, shall be Class 350, mechanical joint, conforming to ANSI Specification A21.53 (AWWA C153) and conform to the weights and dimensions shown in the latest edition of the Ductile Iron Pipe Research Association (DIPRA) “Handbook of Ductile Iron Pipe” and be provided complete with all joint accessories.

B. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends.

C. Hydrant tees shall be mechanical joint anchoring tees and have a rotatable mechanical joint gland on the 6-inch plain end branch to provide positive valve restraint.

D. Caps and plugs shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to a future connection.

E. The interior surface of all fittings shall be cement-mortar lined to twice the thickness specified in ANSI/AWWA C104/A21.4. The pipe manufacturer under controlled factory conditions shall apply the cement-mortar lining and field application is strictly prohibited. The cement-mortar lining shall be seal coated with an asphaltic material in accordance with ANSI/AWWA C150/A21.50 and NSF Standard 61. Asphaltic seal coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphaltic seal coat shall be a product acceptable to the NSF for use in potable water and shall be so listed in the NSF summary of approved products. The asphaltic seal coat shall be applied and cured in strict conformance with the coating manufacturer's instructions. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

F. The outside of all fittings shall be asphaltic coated to a minimum one (1) mil thickness in accordance with ANSI/AWWA C150/A21.50. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

**2.03 - FLEXIBLE AND TRANSITION COUPLINGS**

A. Flexible couplings shall be Dresser Style 138 or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. Gaskets shall be of a material suitable for exposure to liquid within the pipe.

B. Transition couplings shall be Dresser Style 162 or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. Gaskets shall be of a material suitable for exposure to liquid within the pipe.

**2.04 - SOLID SLEEVES**

A. Solid sleeves shall be long body type, ductile iron with mechanical joints.

B. All sleeves shall conform to the weights and dimensions shown in the latest edition of the Ductile Iron Pipe Research Association (DIPRA) “Handbook of Ductile Iron Pipe” and be provided complete with all joint accessories.

**2.05 - RESILIENT SEATED GATE VALVES**

A. Valves shall be manufactured in full compliance with the content and intent of this specification. Valve body shall be cast iron conforming to the latest edition of ASTM A126, Class B. Valves shall mechanical joint, with a 2-inch operating nut, a non-rising stem and shall conform in every respect to AWWA C509. Valves shall be designed for 250 psi working pressure, 350 psi test pressure and shall be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and 0 pressure on the other side.

B. When mechanical joint ends are specified for use, the gasket seating areas shall be fully machined to fixed dimensions and tolerances as per AWWA specifications. All valves shall be provided with "O" rings. The design of the valve shall be such that the seal plate can be fitted with new "O" rings while the valve is under pressure in a fully open position.

C. Interior and exterior surfaces of all valves shall have a 100 percent solids thermoset or fusion bonded epoxy protective coatings, holiday-free in the waterway, which shall meet all requirements of AWWA C550. The epoxy coating shall not impart taste or odor to the water. The coating shall be a product acceptable to the NSF for use in potable water and shall be so listed in the most current NSF summary of approved products. The coating shall be applied and cured in strict conformance with the coating manufacturer's instructions. The valve manufacturer under controlled factory conditions shall apply the coatings and field application is strictly prohibited.

D. Valves shall open left and shall be as manufactured by Mueller or equal.

**2.06 - TAPPING SLEEVES AND VALVES**

A. Tapping sleeves and valves shall conform to the AWWA specifications for tapping sleeves and valves.

C. Tapping sleeves shall be mechanical joint, 2-part castings, flanged on the vertical centerline, and come complete with all joint accessories. The surface area of each flange shall be thoroughly machined, and the sleeve flanges shall be fitted with gaskets recommended by the manufacturer. Each gasket shall cover the entire surface area of each joint for the full length of the sleeve. Bolts used to assemble the sleeves shall pass directly through each flange and through each gasket. Bolts shall be properly spaced to insure uniform gasket pressure and compression.

D. Sleeve outlets shall have counter-bored flanges to insure proper centering of the tapping valve.

E. All tapping valves shall be flanged by mechanical joint and open left. Tapping sleeve valves shall be AWWA approved and shall meet all applicable requirements including test pressure and exterior coating as specified hereinbefore for resilient seated gate valves.

F. Prior to ordering tapping sleeves verify the circumference of the pipe on which each tapping sleeve is to be installed.

**2.07 - VALVE BOXES AND COVERS**

A. Valve boxes shall be cast iron, asphalt coated, adjustable sliding type with cast iron covers with a minimum 6-inch overlap is required between sliding sections. Valve box covers shall be drop type with the word "WATER" and a direction-to-open arrow plainly cast in relief on the top surface of the cover. Valve boxes shall be Buffalo Style #5663, with 24-inch top section and 30-inch bottom section.

B. Bell end of the lower sections shall in all cases be sufficiently large enough to fit over the stuffing boxes of the valves. The top section shall be at least 6-1/8-inches and have top flanges. The bottom section shall be at least 36-inches in length. The top section shall be at least 26-inches in length and have a plain bottom. The smallest inside dimension of the shaft shall not be less than 5-1/4 inches and shall have a belled base.

C. Upper section shall have a flange sufficiently strong enough to furnish the bearing for that section so that all weight or jolting from street traffic or the like shall not be transmitted to the valve.

D. Each valve box including cover shall weight at least 100 pounds.

E. No three-piece combinations shall be acceptable

**2.08 - HYDRANTS**

A. Hydrants shall be of the following type and manufacturer only. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

| | | |
|---|---|---|
| 1. | Make and Model | Mueller Co. A423 “Super Centurion 250” |
| 2. | Type of Thread | National Standard |
| 3. | Number of Outlets | 2-1/2 inch hose connection (2 required) |
| | | 4-1/2 inch steamer connection (1 required) |
| 4. | Diameter Valve Opening | 5-1/4 inches |
| 5. | Diameter of Barrel | 8-1/2 inches |
| 6. | Hub | Mechanical joint |
| 7. | Direction of Opening | Open Left |
| 8. | Depth of Bury | Street Level Shoulder Areas: 5-feet 6-inches |
| | | Raised Sidewalk Areas: 6-feet 0-inches |
| 9. | Color | Two coats of prime paint before shipment and once installed are to be cleaned and painted by the Contractor to match color of existing hydrants of the Owner |

F. Hydrants shall be designed for one hundred fifty (150) pounds per square inch working pressure and shall conform in every respect to AWWA C502.

G. Hydrants shall be traffic model with dual drain ports and ductile iron retaining glands.

H. Hydrants shall have an oil reservoir to provide lubrication to all stem threads, bearing surfaces and O-rings each time the hydrant is operated.

I. Hydrant shall be marked with an arrow and the word "open" to indicate the direction to turn the stem to open the hydrant.

J. Hydrant barrel extensions shall be as recommended by the manufacturer of the hydrant and shall include all couplings, pins, flanges, gaskets, nuts and bolts necessary to provide a complete and workable installation. If more than one (1) type of extension is available, the Engineer shall approve the type to be provided.

K. Hydrants shall have hydrant markers with reinforced fiberglass shaft heavy duty spring mounted 4-foot long x 3/8-inch diameter. One bolt mounting.

**2.09 - THRUST RESTRAINT GLANDS AND JOINTS**

A. Thrust restraint glands shall be used on all mechanical joint fittings, valves and sleeves. The thrust restraint system shall incorporate individually activated gripping surfaces integral to the follower gland that makes up the mechanical joint.

B. Glands shall be manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall be such that they can be used with standard mechanical joint bells and tee head bolts that conform to the latest revision of ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153. Twist-off nuts, sized the same as tee-head bolts, shall be used to insure proper actuating of restraining devices. The mechanical joint restraint shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.

C. Glands shall be specifically designed for use with mechanical joint ductile iron pipe, fittings and valves. Glands shall be Series 1100 MEGALUG by EBBA Iron, Inc., Stargrip Series 3000 as manufactured by Star Pipe Products or equal.

D. Restraints for push-on joints shall be Stargrip Series 3100P as manufactured by Star Pipe Products, Series 1700 as manufactured by EBAA Iron or equal.

**2.10 - WATER SERVICE MATERIALS**

A. All water service materials, which shall include but is not limited to corporation cocks, curb stops, couplings, adapters, and fittings shall have compression type connections. Castings shall be sufficiently heavy to meet all service conditions without springing or leaking and be clean and free from roughness both inside and out. Waterways shall be smooth, full size and free from obstruction. All threads shall be cut sharp, clean and true. The Owner is standardized on the following Manufacturers specified herein.

B. Polyethylene tubing shall be furnished in accordance with the requirements of AWWA Standards C901. Tubing shall be 1-inch PE 3406, iron pipe size with a pressure class of 200 psi designed for buried service. Tubing shall be approved for use with potable water and shall be shall be NSF approved.

C. Corporation cocks shall be constructed of brass and meet the requirements of AWWA C800 and be for polyethylene tubing. The joint shall be a compression joint and the corporation shall be Model F1001-4 as manufactured by the Ford Meter Box Company. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

D. Curb stops shall be constructed of brass and mee the requirements of AWWA C800 and be a ball-type design with compression joint. Curd stops shall be Model B66-44M as manufactured by the Ford Meter Box Company. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

F. Service boxes shall be tar coated, cast iron, sliding type with 2 Hole Erie pattern cover, with a stationary rod to accommodate required bury depth. Covers shall be held in place with bronze bolts. Service box covers shall be have the word "WATER" cast into the cover.

**2.11 - BLOWOFFS**

A. Temporary and permanent blowoffs, to be used for disinfection and testing purposes, shall meet the requirements specified for water service materials and shall be constructed in accordance with the details included on the Contract Drawings and/or as directed by the Engineer.

**2.12 - POLYETHYLENE ENCASEMENT**

A. Polyethylene pipe encasement shall conform to requirements of AWWA C105, latest edition.

B. Virgin polyethylene shall conform to ANSI/ASTM D1248.

C. Minimum nominal thickness shall be 8 mils.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION OF PIPE, FITTINGS AND APPURTENANCES**

A. Pipes shall be thoroughly cleaned before being installed. Particular attention shall be paid to the proper positioning of the rubber gaskets. Joining of pipe and fittings shall be done in accordance with the manufacturers written instructions.

B. Temporary watertight plugs shall be utilized at the end of each working day to prevent the intrusion of silt, debris and water into the pipeline. When working in areas with a high potential for flooding of the pipe from groundwater, streams, storm drains, sewers and/or other means, the temporary plug shall be used on each pipe length during installation.

C. In the event of flooding of the pipeline, all pipe laying shall cease until the pipeline has been thoroughly cleaned, as determined by the Engineer.

D. When joined together, pipeline shall form a smooth continuous line and grade on straight sections and on curved sections (both vertical and horizontal) shall have uniform deflections within the required limits and conforming in general to the line and profile of adjacent roadway or easement. Location of rubber rings shall be determined with a checking gauge before backfilling the pipe.

E. Pipe shall be joined and laid in accordance with the manufacturer's latest published instructions.

F. Pipe shall not be laid with deflection of more than one-half (1/2) the maximum deflection recommended by the manufacturer.

G. Backfill shall be placed on both sides of the pipe and compacted simultaneously with approved tamping bars for the full length of pipe. Bell holes shall be excavated as necessary to ensure that the pipe and not the pipe bells are bearing the weight of backfill and the traffic load.

H. Bells or other joints shall not be installed directly under existing utilities or structures. Use short or random lengths to avoid such conditions.

I. Pipe shall not be installed in areas where excavations have been carried below trench grade, or where groundwater conditions create unstable bottoms, until such time as the trench is excavated, refilled and compacted as specified.

**3.02 - MECHANICAL JOINTS**

A. Mechanical joints shall be installed with all required joint accessories, including gaskets, follower glands with drilled bolt holes, tee head bolts, and hexagonal nuts.

B. Torque wrenches shall be used to take up such joints. Wrenches shall be equipped with adjusting breakable tension gauge, set to break the tension at the tension loading recommended by the manufacturer. Mechanical joints shall be made so as to secure tight joints, every means being taken to secure this result.

**3.03 - CUTTING OF PIPE**

A. All cuts of ductile iron pipe shall be made with either an electric, pneumatic, or gasoline driven power saw. Blades shall be carbide tipped for cutting cement lined ductile iron pipe. Hydraulic cutters may be used provided the cement lining is not damaged by this method.

B. When lengths of pipe are field cut to provide for short lengths, the outside of the cut ends shall be tapered back about one-eight (l/8) inch at an angle of thirty (30) degrees with the centerline of the pipe and as recommended by the manufacturer before field cut pieces are installed.

**3.04 - PIPE BLOCKING**

A. Furnish and install wood blocking where required as directed by the Engineer.

B. Blocking shall be new spruce plank one (1) inch and two (2) inches in thickness. Blocks shall be bedded firmly and level across the bottom of the trench and when any block has been sunk too deeply additional blocking of suitable thickness shall be placed to bring the pipeline to the required grade.

C. Blocks shall be placed at a point 1/5th of the span from each joint. Each block shall be two (2) inch by four (4) inch with a length of four (4) inches larger than the diameter of the pipe. A sufficient quantity of wedges twelve (12) inches long of four (4) inch by four (4) inch fir shall be furnished to properly hold valves and special castings in place. A four (4) inch by four (4) inch timber shall be used to brace hydrant posts.

**3.05 - CONNECTIONS TO EXISTING MAINS**

A. Twenty-four (24) hours prior to connecting to any existing water main notify the water utility. Only the Owner's personnel shall operate existing valves.

B. Make all taps, whether wet or dry and install the required sleeves, tees, couplings, adaptors, reducers, pipe nipples, jointing materials, and other fittings which may be required and make all joints watertight, as specified, where shown on the Contract Drawings and/or as approved by the Engineer. All existing materials removed shall remain the property of the Owner, as determined by the Owner. Legally dispose of all removed materials that the Owner does not want stockpiled.

C. The cutting, removal, plugging and bracing of parts of the existing water system in order to make necessary connections is included in the Work. The shutdown of the existing water system including any subsequent pumping, hand excavating, and time required by the Owner to effect tight closures of existing valves, and any reasonable changes that may be required by the Engineer or any other Work done hereunder shall be considered as an obligation to complete the Work.

D. All Work shall be coordinated with the Owner and such connections that may be required shall be made at such times and in such a manner as to cause as little interference in water service within the existing system as is practicable.

**3.06 - INSTALLATION OF TAPPING SLEEVES AND VALVES**

A. Pipe upon which a tapping sleeve is to be installed shall be thoroughly cleaned of all foreign matter with scraping tools and wire brushes, a minimum of six (6) inches each side of the sleeve.

B. Clean the flanged surface of the sleeve with a wire brush to remove any excess bituminous coating or burrs. The two (2) sections of the sleeve shall be lined up with care being taken to ensure that they are positioned in the same manner as received from the manufacturer.

C. Sufficient blocking and wedges shall be used to secure the sleeve once it has been leveled and positioned.

D. Sleeve bolts shall be alternatively tightened from the extreme end on one side to the extreme end of the opposite side, with approved torque wrenches, until all are securely tightened.

E. Flange bolts shall be tightened in a similar manner, with care being taken not to disturb the gasket.

F. Take care to ensure that the tapping machine is kept in leveled horizontal position and securely supported so as not to transmit any additional weight to the tapping valve.

**3.07 - VALVE BOXES**

A. Furnish and install valve boxes over each valve.

B. Valve boxes shall be cut with a wheel cutter, if necessary, to adjust them for height, where approved by the Engineer.

C. Valve boxes shall be properly adjusted over the operating nuts of valves and adjusted to the proper height to correspond to the roadway or ground surface. Operating nuts shall be centered in the valve boxes.

**3.08 - ABANDONED VALVE BOXES**

A. Upon completion of all Work and successful testing and disinfection of the new pipeline, close all existing valves designated by the Engineer on existing pipelines which have been cut and capped and/or are no longer to remain in service.

B. After closure, each valve box shall be removed, the void filled with gravel and then capped with grout prior to repaving.

**3.09 - HYDRANT BRANCHES**

A. Furnish and install hydrants on hydrant branches where shown on the Contract Drawings and/or as approved by the Engineer.

B. Each hydrant branch shall consist of the following:

1. Short Hydrant Branch - A valve anchoring tee with a 6-inch branch, 6-inch gate valve (mechanical joint), a 6-inch mechanical joint ductile iron pipe nipple of the required length and thrust restraint glands installed on the joints of all hydrants, valves and fittings. The base of hydrants shall be set on a concrete pad.

2. Long Hydrant Branch – A valve anchoring tee with an 8-inch branch, 8-inch gate valve (mechanical joint), 8-inch mechanical joint ductile iron pipe nipple of the required length, 8-inch by 6-inch reducer (mechanical joint), a 6-inch mechanical joint ductile iron pipe nipple of the required length and thrust restraint glands installed on the joints of all hydrants, valves and fittings. The base of hydrants shall be set on a concrete pad.

C. Hydrant barrel extensions shall be furnished and installed where necessary to provide a hydrant elevation acceptable to the Owner.

D. Construct hydrant drainage wells of one-half (1/2) cubic yard capacity of two (2) inch stone placed in the excavation below and around the hydrant bottom.

E. Hydrants shall be given two (2) coats of paint after installation of the same type and color of the existing hydrants of the Owner.

F. Existing Hydrants

1. Where shown on the Contract Drawings and/or directed by Engineer remove existing hydrants and stack them at a location selected by Owner within the municipal limits. Prior to removing any existing hydrants, the Contractor shall notify the local Fire Department and coordinate this Work with that agency.

2. For each hydrant to be removed and stacked close the branch valve, restrain valve if necessary, cut and cap branch, remove gate box, and remove hydrant. Legally dispose of any hydrant that the Owner decides not to accept.

3. Where shown on the Contract Drawings and/or directed by the Engineer, remove existing hydrants and reinstall them at locations designated by the Engineer. Prior to incorporating such hydrants into the Work, they shall be refurbished and repaired to the satisfaction of the Owner. Inspection and repair of existing hydrants shall be performed in accordance with the applicable procedures described in AWWA Manual M17, including, but not limited to, replacement of all gaskets, packing, seals and any other parts which show indication of wear, corrosion or incipient failure. Reinstallation of existing hydrants shall be performed with materials, and in the manner specified for new hydrants.

**3.10 - SERVICE CONNECTIONS**

A. Furnish and install all necessary water service materials required to complete the transfer of water services to the new pipeline(s) installed or required to abandon services replaced. The limit of work related to service connections shall be as approved by the Engineer and/or as follows:

1. If a complete transfer of a water service from the existing pipeline to the new pipeline is required, furnish and install all required materials and install the new service in the vicinity of the existing service to the property line. All connections to the customers' side of the curb stop are included as part of the Work.

2. If a portion of the existing water service, such as but not limited to the curb stop or service pipe, are to be reused, then furnish and install all other materials required to connect the new service materials to the existing materials.

3. If the existing pipeline from which services are being transferred is to remain in service at the completion of the Work, excavate down to each abandoned corporation cock and shut it off. Existing corporations to be abandoned shall only be shut off when approved by the Owner.

B. Service connection work shall only be initiated after the new pipeline has been successfully pressure and leakage tested, disinfected and approved for service by the Owner. Service connection work shall result in a minimum disruption of service to existing consumers.

C. Only "wet taps" shall be made on the new pipeline(s) unless written approval is obtained from the Engineer to use dry taps.

1. Pipe shall be tapped in accordance with the manufacturer's latest published recommendations in regard to but not limited to depth of tap and allowable sizes.

2. Drills and/or taps shall be inspected frequently for signs of wear. Do not exceed the number of taps specified by the manufacturer before reconditioning or replacing drills and/or taps. Service pipe shall be cut with approved wheel cutters only.

D. Prior to excavating for service connections, cut and stockpile all sod on established lawns, remove, replant and/or replace shrubs, hedges, fences and trees that are required to be removed or are damaged by the Work.

E. Equipment with rubber tires shall be used to excavate and backfill on established lawns.

F. Service pipe shall be installed to a minimum depth of five (5) feet and laid in a straight line wherever practicable to the structure to be serviced or to the point of termination of existing service. Install the service pipe beneath paved surfaces and sidewalks by jetting, jacking, boring or pulling the existing service pipe. Open cuts shall only be made when written approval is obtained from the Engineer.

**3.11 - BLOWOFFS**

A. Permanent blowoffs shall be furnished and installed as specified and/or where directed by the Engineer. Copper tubing shall be cut flush with the top of gate boxes.

**3.12 - POLYETHYLENE ENCASEMENT**

A. Ductile iron pipe and fittings shall be wrapped in polyethylene encasement where pipe depth is at or below normal groundwater level.

B. Ductile iron pipe and fittings installed within 5 feet of gas lines shall be wrapped in polyethylene encasement.

**3.13 - CEMENT CONCRETE THRUST RESTRAINTS**

A. Furnish and place cement concrete for thrust restraint, where restrained joint pipe cannot be used as directed by the Engineer.

B. Concrete shall be of proportions, one (l) part cement to two (2) parts sand and four (4) parts coarse aggregate.

C. Care shall be taken to ensure that all concrete thrust blocks bear against undisturbed trench walls, and not to encase flanges and bolts on mechanical joint fittings. Where unsuitable bearing material is encountered, excavate and place sufficient concrete ballast, with the approval of the Engineer, to offset the anticipated thrusts.

**3.14 - OTHER MATERIALS**

A. Furnish and install all necessary materials required for a complete installation as specified.

**3.15 – CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02605**

**TEMPORARY BY-PASS PIPING AND SERVICE CONNECTIONS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing of all labor, tools, equipment, materials and performing all operations necessary for temporary by-pass piping of Municipal water and service connections as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**Note: Funding for this Bid Item is anticipated to be obtained at the Annual Town Meeting proposed to be held in May 2020. Therefore, performing the scope of work specified under this Bid Item is subject to this future appropriation and no payment will be made without written approval by the OWNER.**

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Temporary by-pass pipe, fittings, valves, hydrants and service materials.
2. Provide a complete by-pass piping layout. Layout shall identify the location(s) and pipe diameter(s) of all pipe, hydrants and valves.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The Work of this section shall be coordinated with the Owner.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Each segment of the temporary by-pass piping system shall be fully adequate to withstand the normal working pressures experienced in the Owner’s existing water distribution system or 150 pounds per square inch whichever is greater.

B. All by-pass piping and appurtenances shall be watertight and of materials that do not cause objectionable taste or odor in the potable water system.

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. Each segment of the temporary by-pass piping system, including service connections, shall be flushed clean and disinfected in accordance with AWWA C651 and the Contract Documents, prior to incorporation into temporary use, as approved by the Engineer.

B. In general, temporary by-pass pipe shall be placed at the edge of traveled ways where it will cause the least obstruction and be least susceptible to damage. At roadway intersections the pipe shall be placed in a shallow trench and overlaid with temporary bituminous concrete surfacing as approved by the Owner. Temporary by-pass pipe that crosses driveway areas shall be covered with temporary bituminous concrete cold patch as approved by the Owner.

C. Temporary by-pass piping shall be provided with isolation valves spaced at 500-foot maximum intervals as approved by the Engineer. All temporary service connections shall have an isolation valve located at the connection to the temporary by-pass pipe.

D. Water for temporary by-pass piping service shall be taken from the nearest available fire hydrant(s) or as directed by the Engineer.

E. All temporary by-pass piping attachments to existing fire hydrants shall be made such that they can be easily removed to allow the fire hydrant to be used for fire fighting purposes. Provide a tee with a valve for each hose connection.

### 3.02 - INSTALLATION

A. Prior to the installation of any segment of temporary by-pass piping, notify the local Fire Department and coordinate with the Owner. Make modifications to the proposed layout of the temporary by-pass piping system as approved by the Owner.

B. The operation of all valves located in the existing water distribution system necessary for the isolation of each temporary by-pass piping segment shall be performed by the Owner.

C. Temporary fire hydrants shall come complete with individual control valves and include all necessary pipe, valves and fittings associated therewith as required by the local Fire Department and as approved by the Owner. In general, temporary hydrants shall be placed adjacent to the existing hydrants that are being removed from service.

D. Provide and maintain until removal of the temporary by-pass piping system, bituminous concrete cold patch or other material approved by the Engineer over each connecting coupling included in the temporary by-pass piping system.

### 3.03 - MAINTENANCE AND REMOVAL

A. Temporary by-pass piping systems shall be maintained in a safe and operative condition at all times (24 hours per day) during their use.

B. Temporary by-pass piping systems shall be protected against the potential for freezing conditions (November through March).

C. Each temporary by-pass piping system or independent segment thereof shall be removed from the Project immediately after the corresponding segment of permanent potable water distribution piping has been incorporated into the Owner’s distribution system as approved by the Owner.

D. Upon removal of the temporary by-pass piping system, all areas affected by its use shall be returned to a neat and orderly condition in every respect equal to or better than its original condition. Service connections connected to the temporary by-pass piping system shall be returned to normal service prior to removal of the temporary by-pass piping system.

E. For cleaning and lining projects, each permanent service connection shall be blown back to the permanent service distribution pipe from the service pipe connection at the water meter prior to the removal of the temporary service connection. If there is no water meter, the service line shall be blown back from a location approved by the Engineer.

**3.04 – CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02615**

**DUCTILE IRON PIPE AND FITTINGS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Ductile Iron Pipe and Fittings as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide and test ductile iron pipe, fittings and appurtenances as indicated and in compliance with Contract Documents.

D. Options:

1. For buried exterior pipelines provide push-on joint pipe.
    a. Provide restrained push-on pipe as specified
    b. Provide either restrained push-on joint fittings as specified and indicated or provide mechanical joint fittings with restraint system as specified herein
2. For piping exposed as in buildings and galleries, provide flanged or rigid-joint, grooved-coupled pipe and fittings.
3. Cast iron pipe and fittings are not acceptable.

### 1.02 – MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Pipe manufacturer’s technical specification and product data.
2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.
    a. Pipe layouts in full detail.
    b. Location of hangers and supports.
    c. Location and type of anchors.
    d. Location of couplings and expansion joints.
    e. 1/2-inch = 1 foot-0 inch (1 mm = 25 mm) scale details of all wall penetrations and special fittings.
    f. Schedules of pipe, fittings, special castings, couplings, expansion joints and other appurtenances.
3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed.
4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
5. Brochures and technical data on coatings and linings and proposed method of application.
6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
7. Material Certification
    a. Provide certification from the pipe and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.
    c. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
    d. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

8. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 – PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

**1.06 – DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

E. Inspect and test at foundry according to applicable standard specifications.

F. Owner reserves right to inspect and test by independent service at manufacturer's plant or elsewhere at his own expense.

G. Visually inspect before installation.

H. Job Conditions - Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

**1.07 - REFERENCES**

A. American Society of Mechanical Engineers (ASME)

1. ASME B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

2. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.

4. ASME B31.1 - Power Piping.

B. ASTM International (ASTM)

1. ASTM A240 - Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
2. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile.
3. ASTM A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
4. ASTM A530 - Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
5. ASTM A774 - Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
6. ASTM A778 - Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

C. American Water Works Association (AWWA)

1. AWWA A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA A21.10 - Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
3. AWWA A21.11 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
4. AWWA A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges.
5. AWWA A21.50 - Thickness Design of Ductile-Iron Pipe.
6. AWWA A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds, or Sand-Lined Molds, for Water or Other Liquids.
7. AWWA A21.53 - Ductile-Iron Compact Fittings, 3-in through 16-in. for Water and Other Liquids.

D. Fluid Sealing Association - Technical Handbook.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - PIPE

A. Ductile Iron

1. Design conforming to AWWA A21.50.
2. Manufacture conforming to AWWA A21.15 or AWWA A21.51.
3. Thickness class, unless otherwise indicated or specified:
   a. Minimum Thickness Class 52.
   b. Minimum thickness Class 53 for use with threaded flanges.
   c. Minimum thickness Class 53 for use with flanged pipe.
   d. Minimum thickness for use with grooved couplings conforming to AWWA C606.

### 2.02 - PIPE FOR USE WITH COUPLINGS

A. As specified above except ends shall be plain.

B. With bolted split sleeve couplings, ends cast or machined at right angles to axis.

C. With grooved type coupling:

1. Ductile-Iron of thickness class specified above.
2. Grooved End dimensions conforming to AWWA C606 for flexible or rigid joints to suit joint requirements.

**2.03 - FITTINGS**

A. Provide fittings conforming to AWWA A21.10, at least Class 150 and match piping class.

B. Provide all bell push-on or mechanical-joint fittings unless otherwise indicated or specified.

C. Face and drill flanged fittings conforming to AWWA A21.10 except special drilling or tapping for correct alignment and bolting.

D. If flanged fittings are not available under AWWA A21.10 provide fittings conforming to ASME B16.1 in 125 lb. pressure class.

E. Provide standard base fittings where indicated.

F. Provide grooved-end fittings ductile-iron conforming to AWWA A21.10 for center-to-face dimensions.

1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.

**2.04 - NONSTANDARD FITTINGS**

A. Acceptable design.

1. Same diameter and thickness as standard fittings.

2. Manufactured to meet requirements of same specifications as standard fittings except for laying length and types of ends.

**2.05 - WALL CASTINGS**

A. Provide size and type indicated and specified.

1. Piping 24-inches and Smaller: Mechanical Joint with specified restraint or Restrained Push-On.

B. Wall Castings: Conform to requirements of AWWA A21.10 or fabricate of Class 53 ductile iron pipe with screwed on flanges and welded on waterstop. Screwed on mechanical or push-on joints are not acceptable.

C. Provide water stop centered in wall. Weld water stops on in factory under controlled conditions to ensure adequate strength to permit waterstop to absorb thrust up to the pressure rating of the pipe.

**Wall Castings with Annealed Ductile Iron Water Stops**

| Pipe Size | Waterstop Thickness, inches |
|---|---|
| 4 inch-12 inch | 0.50 |
| 14 inch-24 inch | 0.75 |
| 30 inch-36 inch | 1.00 |
| 42 inch-48 inch | 1.25 |

**Wall Castings with Fabricated Steel Water Stops**

| Pipe Size | Waterstop Thickness, inches |
|---|---|
| 4 inch-16 inch | 0.25 |
| 18 inch-24 inch | 0.38 |
| 30 inch-36 inch | 0.50 |
| 42 inch-48 inch | 0.75 |
| 54 inch-64 inch | 1.00 |

D. On flanged wall castings, provide space between the wall and flange to permit mounting the nuts on the flange bolts.

E. Flanged wall castings located with the flange flush with the wall are not acceptable.

F. Locate push-on joint wall castings with space between the bell and the wall to insert the follower bolts.

G. As an option, fabricated wall pipe of Schedule 40 Type 316L stainless steel may be substituted for wall castings specified above. Provide with waterstops of above dimensions and welded continuously on both sides of stop. Flanges of Type 316 stainless steel. Bolts for connection to buried pipe Type 316 stainless steel. Provide flange insulation gaskets, sleeves and washers for all flanges.

H. Testing: Factory pressure test all wall castings to pipe and joint pressure rating for a minimum of 5 minutes. No visible leakage is acceptable.

**2.06 - ADAPTERS**

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for the correct type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

**2.07 - JOINTS**

A. Provide push-on joint and mechanical joint pipe with necessary accessories, conforming to AWWA A21.11.

1. Provide gasket composition designed for exposure to liquid within pipe.

B. Provide pipe flanges and accessories conforming to AWWA A21.15.

1. Provide flat faced flanges.

2. Provide 1/8-inch thick, full faced gaskets designed for exposure to liquid within pipe.

C. Provide restrained joint on pipe and fittings where indicated. Provide restrained joint which is:

1. Boltless

2. Capable of being deflected after assembly

3. Designs using set screws or requiring field welding are not acceptable.

4. Manufacturers:

a. American Cast Iron Pipe Co. Flex-Ring.

b. U.S. Pipe TR FLEX.

c. Clow Super-Lock.

**2.08 - MECHANICAL JOINT FITTINGS – RESTRAINT SYSTEM**

A. Provide restraint devices for pipe consisting of multiple gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, retaining full mechanical joint deflection during assembly and allowing joint deflection after assembly.

2. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

3. Provide restraint devices Listed by Underwriters Laboratories (3 inch through 24 inch size) and Designed by Factory Mutual (3 inch through 12 inch size).

4. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Working Pressure Rating:

1. 16-inch (400 mm) and Smaller: 350 psi .
2. Minimum safety factor: 2 to 1.

C. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.
7. Provide coating for restraint devices consisting of the following:
    a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
    b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
    c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
    d. Coating system: MEGA-BOND by EBAA Iron, Inc.

D. Manufacturer:

1. EBAA Iron MEGALUG Series 1100
2. Or an acceptable equivalent.

**2.09 - FLANGE ADAPTORS**

A. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.
2. Provide restraint devices Listed by Underwriters Laboratories (3-inch through 12 inch size) and Designed by Factory Mutual (4-inch through 12-inch size).
3. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Joint Deflection capability:

1. 3-inch through 8-inch: 5 degrees

C. Provide flange adaptor to maintain seal with and 0.6 inch gap between end of pipe and mating flange

D. Working Pressure Rating:

1. 16-inch and Smaller: 350 psi
2. Minimum safety factor: 2 to 1.

E. Materials

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.
7. Provide coating for restraint devices consisting of the following:
    a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
    b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
    c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
    d. Coating system: MEGA-BOND by EBAA Iron, Inc.

F. Manufacturer

1. EBAA Iron MEGAFLANGE Series 2100
2. Or an acceptable equivalent.

**2.10 - FLEXIBLE CONNECTIONS**

A. Use as specified or indicated:

1. Bolted split sleeve couplings
2. Grooved couplings
3. Expansion joints

**2.11 - BOLTED SPLIT SLEEVE COUPLINGS**

A. Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

B. Pressure rating at least equal to that of related pipeline.

C. Provide with gaskets of composition designed for exposure to liquid within pipe.

**2.12 - GROOVED COUPLINGS**

A. Conform to AWWA C606.

B. Minimum pipe wall thickness specified under "Pipe For Use With Couplings."

C. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.

D. Where grooved couplings are used instead of flanged joints, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint.

**2.13 - FILLING RINGS**

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125 lb. ANSI (Class 125)

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

**2.14 - CONNECTIONS – TAPPED**

A. Provide service saddles for all taps for lines 24-inch and smaller.

1. Body: Ductile iron ASTM A395 or Bronze.

2. Straps and Hardware: Type 316 stainless steel.

**2.15 - PIPE COATING**

A. Outside of pipe and fittings within structures: Clean and apply one shop coat with a 3 to 5 mil DFT of moisture cured urethane.

B. Outside surfaces of castings to be encased in concrete: No coating.

C. Machined surfaces cleaned and coated with rust-preventative compound at shop.

D. Outside of buried pipe and fittings: Standard bituminous coating conforming to AN Standard.

**2.16 – CEMENT LINING**

A. Inside of pipe and fittings: Provide double thickness cement lining and bituminous seal coat conforming to AWWA A21.4.

**2.17 - GASKETS, BOLTS, AND NUTS**

A. Provide ring or full face synthetic rubber gaskets for flanged joints and neoprene faced phenolic for insulating gaskets in accordance with AWWA A21.11 and ASME B16.21.

1. 1/8 inch (3 mm) thick.

B. Make flanged joints with:

1. Bolts.

2. Bolt studs with nut on each end.

3. Studs with nuts where flange is tapped.

4. Plastic bolt sleeves and washers for insulating joints.

C. Number and size of bolts conform to same ANS as flanges.

D. Provide Type 316 stainless steel bolts, washers and nuts for all services:

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – Not Used**

**3.02 - INSTALLATION**

A. Visually inspect before installation.

B. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

C. Pitch piping toward low points. Provide for draining low points.

D. Before assembly, remove dirt and chips from inside pipe and fittings.

E. Piping Support: Provide in accordance with SECTION 15056, PIPE SUPPORTS.

F. Pipe and Fittings:

1. Remove and replace defective pieces.

2. Clear of all debris and dirt before installing and keep clean until accepted.

3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

4. Provide firm bearing along entire length of buried pipelines.

5. Do not allow deflection of alignment at joints to exceed permissible deflection as specified below:

a. For push-on joint or similar pipe, clean bell of excess tar or other obstruction and wipe out before inserting next pipe spigot. Shove new pipe into place until properly seated and hold securely until joint completed.

b. Set castings to be encased in concrete accurately with bolt holes, if any, carefully aligned. Clean off rust and scale before setting.

**PIPE DEFLECTION ALLOWANCES**

| | **Maximum permissible deflection, inches*** | |
|---|---|---|
| Size of pipe, inches | Push-on joint | Mechanical joint |
| 4 | 19 | 31 |
| 6 | 19 | 27 |
| 8 | 19 | 20 |
| 10 | 19 | 20 |
| 12 | 19 | 20 |
| 14 | 11 | 13-1/2 |
| 16 | 11 | 13-1/2 |
| 18 | 11 | 11 |
| 20 | 11 | 11 |
| 24 | 11 | 9 |
| 30 | 11 | 9 |
| 36 | 11 | 8 |
| 42 | 7-1/2 | 7-1/2 |
| 48 | 7-1/2 | 7-1/2 |
| 54 | 7-1/2 | 0 |

* Maximum permissible deflection for 20-feetlengths; for other lengths in proportion of such lengths to 20-feet.

G. Temporary Plugs: When pipe laying not in progress, close open ends of pipe with temporary watertight plugs. If water in trench, do not remove plug until danger of water entering pipe passed.

H. Appurtenances: Set valves, fittings and appurtenances as indicated.

**3.03 - JOINTS AND COUPLINGS**

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

B. Bolted Joints

1. Remove rust-preventive coatings from machined surfaces.
2. Clean pipe ends, sockets, sleeves, housings, and gaskets and smooth all burrs and other defects.
3. Use torque wrench to tighten to correct range of torque not to exceed values specified below:

**TORQUE RANGE VALUES**

| Nominal pipe size, in | Bolt diameter, in | Range of torque, ft-lb |
|---|---|---|
| 3 | 5/8 | 40-60 |
| 4-24, incl. | 3/4 | 75-90 |
| 30, 36 | 1 | 100-120 |
| 42, 48 | 1-1/4 | 120-150 |

C. Flanged Joint

1. Make up tight.
2. Do not put strain on nozzles, valves, and other equipment.
3. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

D. Mechanical Joints

1. Wire brush surfaces in contact with gasket and clean gasket.
2. Lubricate gasket, bell, and spigot with soapy water.
3. Slip gland and gasket over spigot, and insert spigot into bell until seated.
4. Seat gasket and press gland firmly against gasket.
5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

E. Flexible Joints

1. Clean and dry before assembly.
2. Place gaskets, rings, glands and followers in position in back of spigot ball.
3. Coat ball and socket with thin film of lubricant conforming to joint manufacturer's standards.
4. Insert ball and seat in socket. Seat gasket against ball.
5. Boltless joints:
    a. Assemble retainer rings and glands conforming to manufacturer's standard.
    b. Lock in place with lead strips.

F. Grooved Couplings

1. Clean grooves and other parts.
2. Coat ends of pipe and outside of gasket with soft soap or silicone and slip gasket over one pipe end.
3. Bring pipes to correct position and center gasket over pipe ends with lips against pipe.
4. Place housing sections, insert bolts and tighten nuts until housing sections in metal-to-metal contact.
5. After assembly and inspection and before backfilling, coat exterior surfaces of buried couplings, including bolts and nuts, with heavy-bodied bituminous mastic.

G. Tapped Connection

1. Drill and tap normal to longitudinal axis.
2. Drilled by skilled mechanics using proper tools.
3. Use only tapered threads.

H. Electrical Conductors

1. Install pipes so terminal strips are aligned.
2. Install jumper strips and tighten bolts.

**3.04 – FIELD PAINTING**

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

**3.05 - CLEANUP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.06 - MANUFACTURER'S FIELD SERVICES – Not Used**

**3.07 - MANUFACTURER'S TRAINING – Not Used**

**3.08 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required shall be provided as specified herein.

**3.09 – SPARE PARTS – Not Used**

**3.10 - HANDLING AND CUTTING**

A. Mark pipe and fittings "Rejected" and remove from site when cracked or has received a severe blow.

B. If permitted, cut on sound barrel at a point at least 12 inch from visible limit of crack, at Contractor's expense.

C. Machine cut with milling type cutters, knives, or saws. Snap cutters, torch, or hammer and chisel NOT ALLOWED. Examine for possible cracks.

D. Chamfer cut ends if used for push-on joints.

E. Do not cut glass lined pipes.

**3.11 - FIELD TESTING**

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

B. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

C. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.
2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
3. Test when desired and comply with specifications.
4. Test pipelines in excavation or embedded in concrete before backfill or placing of concrete and test exposed piping before field painting.
5. Fill section of pipe with water and expel air. If hydrants or blowoffs are not available at high points for releasing air, make necessary taps and plug after test completion.
6. Maintain section full of water for 24 hours before conducting combined pressure and leakage test.

7. Conduct pressure and leakage test consisting of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to pipe pressure rating, but not more than 150 psi.

8. Maintain pressure and make leakage test by metering water flow into pipe. Acceptable results:

   a. Average leakage during test: less than 10 gallons per inch of diameter per 24 hours per mile.

   b. No visible leakage in joints.

9. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section fails test.

10. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

11. Modify test procedure only if permitted by Engineer.

**3.12 - DISINFECTING AND FLUSHING**

A. Disinfect potable water lines using procedures and materials conforming to AWWA C651.

B. Dosage to produce minimum 10 ppm after minimum of 24 hour contact period.

C. After treatment, flush with clean water until residual chlorine content less than 0.2 ppm.

D. Prevent contamination of water in existing water mains. Neutralize chlorine content of water used in disinfecting and flushing accordance with AWWA C651.

**3.13 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02625**

**POLYVINYL CHLORIDE SEWER PIPE**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
PART 2 - PRODUCTS ..... 3
2.01 - PIPE AND FITTINGS ..... 3
2.02 - CONCRETE ..... 3
2.03 - UNDERGROUND TAPE AND TRACER WIRE ..... 3
PART 3 - EXECUTION ..... 3
3.01 - PIPE LAYING ..... 3
3.02 - UNDERGROUND TAPE AND TRACER WIRE ..... 4
3.03 - LEAKAGE AND TESTING ..... 4
3.04 - ALLOWABLE PIPE DEFLECTION FOR PVC PIPE ..... 5
3.05 - VISUAL INSPECTION ..... 6
3.06 - CLEANING ..... 6
3.07 - CONTRACT CLOSEOUT ..... 6

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment and performing all operations in connection with the construction of polyvinyl chloride (PVC) sewer lines, complete with chimneys, wyes, fittings, service connections, service connection cleanout/TV inspection port, and other related items, as specified herein and as shown on the drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Pipe and fittings.

2. Gaskets.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

## PART 2 - PRODUCTS

### 2.01 - PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe, couplings and fittings shall conform to the ASTM D3034, with an SDR of 35 unless otherwise shown on the Contract Drawings or ASTM F789. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

B. Wye Branches or Tees shall be of the same material and of the same class and type so as to be compatible to the pipe they are used with.

C. Pipe utilized for service connections and chimneys shall be 6 inches in diameter and be manufactured of PVC. PVC pipe shall conform to ASTM D3034, with an SDR of 35 or ASTM F789. Joints for PVC pipe shall be push-on using elastomeric ring gaskets.

D. Pipe and fittings for Type I Service Connections and Type II Gravity Service Connection/TV Inspection Ports shall be of the same material and of the same class and type so as to be compatible with the pipe they are used.

E. Caps for Type I Service Connections and Type II Gravity Service Connection/TV Inspection Ports shall be Model SMARTPlug equipped with a 3M electronic disc marker system as manufactured by GPK Products, Inc. or equal.

F. Backwater Check Valves shall be “Clean Check” as manufactured by Rectorseal or equal.

### 2.02 - CONCRETE

A. Concrete utilized for the encasement of chimneys or sewer pipes shall have a minimum compressive strength of 4,000 psi and conform to the specifications in DIVISION 3, CONCRETE.

### 2.03 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground tape shall be a 5 mil, 3-inch wide silver metal detectable tape which permanently identifies the underground force main. The tape shall meet APWA requirements and use brown colored stripes with black print indicating “CAUTION BURIED PRESSURE LINE BELOW”.

B. Tracer wire shall be in accordance with SECTION 02890, TRACER WIRE.

## PART 3 - EXECUTION

### 3.01 - PIPE LAYING

A. General

1. All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be laid so as to form a closed joint with the next adjoining pipe and to bring the inverts continuously to the required grade. In order to insure a minimum amount of movement or disturbance, no more than two lengths of pipe may be laid before backfilling to a minimum of 12 inches over the pipe.

2. Suitable coupling holes shall be excavated to provide ample space for making joints and to allow the pipe to have bedding along its entire length. After laying each length to the line and grade shown, the trench shall be backfilled to the midpoint of the pipe and the trench compacted with special care taken to ensure that compacted material is placed under the bell of the pipe. No walking upon or working over the pipe after it is laid will be permitted until it is covered with earth to a depth of at least 12 inches, except as may be necessary for proper compaction. All openings to the pipelines shall be satisfactorily protected to prevent the entrance of earth or water.

B. Laying Pipe

1. Excavations shall be made to accommodate the specified bedding material. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe, which is not laid to grade and alignment, shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

2. The pipe shall be set with a laser beam. The laser beam projector shall be rigidly mounted with two-point suspension to its support platforms. This will assure that all ground equipment vibrations will be kept to a minimum and permit the laser beam to project itself coaxially through the center of the pipe. All units shall have equipment to control atmospheric conditions in the pipe that could affect the acceptable standard of construction. The alignment method selected must be shown to have worked satisfactorily on at lease three prior projects and competent, trained personnel shall operate laser. Establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stakes as a checkpoint between manholes. Laser aligning shall not be used to establish a continuous line in excess of 900 feet.

C. Installation of Wyes and Tees

1. At locations in the field as determined by the Engineer, provide 6-inch wye branches and/or tees. Watertight end caps shall be provided on all wyes and branches until the service is installed.

2. The depth of cover from the road surface to the top of the branch and the distance from the downstream manhole shall also be recorded. No wyes and tees shall be backfilled before the location measurements are taken.

D. Installation of Chimneys

1. Chimneys shall be located as directed by the Engineer and constructed in accordance with the details shown on the Contract Drawings.

2. Ends of the wye branch shall be capped with standard caps.

E. Service Connections

1. Service connections shall be provided in accordance with the applicable paragraphs of this section of these specifications at a slope of 1/4 inch per foot unless otherwise directed by the Engineer. The extreme end of the service connection shall be capped unless it is to be connected to an existing service.

2. Service connection cleanout/TV inspection ports shall be provided on each service connection at the property line. The service connection/TV inspection ports shall consist of all fittings required including but not limited to pipe, wyes, bends and caps. Service connection cleanout/TV inspection ports are not required for service connections which are less than 10 linear feet in length measured from the property line to the face of the building.

3. No service line shall be connected directly into a manhole unless otherwise directed by the Engineer.

4. All necessary adapters, reducers and the like shall be provided to connect to existing services.

5. A steel rod marker (1/2-inch in diameter by 2-foot-long) shall be installed at the end of capped lines for all locations. Refer to the “Typical Lateral Stub Connection” detail on the drawings.

6. All services lines shall be tied into a minimum of three points including, if possible, the permanent corners of the building which is to be served. The depth of cover from the ground surface to the top of the pipe at the cap shall be recorded. The depth and tie information shall be made part of the Project Record Documents.

**3.02 - UNDERGROUND TAPE AND TRACER WIRE**

A. Underground Tape shall be installed, centered, along the entire length of the sewer and services at a maximum depth of 18-inches below finished grade.

B. Tracer Wire shall be installed, centered, along the entire length of the sewer and services in accordance with SECTION 02890, TRACER WIRE.

**3.03 - LEAKAGE AND TESTING**

A. After the completed sewer line, including service connections has been provided, the trench has been backfilled and compacted to specification requirements, and manhole or joints showing noticeable streams or jets have been repaired and/or replaced, perform all tests.

B. Furnish all labor, materials and equipment necessary so that testing can be accomplished at the times and locations the Engineer deems necessary.

C. Test Procedure

1. Sewers not meeting the requirements stated herein shall be repaired as necessary at no cost to the Owner.
2. Low-Pressure Air Test. Utilize equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig.
3. The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline.
4. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.
5. All air used shall pass through a single control panel.
6. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig.
7. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

| **Pipe diameter (inches)** | **Time (minutes)** |
|---|---|
| 6 | 4.0 |
| 8 | 5.0 |
| 10 | 6.5 |
| 12 | 7.5 |
| 14 | 9.0 |
| 15 | 9.5 |
| 18 | 11.5 |
| Greater then 18 | 7.7 X Pipe Diameter (feet) |

8. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section.

**3.04 - ALLOWABLE PIPE DEFLECTION FOR PVC PIPE**

A. Pipe installed under this specification shall have a maximum deflection of 5 percent at the time of testing. Such deflection is defined as the amount of vertical deformation (nominal inside diameter less the minimum vertical diameter when measured) multiplied by 100 and divided by the nominal diameter of the pipe.

B. Upon completion of a sewer section, including the placement and compaction of backfill, and the cleaning of the sewer, measure the amount of deflection in all of the sewer lines. This testing shall be done by the use of a deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. The method of deflection testing shall have the written approval of the Engineer.

C. All sewer lines with a deflection angle of greater than 5 percent shall be repaired by re-bedding or replacement of the pipe.

**3.05 - VISUAL INSPECTION**

A. At the conclusion of the work, all pipelines shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All pipelines which are not straight and plumb shall be removed and replaced at no cost to the Owner.

**3.06 - CLEANING**

A. At the conclusion of the work, thoroughly clean the sewers by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipelines shall be inspected for cleanliness and to be sure no sandbags, broken pipe or other obstructions exist.

B. Cleaning and television inspection is as specified in SECTION 02702, CLEANING AND TELEVISION INSPECTION OF SEWER LINES.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02629**

**POLYVINYL CHLORIDE LOW-PRESSURE SEWER PIPE**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
PART 2 - PRODUCTS ..... 3
2.01 - MATERIALS ..... 3
2.02 - CONCRETE ..... 3
2.03 - UNDERGROUND TAPE AND TRACER WIRE – Not Used ..... 3
2.04 - ENGINEERED STAINLESS STEEL SERVICE LATERALS COMPONENTS – Not Used ..... 3
PART 3 - EXECUTION ..... 3
3.01 - GENERAL ..... 3
3.02 - LAYING PIPE ..... 4
3.03 - THRUST BLOCKS ..... 4
3.04 - UNDERGROUND TAPE AND TRACER WIRE – Not Used ..... 4
3.05 - SERVICE CONNECTIONS – Not Used ..... 4
3.06 - TESTING ..... 4
3.07 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes furnishing all labor, tools, equipment and materials, and performing all operations in connection with the construction of polyvinyl chloride (PVC) low-pressure sewer pipe and pressure sewer pipe stubs, complete with fittings, and other related items, as specified herein and as shown on the drawings.

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Pipe and fittings.

2. Gaskets.

3. Underground Tape.

4. Gave Valves and Caps.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. Buried Polyvinyl Chloride Pressure Sewer Pipe, couplings and fittings shall conform to ASTM 2241, with an SDR of 21. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints conforming to ASTM F477. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

B. Exposed PVC pressure sewer pipe inside of all flushing/drain manholes shall be Schedule 80 flanged pipe. This piping, fittings and valves shall be insulated and jacketed.

C. Pipe utilized for service connections shall be 1-1/4-inches in diameter and be manufactured of PVC. Service pipe shall conform to ASTM 2241, with an SDR of 21. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring gaskets.

D. The Contractor has the option of substituting 1-1/4-inch SDR11 HDPE I.P.S. butt-fused pipe or SDR 7 HDPE I.P.S. pipe with compression fittings and insert stiffeners for the 1-1/4-inch SDR 21 PVC gasketed pipe used for pressure main and services at no additional cost to the Owner. All couplings, fittings, adapters, valves, reducers, tees, and wyes shall be compatible with the type of pipe used. HDPE pipe shall be pressure rated for 200 psi and shall conform to ASTM D1248, ASTM D3350, ASTM D2239, and NSF-14. Compression fitting shall be brass and manufactured by Ford, or equal.

E. Not Used.

H. Gate valves shall be iron body, bronze mounted and have solid wedges. The valves shall be designed for 150 psi working pressure.

I. Pipe and fittings utilized for gravity service connections shall be 6-inches in diameter and be manufactured of PVC. PVC pipe shall conform to ASTM D3034, with an SDR of 35 or ASTM F789. Joints for PVC pipe shall be push-on using elastomeric ring gaskets.

J. Caps for valves shall be Model SMARTPlug equipped with a 3M electronic disc marker system as manufactured by GPK Products, Inc. or equal.

### 2.02 - CONCRETE

A. Concrete utilized for the encasement of chimneys or sewer pipes shall have a minimum compressive strength of 4,000 psi and conform to DIVISION 3, CONCRETE.

### 2.03 - UNDERGROUND TAPE AND TRACER WIRE – Not Used

### 2.04 - ENGINEERED STAINLESS STEEL SERVICE LATERALS COMPONENTS – Not Used

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. Pressure sewer pipe shall be laid as shown on the drawings with a continuous slope between the high and low points as defined on the drawings.

B. Pressure sewer pipe and service connections shall be laid with a minimum cover of four feet.

C. The Contractor must adjust the installation depth of the low-pressure sewer to cross either over or under any existing utility while maintaining a minimum cover of four feet as well as meeting requirements set by MassDEP for separation of water mains and sewers and a minimum of 12-inch separation for other utilities, or as approved by utility Owner.

**3.02 - LAYING PIPE**

A. Excavations shall be made to accommodate the bedding material as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe which is not laid to grade and alignment shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

B. All pressure sewer bends shall be 45 degrees or less.

C. Low-pressure pipe shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

D. Service Connections – Not Used

**3.03 - THRUST BLOCKS**

A. Concrete thrust blocks shall be placed at all pressure sewer bends 11-1/4 degrees and greater, at fittings and as designated by the Engineer, and shall conform to the details as shown herein.

**3.04 - UNDERGROUND TAPE AND TRACER WIRE – Not Used**

**3.05 - SERVICE CONNECTIONS – Not Used**

**3.06 - TESTING**

A. The low-pressure sewer pipe shall be tested in the presence of the Engineer, by water to a pressure equal to 2 times the total dynamic head of the Prefabricated Low-Pressure Sewage Pump Systems to which the low-pressure sewer pipe is attached, unless the test pressure is greater than the working pressure of the pipe. In that case the pipe shall be tested to the working pressure of the pipe. Testing shall conform to the requirements of the AWWA Standard C600. The Engineer shall provide the test pressure. This pressure shall be held for a period of at least 15 minutes, allowing a maximum pressure drop of 1 psi. Any defective work shown by this test shall be replaced at no additional cost to the Owner.

B. All equipment, labor, water, gauges, and the like for the testing of the low-pressure sewer pipe shall be supplied at no additional cost to the Owner.

C. The low-pressure sewer pipe shall be tested as part of the Sequence of Construction specified in SECTION 01030, SPECIAL REQUIREMENTS. Each section of low-pressure sewer pipe identified shall be pass the pressure test prior to moving onto the next section. Failure to comply with this requirement will result in no payment for work performed.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02631**

**POLYVINYL CHLORIDE SEWER FORCE MAIN**

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1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 3
PART 2 - PRODUCTS ..... 3
2.01 - POLYVINYL CHLORIDE PIPE (PVC) ..... 3
2.02 - CONCRETE THRUST BLOCKS ..... 3
2.03 - UNDERGROUND TAPE AND TRACER WIRE ..... 3
PART 3 - EXECUTION ..... 3
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3.03 - THRUST BLOCKS ..... 4
3.04 - UNDERGROUND TAPE AND TRACER WIRE ..... 4
3.05 - TESTING ..... 4
3.06 - VISUAL INSPECTION ..... 4
3.07 - CLEANING ..... 4
3.08 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes furnishing all labor, tools, equipment and materials, and performing all operations in connection with the construction of polyvinyl chloride (PVC) force main, complete with fittings, and other related items, as specified herein and as shown on the drawings.

B. The materials covered by this specification are intended to be standard materials of proven ability as manufactured by reputable concerns. Materials shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer’s technical data containing information on new pipe and fittings.
2. Verifications from the pipe manufacturer of training in the proper method for handling and installing the new pipe.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit at no cost to the Owner.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**PART 2 - PRODUCTS**

**2.01 - POLYVINYL CHLORIDE PIPE (PVC)**

A. Polyvinyl Chloride Pipe, couplings and fittings shall conform to ASTM 2241, with an SDR of 21 unless otherwise shown on the drawings. The Owner has standardized on this pipe, couplings and fittings and therefore no substitutes are allowed.

B. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints conforming to ASTM F477. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

**2.02 - CONCRETE THRUST BLOCKS**

A. Concrete shall have a minimum compressive strength of 4,000 psi and conform to the specifications in DIVISION 3, CONCRETE.

**2.03 - UNDERGROUND TAPE AND TRACER WIRE**

A. Underground tape shall be a 5 mil, 3-inch wide silver metal detectable tape which permanently identifies the underground force main. The tape shall meet APWA requirements and use brown colored stripes with black print indicating “CAUTION BURIED PRESSURE LINE BELOW”.

B. Tracer wire shall be in accordance with SECTION 02890, TRACER WIRE.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Force main shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

**3.02 - LAYING PIPE**

A. Excavations shall be made to accommodate the bedding material as specified in the DIVISION 2, SITE WORK. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe, which is not laid to grade and alignment, shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

B. Force main shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

C. Allowable Deflection for PVC Pipe

1. Pipe installed under this specification shall have a maximum deflection of 5 percent at the time of testing. Such deflection is defined as the amount of vertical deformation (nominal inside diameter less the minimum vertical diameter when measured) multiplied by one hundred and divided by the nominal diameter of the pipe.

2. Upon completion of each force main, including the placement and compaction of backfill, and the cleaning of the force main, the Contractor shall measure the amount of deflection in all of the force mains. This testing shall be done by the use of a deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. The method of deflection testing shall have the written approval of the Engineer.

3. All force main lines with a deflection angle of greater than 5 percent shall be repaired by re-bedding or replacement of the pipe.at no cost to the Owner.

**3.03 - THRUST BLOCKS**

A. Concrete thrust blocks shall be placed at all force main bends 11-1/4 degrees and greater, at fittings and as designated by the Engineer, and shall conform to the drawings.

**3.04 - UNDERGROUND TAPE AND TRACER WIRE**

A. Underground Tape shall be installed, centered, along the entire length of the force main at a maximum depth of 18-inches below finished grade.

B. Tracer Wire shall be installed, centered, along the entire length of the force main in accordance with SECTION 02890, TRACER WIRE.

**3.05 - TESTING**

A. The force main shall be tested in the presence of the Engineer, by water to a pressure equal to 2 times the total dynamic head of the pump (estimated at 110 feet) to which the force main is attached, unless the test pressure is greater than the working pressure of the pipe. In that case the pipe shall be tested to the working pressure of the pipe. The Engineer shall provide the test pressure. This pressure shall be held for a period of at least 15 minutes, allowing a maximum pressure drop of 5 psi. Any defective work shown by this test shall be replaced at no additional cost to the Owner.

B. All equipment, labor, water, gauges, and the like for the testing of the force main shall be supplied at no cost to the Owner.

**3.06 - VISUAL INSPECTION**

A. At the conclusion of the work, all pipelines shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All pipelines which are not straight and plumb shall be removed and replaced at no cost to the Owner.

**3.07 - CLEANING**

A. At the conclusion of the work, the Contractor shall thoroughly clean the sewer lines by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipelines shall be inspected for cleanliness and to be sure no sandbags, broken pipe or other obstructions exist.

B. Cleaning and television inspection is as specified in SECTION 02702, CLEANING AND TELEVISION INSPECTION OF SEWER LINES.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02645**

**MONITORING WELL INSTALLATION AND DEVELOPMENT**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to perform all operations in connection with the monitoring well installation and development, preparing records of the drilling, ingress and egress, as specified and/or as shown on the Contract Drawings.

B. A total of four new monitoring wells (LH-6, LH-7, LH-8 and LH-9) are to be installed at 32 Lots Hollow Road. The location and coordinates of the new monitoring wells is attached to the end of this section. Boring logs of existing monitoring wells at the site are attached to the end of this section. The monitoring wells are to be constructed in accordance with MassDEP standard monitoring well guidelines. The monitoring wells will consist

of 2-inch diameter PVC risers and 10-foot lengths of schedule 40, slotted PVC screen. The screens are to be surrounded by a filter pack of sand and the annulus of the borehole above the screen is to be sealed with bentonite clay. Each monitoring well is to be protected with a locked protective casing permanently cemented into place.

C. A total of three existing monitoring wells (LH-1, LH-2 and LH-3) are to be modified by removing the existing above ground cover, cutting the existing PVC casing to just below the proposed grade, and completing the wells with a flush to ground protective casing (6-inch minimum diameter), a removable locking cap and concrete pad. The location and coordinates of the monitoring wells are attached to the end of this section.

D. Contractor shall visit the Project Site, examine conditions and become thoroughly acquainted with the conditions for performing the Work. Contractor shall study the Specifications for the Work and compare the same with the information gathered during the examination of the Project Site, as no extra compensation will be authorized for extra Work caused by unfamiliarity with the Project Site and/or the conditions peculiar to the Work.

E. Attention is directed to the GENERAL INFORMATION and DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with provisions of DOCUMENT 00700, GENERAL CONDITIONS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, and clearances. Submittals shall include at least the following:

1. Drawings, including all equipment and components.
2. Brochures and/or Catalogue Cuts for the well casing, well screen, concrete seal, protective cap, and all accessories.

C. Upon completion of the monitoring well, submit to the Engineer for review and approval a soil boring log with a well construction diagram of the permanent well. A blank soil boring log with monitoring well diagram is attached at the end of this section. The diagram shall be a profile, having a vertical scale and include the following:

1. All casing, concrete seal, gravel pack, slot size, and well screen design data for each monitoring well.
2. Detailed log of existing formation material.
3. Static water level and measurement reference (top of casing and ground surface).
4. Type of monitoring well construction material and appurtenances.
5. Depth and linear footage interval of any well construction material and appurtenances.

D. Provide representative soil samples for all natural formation materials from the ground surface to the bottom of well excavation drilled for the Project. Samples shall be collected in glass jars with screw covers properly identified (10-ounce minimum volume).

E. Upon completion of work, the required records, reports and samples, completed monitoring well logs referenced to ground surface with strata classification as previously described, together with all notes, remarks, and pertinent information required by this specification, shall be submitted and delivered by the Contractor to the Owner as specified below.

1. Field Logs: The Contractor shall keep a record of all field logs for each monitoring well. The Contractor shall provide a copy of the field logs to the Engineer no later than three (3) working days after completion of each monitoring well.
2. Final Logs: The original and one copy of each completed final monitoring well log referenced to ground surface, including classification of soil strata and rock, together with all notes, remarks, and pertinent information, shall be submitted by the Contractor to the Engineer no later than ten (10) calendar days after completion of each monitoring well. All completed logs shall be neatly typewritten on 8 ½-inches wide by 11-inches long standard boring log report sheets. At the request of the Engineer, the Contractor shall mail a copy of the final logs to the Engineer.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Entry to the Project Site is from 32 Lots Hollow Road. Contractor shall visit the Project Site prior to mobilization to inspect conditions and plan their access route in consultation with the Owner and Engineer.

C. It is the intent of the Client to minimize permanent changes to existing topography and to avoid damage or removal of existing trees and vegetation.

D. Contractor shall provide daily ingress and egress to the Project Site including all labor, equipment and/or materials necessary to perform this Work, as approved by the Engineer.

**1.07 - QUALIFICATIONS**

A. Contractor shall have a Certificate of Registration to engage in the business of digging or drilling wells within the Commonwealth of Massachusetts, registered with the Division of Water Resources, as required by the Water Well Drillers Registration statute M.G.L. c.21, s.16. The Contractor shall meet all requirements included in 313 CMR 3.00 Water Well Diggers and Drillers Registration.

B. Contractor's personnel that perform drilling Work under the Subcontract shall have a minimum of five (5) years of experience in drilling test wells. The name and experience record of each well driller shall be submitted in writing to the Engineer for approval before mobilization to the Project Site.

**1.08 - ENVIRONMENTAL PROTECTION**

A. Contractor shall maintain a zero release of petroleum products to the environment. To this end, Contractor shall provide and maintain secondary containment for all fuel stored at each drilling site, with a capacity of 120% of the volume of the primary fuel containers. Contractor shall manage their fuel so that no more than five (5) gallons of fuel is left in any one fuel container at any drilling site, overnight and on weekends.

**1.09 - PROTECTION OF WORK AND THE PUBLIC**

A. Prior to mobilization, Contractor shall steam clean the drilling rig and all drilling tools and well casings that are expected to enter borehole(s) to remove all soil and earth materials, grease, fuel and other petroleum substances and residues of grease and petroleum substances. If the drilling rig, casing and tools arrive at any drilling site with any of these substances, residues or other deleterious matter, Contractor shall be ordered to remove the rig and tools until they are properly steam cleaned.

B. All Work is to be carefully protected so that no injury will come to it from water, frost, accident or other cause, and any injury, which will come to the Work, is to be repaired at no expense to the Owner. Contractor shall protect the Owner's property from injury or loss arising in connection with this Work and make good any damage, injury, or loss.

C. Contractor shall take all necessary precautions for the safety of employees on the work and comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where the Work is being performed.

D. Contractor shall erect and properly maintain, at all times, as required by the conditions and progress of the Work, all necessary fences, barriers, warning signs and lights that may be necessary to adequately protect the general public.

**1.10 - SEQUENCE OF OPERATIONS**

A. Contractor shall be fully informed of the conditions relating to construction and labor under which Work will be or is now being performed and employ such methods and means in the carrying out of this Work as will not cause any interruptions or interference with any other Work at the Project Site.

B. Contractor shall provide whatever additional equipment and manpower as may be necessary to complete the Work as specified.

C. Contractor shall make all arrangements for and furnish at their own expense all utilities required for construction purposes. Contractor shall coordinate with the Owner for water supply, which is available from a fire hydrant at the project site. Contractor shall notify and obtain permission from the Orleans Water Department prior to connecting to the fire hydrant. Contractor shall not use surface water in the drilling of monitoring wells.

**1.11 - SITE PREPARATION**

A. The Contractor shall modify the areas adjacent to the proposed test well sites, as approved by the Client, to accommodate well drilling equipment and/or material storage at no additional cost to the Client.

**1.12 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

## PART 2 - PRODUCTS

### 2.01 - 2-INCH DIAMETER PVC WELL SCREEN, CASING AND BOTTOM CAP

A. Provide 2-inch diameter, threaded flush joint, schedule 40 polyvinyl chloride (PVC) pipe with length(s) and depth(s) as determined by the Engineer at the site.

B. Provide 2-inch diameter, schedule 40, machine slotted (10 slot), threaded, flush joint PVC pipe(s) with length(s) and depth(s) as determined by the Engineer at the site.

C. Provide 2-inch diameter, schedule 40, threaded, flush joint PVC bottom caps.

### 2.02 - SAND PACK MATERIAL

A. Provide Ottawa Silica Sand, or equal, "clean" in nature consisting of inert material that is hard durable sand, free from loam, clay, surface coatings and deleterious materials.

B. Size of the sand may vary from 0.04 inch (1.0 mm) to 0.06 inch (1.5 mm), and may not be of any other size or gradation unless authorized by the Engineer.

### 2.03 - PROTECTIVE METAL CASINGS, COVERS AND LOCKS

A. Provide protective metal casing(s) (guard pipes) with lockable covers a minimum of 5-feet in linear dimension.

B. Provide protective metal flush to ground protective cover (minimum 6-inch diameter) with lockable expandable cap.

C. Provide keyed alike metal locks for each.

D. Provide 10 keys.

## PART 3 - EXECUTION

### 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

### 3.02 - OBSERVATION/MONITORING WELLS

A. Installation of 2-inch Diameter Observation/Monitoring Wells

1. Wells shall be installed using hollow-stem auger or direct-push drilling equipment. Drilling equipment shall be sufficiently designed and powered to achieve depths of 150 feet in sand and gravel formations typical of Cape Cod. Drilling equipment shall have rotary capability, in case of obstructions, such as cobbles.

2. Wells shall be driven in the sequence, number and locations designated by the Engineer. Drilling and well installation Work shall be completed on an interrupted basis.

3. Borehole(s) shall be a 4.5-inch diameter cased hole.

4. Drilling shall proceed to a depth of approximately 130 feet below ground surface.

5. Continuous soil cores shall be obtained in no longer than 5-foot lengths.

6. 2-inch diameter PVC well screen shall be securely joined to the steel or PVC well casing. The entire string of casing and screen shall then be inserted inside the borehole to the bottom.

7. The 4.5-inch diameter drive casing shall be extracted and the native soil formation shall be allowed to cave in on the observation well screen and casing. If necessary, quartz sand shall be added to the annulus where the borehole does not collapse.

8. Bentonite shall be installed in the annulus where the borehole penetrates clay or sandy clay. In addition, a 2-

foot long bentonite seal shall be installed in the annulus between the borehole wall and the well casing at the water table.

9. Where PVC is used for well casing, a suitable steel protective pipe shall be installed over the PVC and secured in place from ground surface to 3 feet below ground surface by placing quartz sand inside and outside the protective pipe. The top of the protective pipe shall have a locking cap. Steel protective pipes for PVC observation wells shall be set such that the rim of the PVC and the rim of the steel pipe are at the same elevation.
10. All caps for steel and PVC wells shall have vent holes.
11. Each well shall be installed at the depths approved by the Engineer.
12. Each observation well shall be developed by diaphragm pumping, flushing, backwashing, plunging, airlifting, centrifugal or submersible pumping, as appropriate, until it is substantially free of sand.
13. Wells shall be numbered consecutively, as directed by the Engineer. The well number shall be clearly marked with heavy duty weather-resistant paint or permanent marker at the top of each well casing and/or guard-pipe. The top of the well casing shall be left two feet above the ground at the well and special short lengths shall be used if required.
14. Complete written records of all Work shall be kept on forms supplied by the Engineer or a form prepared by the Contractor and acceptable to the Engineer. Permanent records shall be submitted to the Engineer within three (3) working days of completion of the Work.
15. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

B. Observation/Monitoring Well Modification

1. Existing observation/monitoring wells LH-1, LH-2 and LH-3 are to be modified by removing the existing above ground steel protective cover and concrete pad.
2. Existing PVC casing shall be cut to 3 to 5 inches below the proposed grade, as approved by the Engineer.
3. Complete wells with a flush to grade protective cover (6-inch minimum diameter) secured with a concrete pad.
4. Each 2-inch diameter PVC well shall be installed with a vented lockable cap.
5. The location of the observation/monitoring wells are shown on the figure attached to the end of this section.
6. The wells are to be protected during construction and repaired or replaced if damaged.

**3.03 - CLEAN UP**

A. During the course of the Work, Contractor shall keep the Project Site in a clean and neat condition, and shall legally dispose of all debris resulting from the Work. At the conclusion of the Work, Contractor shall remove and legally dispose of any other refuse remaining from Contractor's operations and leave the entire Project Site in a neat and orderly condition, subject to the approval of the Engineer.

B. The drilling rig(s) and all other equipment shall mobilize on-site ready for operations with all drilling equipment cleaned, at the expense of the Contractor as explained below.

C. No substances such as Revert mud or any other material, which will potentially contaminate any of the groundwater, shall be used to facilitate drilling procedures. Only water of drinking water quality may be used for this procedure. No grease shall be used on drill stem joints or other surfaces where it may come in contact with the soil or groundwater.

**3.04 - OBSERVATION WELL LOGS**

A. Contractor shall prepare and deliver to the Engineer, logs of each test well and observation well. These records shall be complete, recorded with a black ink pen, legible and satisfactory to the Engineer prior to payment for the Work completed, as specified and approved by the Engineer. Contractor shall check all logs and records for correctness and completeness prior to submittal to the Engineer. Penciled copies of reports will not be acceptable.

B. The following information shall be included on the observation-well logs.

1. Test Well No. – To be identified by the Engineer.
2. Date – Provide day, month and year started and completed.
3. Contractor - Name of Contractor.
4. Name of City or Town or District and State.
5. Project Site Name.
6. Property Owner - Name of property Owner.
7. Test Well Location Map – To be provided by Engineer.
8. Well Construction Diagram showing: depth of borehole; well-screen interval; well casing depths; pipe above-ground; well-screen slot size; static water level below ground and top of pipe; backfill materials and installation depths; diameter of well pipe, screen and borehole. All measurements shall be taken from the top of pipe and shall be in feet and tenths of a foot.
9. Well Development: Hours required to develop well and type of equipment used (diaphragm, centrifugal or submersible pump); cumulative volume of soil removed, estimated in gallons.
10. Soil Descriptions: A description of the soil, as specified in herein, at each 5-foot interval or change in soil type, along with the depth of the change, in feet.

**3.05 - SOIL SAMPLES**

A. Soil samples shall be collected continuously. Unless requested otherwise by the Engineer, samples shall be stored in one-gallon, sealable, heavy-plastic sample bags. Sample bags shall be marked with the Client/Site name, well ID, and sample depth. All samples are to be delivered to the Engineer.

B. The following VISUAL identification system will be used to identify soil samples:

1. GRAIN SIZE (According to the Unified Soil Classification System) - on the basis of grain size, soils are divided into the following classes:

| | Sizes | |
|---|---|---|
| **Description** | **From** | **To** |
| Boulders | Greater than | 12-inch |
| Cobbles | 3-inch | 12-inch |

| | Sieve Size | | Grain Size (millimeters | |
|---|---|---|---|---|
| **Description** | **Passing** | **Retained** | **Passing** | **Retained** |
| Gravel – Coarse | 3-inch | ¾-inch | 76.20 | 19.00 |
| Gravel – Fine | ¾-inch | #4 | 19.00 | 4.75 |
| Sand – Coarse | #4 | #10 | 4.75 | 2.00 |
| Sand - Medium | #10 | #40 | 2.00 | 0.25 |
| Sand – Fine | #200 | #230 | 0.25 | 0.125 |
| Sand – Very Fine | #230 | | 0.125 | 0.074 |

Several entries are made to describe a soil according to its grain size:

a. The first entry represents the predominant type of soil in the sample. This should be capitalized in each case, such as COARSE SAND, FINE GRAVEL, SILT, ETC.

b. The second entry indicates the second-most abundant soil component, the third entry, the third-most, etc. The amounts should be indicated by the following terms:

- "and" 35% to 50%
- "some" 20% to 35%
- "little" 10% to 20%
- "trace" 10% or less

Examples:

- brown, SILT, some fine Sand, trace of Clay.
- gray FINE SAND, some Silt and Clay
- gray SILT, trace of fine Sand and Clay
- brown SILT, some coarse Sand and Gravel

c. Fine Grained Soils are predominantly Silt and/or Clay.

d. Coarse Grained Soils are predominantly Gravel and/or Sand.

2. Consistency: The consistency of the soil sample shall be described as follows:

a. Fine Grained Soils - "hard", "medium", or "soft", as well as a designation of whether the soil is "plastic" or "non-plastic".

b. Coarse Grained Soils - "loose" or "compact" and a designation as to whether or not the soil is "cemented".

c. Hardpan - Some soil mixtures have been subjected to extremely heavy pressures and have formed so-called “Hardpan”. This term should be used to amplify the soil description, but should not take the place of the grain-size classification.

d. Color - The predominant color of the soil sample in the natural state shall be designated: "White", "Yellow", "Red", "Gray", "Blue", "Brown", or "Black".

e. Other Soil Characteristics - In coarse-grained soils, the shape of the grain shall be described as: "flat", "sharp", and/or "round". The overall grading of the material shall be termed "well-graded", "poorly-graded", or if the material is noticeably of one size, it should be termed "uniform".

f. Vegetable Muck and Peat - Vegetable muck and peat are soil mixtures with varying percentages of organic and soil matter formed by decomposition of leaves, grasses and other fibrous materials. The color ranges from light brown to black. When the mixture contains a high percentage of vegetable material, it is called peat. The soil and organic content should be estimated in percent.

g. Silt or Clay - Silt shall be distinguished from clay using the dilatancy test, in the following manner: Silt- water disappears from surface; Clay- water stays on surface.

h. Loss of Wash Water - At the end of each wash, a determination shall be made as to the amount of the loss of wash water when the wash/jetting pipe exits the drive shoe. The loss of wash water shall be described on the well log as none, fair, good, excellent.

i. Other Descriptions - Additional descriptive terms may be used, but they should not replace the basic description. These terms could include: “rock fragments”, “stones”, and/or “rock flour”.

**3.06 - ABANDONED BOREHOLES**

A. Under the following conditions, the Contractor shall make an additional boring at locations selected by the Engineer and no payment shall be made for at the original, abandoned borehole or any samples or cores obtained therefrom:

1. The Contractor abandons the borehole without the permission or the Engineer.
2. The Contractor fails to carry a boring to the depth required by the Engineer.
3. The Contractor fails either to keep complete records of materials encountered or to furnish the Owner with the required samples and cores.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

SEE ATTACHMENTS

Attachment 1 - Groundwater Monitoring Well Locations

Attachement 2 - Existing Montoring Well Logs

Attachment 3 - Blank Test Well Record

**Attachment 1 – Groundwater Monitoring Well Locations**

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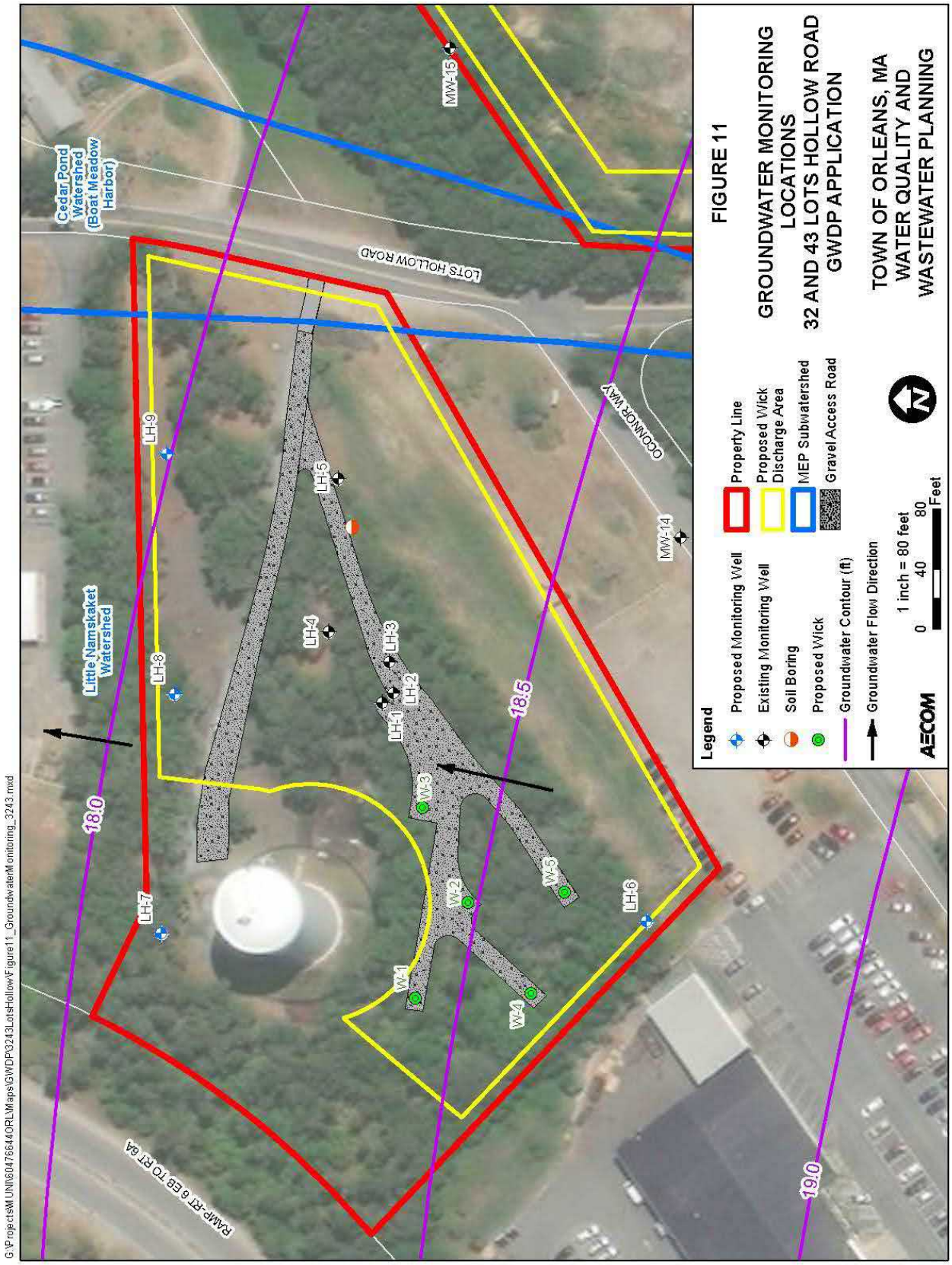
FIGURE 11
GROUNDWATER MONITORING LOCATIONS
32 AND 43 LOTS HOLLOW ROAD
GWDP APPLICATION
TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING
Legend
Proposed Monitoring Well
Existing Monitoring Well
Soil Boring
Proposed Wick
Groundwater Contour (ft)
Groundwater Flow Direction
Property Line
Proposed Wick Discharge Area
MEP Subwatershed
Gravel Access Road
1 inch = 80 feet
0
40
80
Feet
AECOM
N
LOTS HOLLOW ROAD
O'CONNOR WAY
RAMP-RT 6 EB TO RT 6A
Cedar Pond Watershed (Boat Meadow Harbor)
Little Namskaket Watershed
LH-1
LH-2
LH-3
LH-4
LH-5
LH-6
LH-7
LH-8
LH-9
W-1
W-2
W-3
W-4
W-5
MW-14
MW-15
18.0
18.5
19.0
G:\Projects\M UNI\60476440RL\Maps\GWDP\3243LotsHollow\Figure11_GroundwaterMonitoring_3243.mxd

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**Attachement 2 - Existing Montoring Well Logs**

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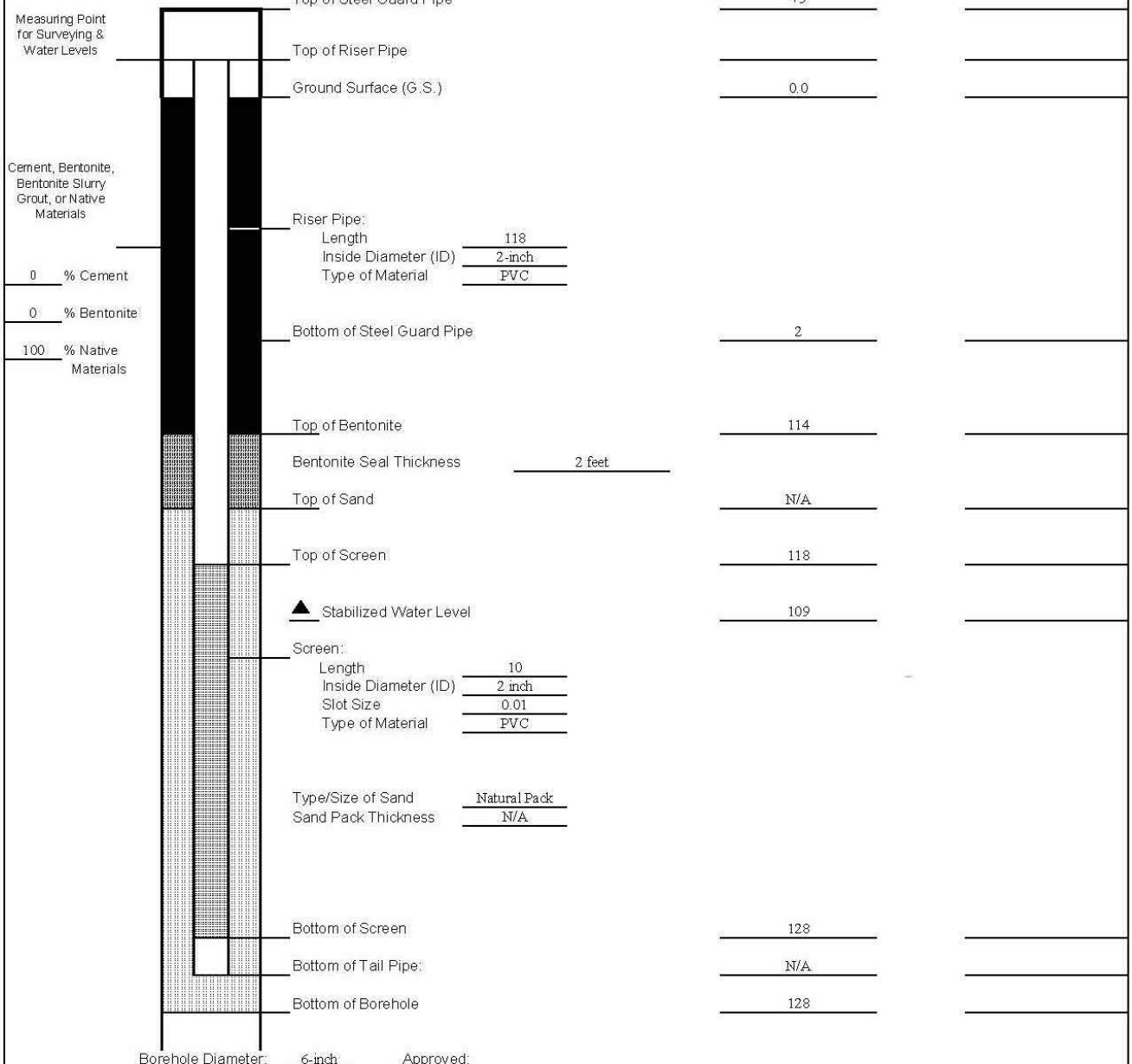
AECOM

Client: Town of Orleans
Project Number: 60476644
Site Location: Orleans, MA
Well Location: 32 Lots Hollow Coords:
Method: CME truck mounted hollow-stem auger

**WELL ID: LH-1**
Date Installed: 01/03/2018
Inspector: Erika Amir-Lin
Contractor: Desmond Drilling

## MONITORING WELL CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Steel Guard Pipe | +3 | |
| Top of Riser Pipe | | |
| Ground Surface (G.S.) | 0.0 | |
| Riser Pipe: Length 118; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Steel Guard Pipe | 2 | |
| Top of Bentonite | 114 | |
| Bentonite Seal Thickness 2 feet | | |
| Top of Sand | N/A | |
| Top of Screen | 118 | |
| ▲ Stabilized Water Level | 109 | |
| Screen: Length 10; Inside Diameter (ID) 2 inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand Natural Pack; Sand Pack Thickness N/A | | |
| Bottom of Screen | 128 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 128 | |

Approved:

Signature

Date

Describe Measuring Point:

Top of PVC.

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

## *Boring Log LH-2*

*Boring Number:* 2
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

*Project Manager:* M. Owen
*Drilling Contractor:* Desmond
*Field Tech:* E. Amir-Lin
*Driller:* Tommy/Josh
*Date Started:* 12/13/2017
*Date Completed:* 12/22/2017

### *Well Data*

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | Well completed with 3 foot metal standpipe and concrete pad | | | | 1 |
| 2 | | | | | | 27 | dry | 2" Dark brown loam/topsoil<br>3" Grey M SAND, little C sand, trace F sand.<br>22" Dark tan M SAND, little F sand, trace C sand. | | | | | 2 |
| 3 | | | | | | | | | | | | | 3 |
| 4 | | | | | | | | | | | | | 4 |
| 5 | | | | | | | | | | | | | 5 |
| 6 | | | | | | 47 | dry | 24" Tan F SAND, little M sand, trace C sand.<br>23" Light tan M SAND, some F sand, trace C sand. | | | | | 6 |
| 7 | | | | | | | | | | | | | 7 |
| 8 | | | | | | | | | | | | | 8 |
| 9 | | | | | | | | | | | | | 9 |
| 10 | | | | | | 26 | dry | 15" Tan M SAND, little F sand, trace C sand.<br>6" Brown F SAND.<br>5" Tan M SAND, little F sand, trace C sand. | | | | | 10 |
| 11 | | | | | | | | | | | | | 11 |
| 12 | | | | | | | | | | | | | 12 |
| 13 | | | | | | | | | | | | | 13 |
| 14 | | | | | | 41 | moist | 41" Orange-tan M SAND, little F sand, little C sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 14 |
| 15 | | | | | | | | | | | | | 15 |
| 16 | | | | | | | | | | | | | 16 |
| 17 | | No Blow Counts Collected - Drilled Direct Push to 88 feet | | | | | | | | | | | 17 |
| 18 | | | | | | 40 | moist | Same as above; increasingly orange/Fe stained. | | | | | 18 |
| 19 | | | | | | | | | | | | | 19 |
| 20 | | | | | | | | | | | | | 20 |
| 21 | | | | | | | | | | | | | 21 |
| 22 | | | | | | 32 | moist | 28" Tan M SAND, little F sand, trace C sand.<br>4" Orange M SAND, little F sand, trace C sand. | | | | | 22 |
| 23 | | | | | | | | | | | | | 23 |
| 24 | | | | | | | | | | | | | 24 |
| 25 | | | | | | | | | | | | | 25 |
| 26 | | | | | | 26 | moist | 26" Light tan-buff M SAND, little C sand, trace F sand. | | | | | 26 |
| 27 | | | | | | | | | | | | | 27 |
| 28 | | | | | | | | | | | | | 28 |
| 29 | | | | | | | | | | | | | 29 |
| 30 | | | | | | 37 | moist | 16" Tan/brown mottled M SAND, occasional stringers of dark brown, F sand.<br>21" Tan-orange C SAND, little M sand, trace F sand. | | | | | 30 |
| 31 | | | | | | | | | | | | | 31 |
| 32 | | | | | | | | | | | | | 32 |
| 33 | | | | | | | | | | | | | 33 |

Notes: F=Fine, M=Medium, C=Coarse

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen
*Field Tech:* E. Amir-Lin
*Date Started:* 12/13/2017
*Drilling Contractor:* Desmond
*Driller:* Tommy/Josh
*Date Completed:* 12/22/2017

## Boring Log LH-2

*Boring Number:* 2
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### Well Data

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | | No Blow Counts Collected - Drilled Direct Push to 88 feet | | | | 41 | moist | 41" Tan M SAND, little F sand, trace C sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 34 |
| 35 | | | | | | | | | | | | | 35 |
| 36 | | | | | | 42 | moist | 42" Tan M SAND, little F sand, one 2" piece of subrounded C gravel. | | | | | 36 |
| 37 | | | | | | | | | | | | | 37 |
| 38 | | | | | | | | | | | | | 38 |
| 39 | | | | | | | | | | | | | 39 |
| 40 | | | | | | 37 | moist | 26" Tan M and C SAND, little F sand, trace F subrounded gravel.<br>11" Tan M SAND, some F sand, trace C sand. | | | | | 40 |
| 41 | | | | | | | | | | | | | 41 |
| 42 | | | | | | | | | | | | | 42 |
| 43 | | | | | | | | | | | | | 43 |
| 44 | | | | | | 36 | moist | 36" Light brown M SAND, clean. | | | | | 44 |
| 45 | | | | | | | | | | | | | 45 |
| 46 | | | | | | | | | | | | | 46 |
| 47 | | | | | | | | | | | | | 47 |
| 48 | | | | | | 36 | moist | 6" Orange-brown M SAND, some C sand, little F sand, trace F rounded gravel.<br>30" Tan M SAND, little F sand, coarse lens at 50.5 feet, at 50 feet a lens of F rounded gravel. | | | | | 48 |
| 49 | | | | | | | | | | | | | 49 |
| 50 | | | | | | | | | | | | | 50 |
| 51 | | | | | | | | | | | | | 51 |
| 52 | | | | | | 36 | moist | 8" Tan M SAND, some C sand, little F sand, trace F gravel.<br>2" Brown/grey mottled SILT.<br>26" Tan F SAND, one lens F gravel/C sand. | | | | | 52 |
| 53 | | | | | | | | | | | | | 53 |
| 54 | | | | | | | | | | | | | 54 |
| 55 | | | | | | | | | | | | | 55 |
| 56 | | | | | | 48 | moist | 14" Orange-tan-brown C SAND, little M sand, little F sand, little F subrounded to subangular gravel.<br>34" Tan F SAND, clean. | | | | | 56 |
| 57 | | | | | | | | | | | | | 57 |
| 58 | | | | | | | | | | | | | 58 |
| 59 | | | | | | | | | | | | | 59 |
| 60 | | | | | | 37 | moist | 8" Orange/tan mottled M SAND, some C sand, little F sand, trace F subrounded gravel.<br>23" Tan/orange mottled M SAND.<br>6" Tan F SAND, clean. | | | | | 60 |
| 61 | | | | | | | | | | | | | 61 |
| 62 | | | | | | | | | | | | | 62 |
| 63 | | | | | | | | | | | | | 63 |
| 64 | | | | | | 39 | moist | 39" Tan F SAND, clean. Orange to dark brown lens at 65.5 feet. | | | | | 64 |
| 65 | | | | | | | | | | | | | 65 |
| 66 | | | | | | | | | | | | | 66 |

Notes: F=Fine, M=Medium, C=Coarse

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen
*Field Tech:* E. Amir-Lin
*Date Started:* 12/13/2017
*Drilling Contractor:* Desmond
*Driller:* Tommy/Josh
*Date Completed:* 12/22/2017

## *Boring Log LH-2*

*Boring Number:* 2
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### *Well Data*

Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fil Met | Tube | Fil Met | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | | No Blow Counts Collected - Drilled Direct Push to 88 feet, then downhole hammer employed | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 67 |
| 68 | | | | | | 29 | moist | 29" Tan-light brown F SAND. Orange mottling. Two lenses of brown SILT, 2" thick each, at 71 and 72 feet. | | | | | 68 |
| 69 | | | | | | | | | | | | | 69 |
| 70 | | | | | | | | | | | | | 70 |
| 71 | | | | | | | | | | | | | 71 |
| 72 | | | | | | 31 | moist | 6" Light brown F SAND.<br>25" Tan M SAND, slight Fe stain and mottling. | | | | | 72 |
| 73 | | | | | | | | | | | | | 73 |
| 74 | | | | | | | | | | | | | 74 |
| 75 | | | | | | | | | | | | | 75 |
| 76 | | | | | | 42 | moist | 42 " Tan M SAND, trace F sand. Orange Fe mottling. | | | | | 76 |
| 77 | | | | | | | | | | | | | 77 |
| 78 | | | | | | | | | | | | | 78 |
| 79 | | | | | | | | | | | | | 79 |
| 80 | | | | | | 47 | moist | 47" Light brown M SAND, little F sand. | | | | | 80 |
| 81 | | | | | | | | | | | | | 81 |
| 82 | | | | | | | | | | | | | 82 |
| 83 | | | | | | | | | | | | | 83 |
| 84 | | | | | | 41 | moist | Same as above. | | | | | 84 |
| 85 | | | | | | | | | | | | | 85 |
| 86 | | | | | | | | | | | | | 86 |
| 87 | | | | | | | | | | | | | 87 |
| 88 | | | | | | 12 | | 12" Tan-buff M SAND, some F sand. | | | | | 88 |
| 89 | | | | | | | | | | | | | 89 |
| 90 | | | | | | 15 | | 15" Buff F SAND, clean. | | | | | 90 |
| 91 | | | | | | | | | | | | | 91 |
| 92 | | | | | | 19 | | 19" Tan F SAND, clean. | | | | | 92 |
| 93 | | | | | | | | | | | | | 93 |
| 94 | | | | | | 22 | | 22" Tan F SAND, clean. | | | | | 94 |
| 95 | | | | | | | | | | | | | 95 |
| 96 | | | | | | 21 | | 16" Tan F SAND, clean, slight Fe mottling.<br>5" Buff M SAND, little F sand. | | | | | 96 |
| 97 | | | | | | | | | | | | | 97 |
| 98 | | | | | | 22 | moist | 22" Tan F SAND, little M sand, slight Fe mottling. | | | | | 98 |
| 99 | | | | | | | | | | | | | 99 |

Notes: F=Fine, M=Medium, C=Coarse

Project Number: 60476644
Client:
City of Orleans
Orleans, MA
Site Location:
32 Lots Hollow Road, Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Project Manager: M. Owen
Drilling Contractor: Diesmond
Field Tech: E. Amir-Lin
Driller: Tommy/Josh

## Boring Log LH-2

Boring Number: 2
Sheet: 1 of 4
Surface Elevation (ft-asl):
Equipment: CME
Inside Diameter:
Date Started: 12/13/2017
Date Completed: 12/22/2017

### Well Data

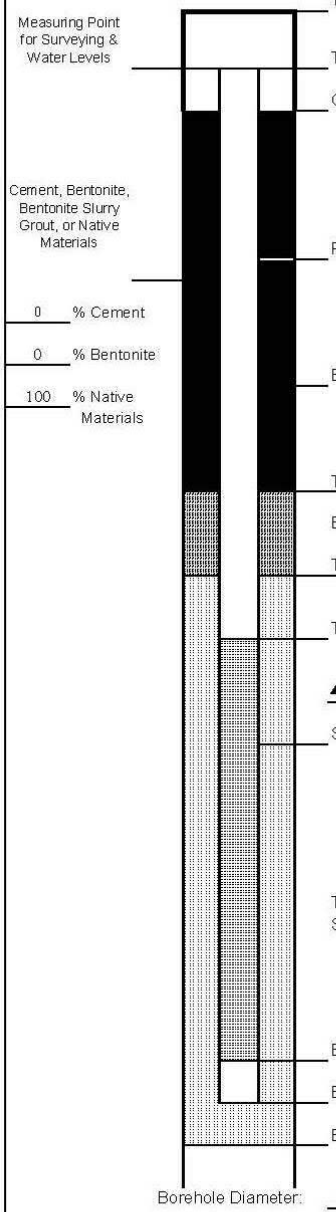
Boring Depth: 129 feet
Screen Depth: 119-129 feet
Screen length: 10 feet
Water Level: ~107 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | | No Blow Counts Collected - Drilled Direct Push to 88 feet, then downhole hammer employed | | | | | | | | | | | 100 |
| 101 | | | | | | 22 | moist | 19" Light brown F SAND, little M sand.<br>3" Grey SILT, trace clay, little F-M sand. | | | | | 101 |
| 102 | | | | | | | | | | | | | 102 |
| 103 | | | | | | 19 | moist | 19" Tan-light brown F SAND. | | | | | 103 |
| 104 | | | | | | 18 | moist | 11" Light brown F SAND.<br>4" Brown SILTY SAND, F sand.<br>3" Grey/brown mottled SILT, medium stiff. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 104 |
| 105 | | | | | | | | | | | | | 105 |
| 106 | | | | | | 24 | moist-wet | 3" Same as above; SILT.<br>21" Brown F SAND, some silt. | | | | | 106 |
| 107 | | | | | | | | | | | | | 107 |
| 108 | | | | | | 24 | wet | 24" Brown F SAND, little silt, Fe mottling, stiff. | | | | | 108 |
| 109 | | | | | | | | | | | | | 109 |
| 110 | | | | | | 18 | wet | 18" Brown F and M SAND, Fe staining, dense. | | | | | 110 |
| 111 | | | | | | | | | | | | | 111 |
| 112 | | | | | | 22 | wet | 22" Brown F and M SAND, dense. | Time-release bentonite chip seal. | | | | 112 |
| 113 | | | | | | | | | | | | | 113 |
| 114 | | | | | | 18 | wet | 18" Brown F and M SAND, micaceous, dense. | | | | | 114 |
| 115 | | | | | | | | | | | | | 115 |
| 116 | | | | | | 17 | wet | 17" Brown M SAND, some F sand, lenses of reddish-brown M sand, dense. | | | | | 116 |
| 117 | | | | | | | | | | | | | 117 |
| 118 | | | | | | 14 | wet | 14" Brown M and F SAND, dense. | | | | | 118 |
| 119 | | | | | | | | | | | | | 119 |
| 120 | | | | | | 24 | wet | 25" Brown M SAND, little F sand, dense. 2" lens grey/brown mottled SILT at 121.5 feet. | | | | | 120 |
| 121 | | | | | | | | | | | | | 121 |
| 122 | | | | | | 24 | wet | 24" Brown M SAND, little F sand, dense. | | | | | 122 |
| 123 | | | | | | | | | | | | | 123 |
| 124 | | | | | | 21 | wet | 18" Brown M SAND, little F sand, dense.<br>3" Grey/brown mottled SILT, little clay, stiff. | .010 slot PVC screen | | | | 124 |
| 125 | | | | | | | | | | | | | 125 |
| 126 | | | | | | 24 | wet | Brown M SAND, little F sand, dense. | | | | | 126 |
| 127 | | | | | | | | | | | | | 127 |
| 128 | | | | | | | | | | | | | 128 |
| 129 | | | | | | Bottom of Boring at 129 feet | | | | | | | 129 |
| 130 | | | | | | | | | | | | | 130 |
| 131 | | | | | | | | | | | | | 131 |
| 132 | | | | | | | | | | | | | 132 |

Notes: F=Fine, M=Medium, C=Coarse

| | | |
|---|---|---|
| AECOM | Client: Town of Orleans | WELL ID: LH-3 |
| | Project Number: 60476644 | |
| | Site Location: Orleans, MA | Date Installed: 02/06/2018 |
| | Well Location: 32 Lots Hollow Coords: | Inspector: Erika Amir-Lin |
| | Method: CME truck mounted hollow-stem auger | Contractor: Desmond Drilling |

## MONITORING WELL CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Steel Guard Pipe | +3 | |
| Top of Riser Pipe | | |
| Ground Surface (G.S.) | 0.0 | |
| Riser Pipe: Length 119; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Steel Guard Pipe | 2 | |
| Top of Bentonite | 114 | |
| Bentonite Seal Thickness 2 feet | | |
| Top of Sand | N/A | |
| Top of Screen | 119.0 | |
| ▲ Stabilized Water Level | 104 | |
| Screen: Length 10; Inside Diameter (ID) 2-inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand native pack; Sand Pack Thickness N/A | | |
| Bottom of Screen | 129 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 129 | |

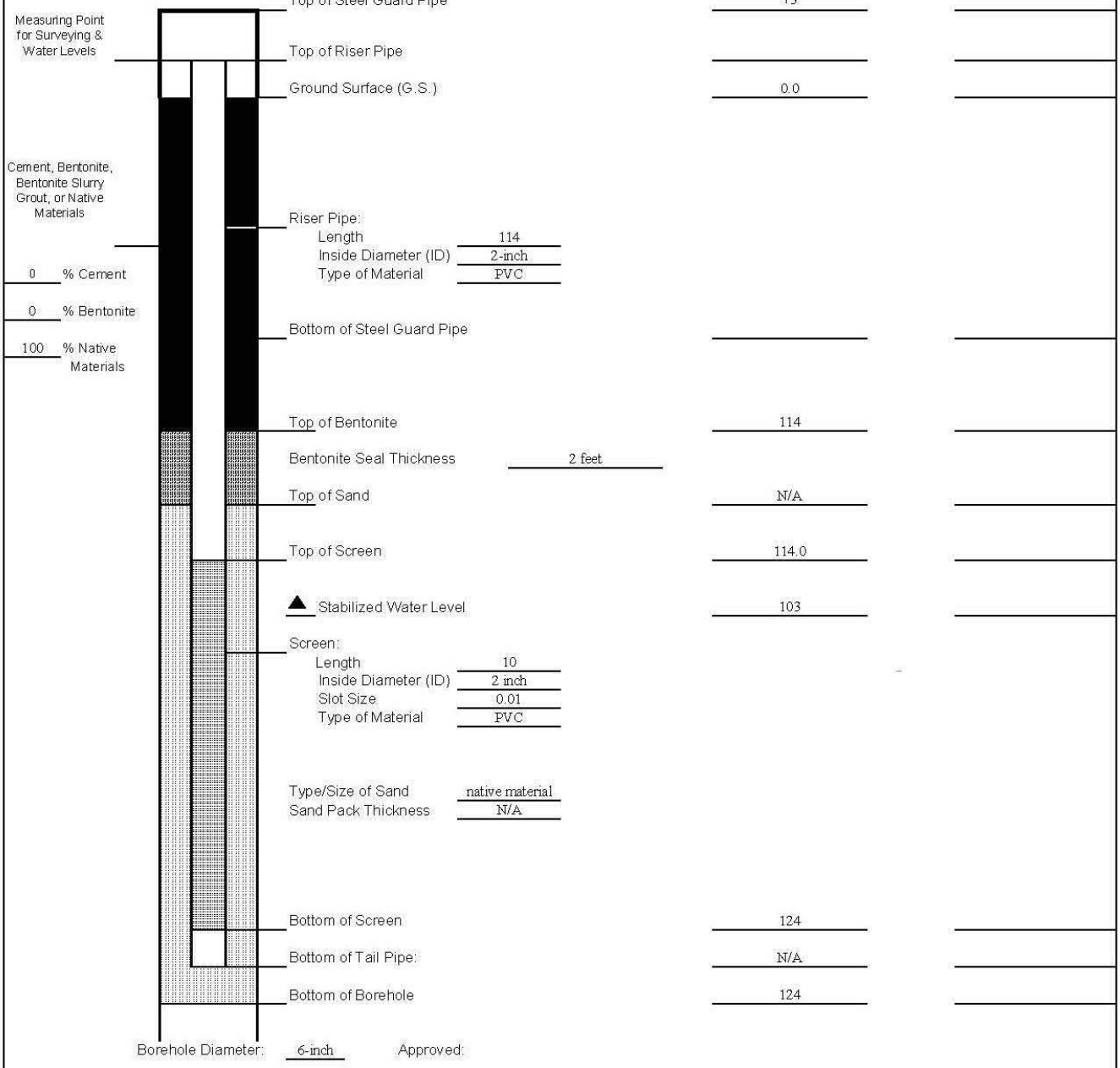
Borehole Diameter: 6-inch

Approved: _____ Signature _____ Date

Describe Measuring Point:
Top of PVC.

| AECOM | Client: Town of Orleans | WELL ID: LH-4 |
|---|---|---|
| | Project Number: 60476644 | |
| | Site Location: Orleans, MA | Date Installed: 01/04/2018 |
| | Well Location: 32 Lots Hollow Coords: | Inspector: Erika Amir-Lin |
| | Method: CME truck mounted hollow-stem auger | Contractor: Desmond Drilling |

## MONITORING WELL CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Steel Guard Pipe | +3 | |
| Top of Riser Pipe | | |
| Ground Surface (G.S.) | 0.0 | |
| Riser Pipe: | | |
| Length: 114 | | |
| Inside Diameter (ID): 2-inch | | |
| Type of Material: PVC | | |
| Bottom of Steel Guard Pipe | | |
| Top of Bentonite | 114 | |
| Bentonite Seal Thickness: 2 feet | | |
| Top of Sand | N/A | |
| Top of Screen | 114.0 | |
| ▲ Stabilized Water Level | 103 | |
| Screen: | | |
| Length: 10 | | |
| Inside Diameter (ID): 2 inch | | |
| Slot Size: 0.01 | | |
| Type of Material: PVC | | |
| Type/Size of Sand: native material | | |
| Sand Pack Thickness: N/A | | |
| Bottom of Screen | 124 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 124 | |

Borehole Diameter: 6-inch

Approved: _____ Signature

Date

Describe Measuring Point:

Top of PVC.

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

*Project Manager:* M. Owen
*Drilling Contractor:* Desmond
*Field Tech:* E. Amir-Lin
*Driller:* Tommy/Josh
*Date Started:* 12/15/2017
*Date Completed:* 12/19/2017

## *Boring Log LH-5*

*Boring Number:* 5
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

### *Well Data*

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | No Blow Counts Collected - Drilled Direct Push to 80 feet | | | | | | | Well completed with 3 foot metal standpipe and concrete pad | | | | 1 |
| 2 | | | | | | 25 | dry | 2" Brown loam. 24" Yellow-brown M SAND, little F sand, trace C sand, trace F rounded gravel. | | | | | 2 |
| 3 | | | | | | | | | | | | | 3 |
| 4 | | | | | | | | | | | | | 4 |
| 5 | | | | | | | | | | | | | 5 |
| 6 | | | | | | 21 | dry | 21" Light brown M SAND, intermittent Fe stained bands. | | | | | 6 |
| 7 | | | | | | | | | | | | | 7 |
| 8 | | | | | | | | | | | | | 8 |
| 9 | | | | | | | | | | | | | 9 |
| 10 | | | | | | 40 | dry | 18" Light brown M SAND, little C sand, Fe staining. 6" Light brown F SAND. 16" Light brown M SAND, little C sand, Fe staining. | | | | | 10 |
| 11 | | | | | | | | | | | | | 11 |
| 12 | | | | | | | | | | | | | 12 |
| 13 | | | | | | | | | | | | | 13 |
| 14 | | | | | | 22 | dry | 22" Light brown to orange-brown M SAND, some C sand, little F sand, trace F rounded gravel. | | | | | 14 |
| 15 | | | | | | | | | Schedule 40 PVC riser to surface Natural formation pack | | | | 15 |
| 16 | | | | | | | | | | | | | 16 |
| 17 | | | | | | | | | | | | | 17 |
| 18 | | | | | | 23 | dry | 23" Light brown M SAND, little F sand, trace C sand, trace F rounded gravel, mottled Fe stain. | | | | | 18 |
| 19 | | | | | | | | | | | | | 19 |
| 20 | | | | | | | | | | | | | 20 |
| 21 | | | | | | | | | | | | | 21 |
| 22 | | | | | | 28 | dry | 28" Light brown M SAND, some C sand, little F sand, trace F subrounded gravel, Fe staining. | | | | | 22 |
| 23 | | | | | | | | | | | | | 23 |
| 24 | | | | | | | | | | | | | 24 |
| 25 | | | | | | | | | | | | | 25 |
| 26 | | | | | | 34 | dry | 26" Tan M SAND, little C sand, trace F sand, trace F rounded gravel, occasional Fe stain. 8" Reddish brown C SAND, little F gravel, one piece C angular gravel, little M sand, trace F sand. | | | | | 26 |
| 27 | | | | | | | | | | | | | 27 |
| 28 | | | | | | | | | | | | | 28 |
| 29 | | | | | | | | | | | | | 29 |
| 30 | | | | | | 30 | moist | 30" Light brown M SAND, some C sand, little F sand, little F-C gravel. | | | | | 30 |
| 31 | | | | | | | | | | | | | 31 |
| 32 | | | | | | | | | | | | | 32 |
| 33 | | | | | | | | | | | | | 33 |

Notes: F=Fine, M=Medium, C=Coarse

*Project Number:* 60476644
*Client:*
City of Orleans
Orleans, MA
*Site Location:*
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

## *Boring Log LH-5*

*Boring Number:* 5
*Sheet:* 1 of 4
*Surface Elevation (ft-asl):*
*Equipment:* CME
*Inside Diameter:*

*Project Manager:* M. Owen
*Drilling Contractor:* Desmond
*Field Tech:* E. Amir-Lin
*Driller:* Tommy/Josh
*Date Started:* 12/15/2017
*Date Completed:* 12/19/2017

### *Well Data*

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | | No Blow Counts Collected - Drilled Direct Push to 80 feet | | | | 30 | moist | 8" Light brown M SAND, some C sand, little F sand, little F-C gravel.<br>22" Brown/tan mottled M SAND, little fine sand. | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 34 |
| 35 | | | | | | | | | | | | | 35 |
| 36 | | | | | | 29" | moist | 29" Brown-tan M SAND, little F sand, trace C sand. | | | | | 36 |
| 37 | | | | | | | | | | | | | 37 |
| 38 | | | | | | | | | | | | | 38 |
| 39 | | | | | | | | | | | | | 39 |
| 40 | | | | | | 42 | moist | 42" Light brown-tan M SAND, little F sand, little C sand, lens of brown M and C sand at 43.3 feet. | | | | | 40 |
| 41 | | | | | | | | | | | | | 41 |
| 42 | | | | | | | | | | | | | 42 |
| 43 | | | | | | | | | | | | | 43 |
| 44 | | | | | | 40 | moist | 40" Light brown-tan M SAND, little F, trace C, Fe staining. | | | | | 44 |
| 45 | | | | | | | | | | | | | 45 |
| 46 | | | | | | | | | | | | | 46 |
| 47 | | | | | | | | | | | | | 47 |
| 48 | | | | | | 32 | moist | Same as above, decreasing Fe staining. | | | | | 48 |
| 49 | | | | | | | | | | | | | 49 |
| 50 | | | | | | | | | | | | | 50 |
| 51 | | | | | | | | | | | | | 51 |
| 52 | | | | | | 26 | moist | 26" Tan M SAND, little F sand, little C sand, trace F subangular gravel. | | | | | 52 |
| 53 | | | | | | | | | | | | | 53 |
| 54 | | | | | | | | | | | | | 54 |
| 55 | | | | | | | | | | | | | 55 |
| 56 | | | | | | 30 | moist | 10" Tan M SAND, occasional Fe staining.<br>3" Grey/brown mottled SILT.<br>5" Tan F SAND, Fe stain.<br>12" Tan M SAND, some F sand, occasional Fe staining. | | | | | 56 |
| 57 | | | | | | | | | | | | | 57 |
| 58 | | | | | | | | | | | | | 58 |
| 59 | | | | | | | | | | | | | 59 |
| 60 | | | | | | 31 | moist | 31" Tan M SAND, little F sand, occasional dark brown bands. | | | | | 60 |
| 61 | | | | | | | | | | | | | 61 |
| 62 | | | | | | | | | | | | | 62 |
| 63 | | | | | | | | | | | | | 63 |
| 64 | | | | | | 36 | moist | 36" Tan-light brown M SAND, little F sand, occasional Fe stain. | | | | | 64 |
| 65 | | | | | | | | | | | | | 65 |
| 66 | | | | | | | | | | | | | 66 |

Notes: F=Fine, M=Medium, C=Coarse

Project Number: 60476644
Client:
City of Orleans
Orleans, MA
Site Location:
32 Lots Hollow Road; Water Tower
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Project Manager: M. Owen | Field Tech: E. Amir-Lin | Date Started: 12/15/2017
Drilling Contractor: Desmond | Driller: Tommy/Josh | Date Completed: 12/19/2017

## Boring Log LH-5

Boring Number: 5
Sheet: 1 of 4
Surface Elevation (ft-asl):
Equipment: CME
Inside Diameter:

### Well Data

Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat. | Tube | Fill Mat. | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | | No Blow Counts Collected - Drilled Direct Push to 80 feet, then downhole hammer employed | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 67 |
| 68 | | | | | | 38 | moist | 38" Tan-light brown M SAND, little F sand, trace Fe stain. | | | | | 68 |
| 69 | | | | | | | | | | | | | 69 |
| 70 | | | | | | | | | | | | | 70 |
| 71 | | | | | | | | | | | | | 71 |
| 72 | | | | | | 25 | moist | 21" Same as above, two C gravel pieces.<br>4" Brown F SAND with SILT. | | | | | 72 |
| 73 | | | | | | | | | | | | | 73 |
| 74 | | | | | | | | | | | | | 74 |
| 75 | | | | | | | | | | | | | 75 |
| 76 | | | | | | 24 | moist | 24" Tan-light brown M SAND, little F sand, Fe staining. | | | | | 76 |
| 77 | | | | | | | | | | | | | 77 |
| 78 | | | | | | | | | | | | | 78 |
| 79 | | | | | | | | | | | | | 79 |
| 80 | | | | | | 22 | moist | 22" Tan M SAND, little F sand, clean. | | | | | 80 |
| 81 | | | | | | | | | | | | | 81 |
| 82 | | | | | | 22 | moist | 22" Light brown M SAND, little F sand, clean. | | | | | 82 |
| 83 | | | | | | | | | | | | | 83 |
| 84 | | | | | | 21 | moist | 21" Same as above. | | | | | 84 |
| 85 | | | | | | | | | | | | | 85 |
| 86 | | | | | | 19 | moist | 19" Tan M SAND, little F sand, clean. | | | | | 86 |
| 87 | | | | | | | | | | | | | 87 |
| 88 | | | | | | 20 | moist | 20" Light brown to tan M SAND, little F sand. | | | | | 88 |
| 89 | | | | | | | | | | | | | 89 |
| 90 | | | | | | 21 | moist | 21" Light brown M SAND, little F sand. | | | | | 90 |
| 91 | | | | | | | | | | | | | 91 |
| 92 | | | | | | 24 | moist | 24" Same as above. | | | | | 92 |
| 93 | | | | | | | | | | | | | 93 |
| 94 | | | | | | 24 | moist | 24" Same as above. | | | | | 94 |
| 95 | | | | | | | | | | | | | 95 |
| 96 | | | | | | 11 | moist | 11" Tan M SAND, little F sand. | | | | | 96 |
| 97 | | | | | | | | | | | | | 97 |
| 98 | | | | | | 24 | moist | 24" Light brown M SAND, little F sand, faint Fe staining. | | | | | 98 |
| 99 | | | | | | | | | | | | | 99 |

Notes: F=Fine, M=Medium, C=Coarse

| | | |
|---|---|---|
| *Project Number:* 60476644<br>*Client:*<br>City of Orleans<br>Orleans, MA<br>*Site Location:*<br>32 Lots Hollow Road; Water Tower<br>Orleans, MA | AECOM<br>250 Apollo Drive<br>Chelmsford, Massachusetts<br>(978) 905-2100 | ***Boring Log LH-5***<br>*Boring Number:* 5<br>*Sheet:* 1 of 4<br>*Surface Elevation (ft-asl):*<br>*Equipment:* CME<br>*Inside Diameter:* |
| *Project Manager:* M. Owen<br>*Drilling Contractor:* Desmond | *Field Tech:* E. Amir-Lin<br>*Driller:* Tommy/Josh | *Date Started:* 12/15/2017<br>*Date Completed:* 12/19/2017 |

***Well Data***
Boring Depth: 134 feet
Screen Depth: 115-125 feet
Screen length: 10 feet
Water Level: ~104 feet

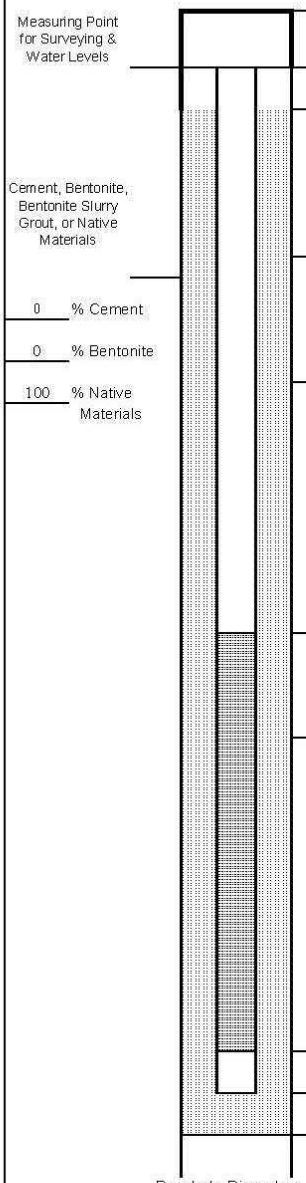
| Depth | Sample Depth | Blow Counts (24") 0-6 | 6-12 | 12-18 | 18-24 | Rec (") | Moisture | Field Identification | Description | Fill Mat | Tube | Fill Mat | Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | | | | | | | | | | | | | 100 |
| 101 | | | | | | 19 | moist | 19" Tan M SAND, some F sand, faint Fe staining. | | | | | 101 |
| 102 | | | | | | | | | | | | | 102 |
| 103 | | | | | | 24 | moist | 24" Light brown M SAND, little F sand. | | | | | 103 |
| 104 | | | | | | | | | | | | | 104 |
| 105 | | | | | | 24 | moist - wet | 24" Brown M sand, some F sand. | Time-release bentonite chip seal. | | | | 105 |
| 106 | | | | | | | | | | | | | 106 |
| 107 | | | | | | 19 | wet | 19" Same as above. | | | | | 107 |
| 108 | | | | | | | | | | | | | 108 |
| 109 | | | | | | 22 | wet | 22" Brown M and F SAND. | | | | | 109 |
| 110 | | | | | | | | | Schedule 40 PVC riser to surface<br>Natural formation pack | | | | 110 |
| 111 | | | | | | 24 | wet | 24" Same as above. | | | | | 111 |
| 112 | | | | | | | | | | | | | 112 |
| 113 | | | | | | 18 | wet | 24" Same as above. | | | | | 113 |
| 114 | | | | | | | | | | | | | 114 |
| 115 | | | | | | 22 | wet | 22" Brown M SAND, some F sand. | | | | | 115 |
| 116 | | No Blow Counts Collected - Drilled Direct Push to 80 feet, then downhole hammer employed | | | | | | | | | | | 116 |
| 117 | | | | | | 24 | wet | 19" Brown M SAND, some F sand.<br>5" Brown SANDY SILT. | | | | | 117 |
| 118 | | | | | | | | | 0.010 slot PVC screen | | | | 118 |
| 119 | | | | | | 24 | wet | 24" Brown M and F SAND, becoming M with some F at bottom of spoon. | | | | | 119 |
| 120 | | | | | | | | | | | | | 120 |
| 121 | | | | | | 24 | wet | 5" Brown M and F SAND.<br>1" Brown SILT.<br>18" Light brown M SAND, little F sand. | | | | | 121 |
| 122 | | | | | | | | | | | | | 122 |
| 123 | | | | | | 24 | wet | 3" Same as above.<br>21" Brown F and M SAND. | | | | | 123 |
| 124 | | | | | | | | | | | | | 124 |
| 125 | | | | | | 24 | wet | 24" Brown F SAND, little M sand. | | | | | 125 |
| 126 | | | | | | | | | | | | | 126 |
| 127 | | | | | | 21 | wet | 21" Same as above. | | | | | 127 |
| 128 | | | | | | | | | | | | | 128 |
| 129 | | | | | | 24 | wet | 24" Brown F SAND, trace M sand, clean. | | | | | 129 |
| 130 | | | | | | | | | | | | | 130 |
| 131 | | | | | | 20 | wet | 20" Same as above. | | | | | 131 |
| 132 | | | | | | | | | | | | | 132 |
| 133 | | | | | | 18 | wet | 18" Brown M SAND, some F sand. | | | | | 133 |
| 134 | | | | | | | | **Bottom of Boring at 134 feet** | | | | | 134 |
| 135 | | | | | | | | | | | | | 135 |

Notes: F=Fine, M=Medium, C=Coarse

AECOM

| | |
|---|---|
| *Client: Town of Orleans* | ***Test Wick - 32 Lots Hollow*** |
| *Project Number: 60476644* | |
| *Site Location: Orleans, MA* | *Date Installed: 02/06/2018* |
| *Well Location: 32 Lots Hollow Coords:* | *Inspector: Erika Amir-Lin* |
| *Method: CME truck mounted hollow-stem auger* | *Contractor: Desmond Drilling* |

## WICK DISCHARGE CONSTRUCTION DETAIL




| | Depth from G.S. (feet) | Elevation(feet) |
|---|---|---|
| Top of Plastic Culvert Pipe (6-foot diameter) | +2 | |
| Top of PVC well | +1 | |
| Ground Surface (G.S.) | 0.0 | |
| Well Riser Pipe: Length 25; Inside Diameter (ID) 2-inch; Type of Material PVC | | |
| Bottom of Plastic Culvert Pipe | 4 | |
| Note: PVC well set in center of the wick. | N/A | |
| | N/A | |
| Top of Screen | 25 | |
| ▲ Stabilized Water Level | above water table | |
| Screen: Length 80; Inside Diameter (ID) 2 inch; Slot Size 0.01; Type of Material PVC | | |
| Type/Size of Sand 3/8" gravel - Sand Pack Thickness 5 inches | | |
| Bottom of Screen | 105 | |
| Bottom of Tail Pipe: | N/A | |
| Bottom of Borehole | 105 | |

Approved: _____ Signature _____ Date

Describe Measuring Point:
Top of PVC.

**Attachment 3 - Blank Test Well Record**

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| | | |
|---|---|---|
| COMPANY:_____<br>ADDRESS: _____ | PROJECT: _____ | BORING NUMBER<br>SHEET 1 OF<br>DATE FILE NO |
| DRILLING COMPANY<br>FOREMAN<br>GEOLOGIST | | BORING LOCATION<br>CASING ELEVATION<br>DATE STARTED DATE ENDED |

| DRILLING SUMMARY | WELL DETAILS | Shallow | Deep | GROUNDWATER READINGS |
|---|---|---|---|---|
| Method<br>Casing Diameter<br>Sampler<br>Hammer Weight | Casing Diameter<br>Material<br>Stick up<br>Screen Interval<br>Slot Size | | | Well ID / Date / Time / Depth / Elevation |

| SAMPLE | | | | STRATA CHANGE/ | EQUIPMENT/ |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | SAMPLE DESCRIPTION | GENERAL DESCRIPTION | WELL INSTALLED |
| 10 | | | | | |
| 20 | | | | | |
| 30 | | | | | |
| 40 | | | | | |
| 50 | | | | | |

PROPORTIONS SED

| | |
|---|---|
| TRACE | 0 TO 10% |
| LITTLE | 10 TO 20% |
| SOME | 20 TO 35% |
| AND | 35 TO 50% |

WELL CONSTRUCTION LEGEND

CASING | CONCRETE XXXXXX | BENTONITE ////////// | GROUT +++++++

SCREEN ======= | SILICA SAND | NATURAL BACKFILL | BEDROCK **********

*E:\Backup Folders\3 11 10 Pen\1 Mark Work\Orleans\Wick Design\Space\Monitoring Well\Construction\Attachments\Blank Test Well Record.doc*

| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 52 | | | | | |
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| 62 | | | | | |
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| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 122 | | | | | |
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| 132 | | | | | |
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| COMPANY: _____<br>ADDRESS: _____<br>_____ | PROJECT: _____<br>_____<br>_____ | BORING NUMBER _____<br>SHEET _____ OF _____<br>DATE _____ FILE _____ |
|---|---|---|

| SAMPLE | | | SAMPLE DESCRIPTION | STRATA CHANGE AND GENERAL DESCRIPTION | EQUIPMENT/ WELL INSTALLED |
|---|---|---|---|---|---|
| DEPTH | SAMPLE INTERVAL | RECOVERY | | | |
| 192 | | | | | |
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| 202 | | | | | |
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**SECTION 02675**

**HYDROSTATIC TESTING AND DISINFECTION**

PART 1 - GENERAL ..... 1
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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, tools, materials and equipment and performing all operations necessary for the flushing, pressure testing, leakage testing and disinfection of potable water pipeline(s) as specified herein and as required to complete the Work.

B. The Work of this section shall be coordinated with the Owner. Use of water will only be as approved by the Owner. All work shall be in accordance with this specification, AWWA C600 and AWWA C651. Where conflicts appear between these specifications and AWWA C600 and AWWA C651 the more stringent requirement shall apply. All flushing, pressure and leakage testing and chlorinating shall be done by the Contractor in the presence of the Engineer.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**Note: Funding for this Bid Item is anticipated to be obtained at the Annual Town Meeting proposed to be held in May 2020. Therefore, performing the scope of work specified under this Bid Item is subject to this future appropriation and no payment will be made without written approval by the OWNER.**

B. In addition, the following conditions apply:

1. If sufficient manpower and equipment are not provided to prosecute this phase of the Work, the Owner reserves the right to engage an independent contractor to perform the flushing, testing, and disinfection Work. The cost for this Work will be deducted from payments due the Contractor, and it shall not place any claims against the Owner, Engineer or said independent contractor, for any leaks, damages to public or private property, production loss and/or profits, incurred by this Work.

2. If the leakage test is declared a failure by the Engineer, the Contractor shall at its own expense locate and make repairs as necessary, until the leakage is within the specified allowance. All costs associated with additional testing shall be borne by the Contractor.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Sampling Procedure.
2. Certified Lab Documentation.
3. Analysis Results.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. All products and materials shall conform to the applicable standards of ANSI and AWWA and/or as specified herein.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Each temporary blow-off, sample tap, and/or pressure tap shall consist of a corporation cock, Type K copper tubing and a curb stop, each of not less than one (1) inch diameter.

B. A pumping unit or proportionate feeder suitable for delivering a chlorine solution to the isolated pipeline(s) shall be provided. The unit used shall prevent chlorine solution from flowing back into the existing water system.

C. Chlorine solution for disinfecting pipeline(s) and appurtenances shall be made from either liquid sodium hypochlorite, or solid calcium hypochlorite, which shall conform to AWWA B300 Standard for Hypochlorites.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Flushing, testing and disinfection of pipeline(s) shall closely follow the pipe laying work. As the pipeline is installed, it shall be tested approximately every one thousand (1,000) feet, or between in-line isolation valves, whichever is less, as directed by the Engineer. Should a designated section of pipeline fail to be flushed, tested, and disinfected as specified, the pipe laying work shall be suspended until this Work is completed.

B. All flushing, testing and disinfection shall be done in the presence of the Engineer. The method of disinfection shall be the Continuous Feed Method of a chlorine solution as described hereinafter. Consult with the Owner and Engineer to identify acceptable location(s) for the discharge of the heavily chlorinated water that will result from the disinfection procedure.

C. Final acceptance of each segment of pipeline tested will be based on successful (negative) results of bacteriological testing. Location(s) for sampling shall be as directed by the Engineer.

D. The Contractor, with the assistance of the Owner, shall fill each new pipeline section as slowly as practicable so as not to cause dirty water and serious pressure drops within the existing water system. Vent air from the new pipeline(s) during the filling process.

E. Make taps on the new pipeline(s) where directed by the Engineer necessary to properly complete the hydrostatic and disinfection Work. After successful completion of the Work, with the authorization of the Owner, remove all temporary sampling tubing and blow-offs. The remaining corporation(s) shall be plugged and protected from damage by backfilling as approved by the Engineer.

**3.02 - FLUSHING**

A. All new pipeline(s), and existing pipeline(s) that have been drained and cut-into for making new connections, shall be thoroughly flushed prior to pressure and/or leakage testing and final disinfection.

B. Flushing shall be accomplished through partial opening and closing of valves, hydrants, and blow offs under expected line pressure as necessary to obtain the required scouring velocity. Flow velocities shall not be less than 2.5 feet per second in each pipeline section that is being flushed.

C. The size and number of hydrant outlets or pipeline taps to provide the required flow (at 40 psi residual pressure) is as follows. Minimum required flow and opening(s) diameter to flush pipeline segments based on 40-psi residual pressure in the pipeline.

| **Pipe Diameter (Inches)** | **Flow to Produce 2.5 fps Minimum Velocity in Pipe (GPM)** | **Minimum Size of Taps on Pipe (Inches)** | **Outlet Openings** | |
|---|---|---|---|---|
| | | | Number | Size (Inch) |
| 4 | 100 | 15/16 | 1 | 2-1/2 |
| 6 | 220 | 1-3/8 | 1 | 2-1/2 |
| 8 | 390 | 1-7/8 | 1 | 2-1/2 |
| 10 | 610 | 2-5/16 | 1 | 2-1/2 |
| 12 | 880 | 2-13/16 | 1 | 2-1/2 |
| 16 | 1,565 | 3-5/8 | 2 | 2-1/2 |

1. If less than a 40-psi residual pressure is available in the pipeline, with the size tap shown above, then a larger number of taps or hydrant outlets will be required, as directed by the Engineer.

2. The length of time for flushing, at or above the minimum allowable velocity shall be computed to allow a minimum of three (3) times the total volume of water stored in the pipeline segment being flushed to waste.

**3.03 - PRESSURE TESTING**

A. All new pipeline(s), or any valved section(s) thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure that will exist at the point of testing, or 150 psi, whichever is greater. Test pressures shall meet the following requirements.

1. Be of at least 2.5-hour duration.

2. Be not less than 1.25 times the expected system working pressure at the highest point along the test section.

3. Not exceed pipe or thrust-restraint design pressures.

4. Not vary by more than plus or minus 5-psi for the duration of the test.

5. Not exceed two (2) times the rated pressure of valves or hydrants when the pressure boundary includes closed butterfly valves, gate valves and/or hydrants. Valves shall not be operated in either direction at differential pressures greater than the rated pressures.

B. Air Removal. Following flushing, and before applying the specified test pressure, air shall be completely expelled from the pipeline segment being tested. After all air has been expelled, the air blowoffs shall be closed, and the test pressure applied.

C. Pressure Test. Each valved section of pipeline shall be slowly raised to the specified test pressure for two separate periods. The first period shall be for fifteen (15) minutes, after which the pressure in the test section shall be allowed to drop slowly back to system pressure. The pressure shall then be slowly raised again to the specified test pressure and maintained for 2-1/2 hours. The test pressure shall be based on the elevation of the lowest point of the pipeline in the test section and shall be corrected to the elevation of the test gauge, as directed by the Engineer. The test pressure shall be applied by means of a pump connected to the pipeline, in a manner satisfactory to the Engineer, and which will prevent any backflow into the existing water system.

D. Examination. Any exposed pipe, fittings, valves, hydrants and joints shall be carefully examined during the test. Any damaged or defective pipe, fittings, hydrants, or valves discovered following, or as a result of the pressure test shall be repaired or replaced with sound material. If faulty materials are removed and replaced, the pressure testing procedure shall be repeated until satisfactory to the Engineer.

**3.04 - LEAKAGE TEST**

A. Leakage testing shall be conducted concurrently with the pressure test.

B. Leakage Defined. Leakage shall be defined as the quantity of water that must be pumped into the new pipeline or any valved section thereof, to maintain pressure within plus or minus 5-psi of the specified test pressure, after the pipeline(s) have been filled with water and all air has been expelled. Leakage shall be recorded to the nearest one-tenth (0.10) of a gallon, by means of a calibrated test meter. Drawdown may be measured in a calibrated barrel, as approved by the Engineer. All records and charts shall become the property of the Engineer. Employ qualified personnel for all testing. Leakage testing shall not be measured as a drop in pressure over a specified period of time.

C. Allowable Leakage.

1. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$L = \underline{SD(P^{0.5})} / 133{,}200$ where: L = allowable gallons of leakage per hour (GPH)

S = the length of pipe tested (feet)

D = the nominal pipe diameter (inches)

P = the average test pressure during the test (psi)

2. The leakage formula is based on an allowable leakage of 11.65 gallons per day, per mile of pipe, per inch (nominal) of pipe diameter, at a pressure of 150-psi.

3. The allowable leakage in GPH per 1,000 feet of pipe at various pressures and pipe diameters are shown below:

| Test Pressure (PSI) | Pipe Diameter (Inches) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 8 | 10 | 12 | 16 | 20 | 24 | 30 | 36 | 42 | 48 |
| 450 | 0.95 | 1.27 | 1.59 | 1.91 | 2.55 | 3.18 | 3.82 | 4.78 | 5.73 | 6.69 | 7.64 |
| 400 | 0.90 | 1.20 | 1.50 | 1.80 | 2.40 | 3.00 | 3.60 | 4.50 | 5.41 | 6.31 | 7.21 |
| 350 | 0.84 | 1.12 | 1.40 | 1.69 | 2.25 | 2.81 | 3.37 | 4.21 | 5.06 | 5.90 | 6.74 |
| 300 | 0.78 | 1.04 | 1.30 | 1.56 | 2.08 | 2.60 | 3.12 | 3.90 | 4.68 | 5.46 | 6.24 |
| 275 | 0.75 | 1.00 | 1.24 | 1.49 | 1.99 | 2.49 | 2.99 | 3.73 | 4.48 | 5.23 | 5.98 |
| 250 | 0.71 | 0.95 | 1.19 | 1.42 | 1.90 | 2.37 | 2.85 | 3.56 | 4.27 | 4.99 | 5.70 |
| 225 | 0.68 | 0.90 | 1.13 | 1.35 | 1.80 | 2.25 | 2.70 | 3.38 | 4.05 | 4.73 | 5.41 |
| 200 | 0.64 | 0.85 | 1.06 | 1.28 | 1.70 | 2.12 | 2.55 | 3.19 | 3.82 | 4.46 | 5.09 |
| 175 | 0.59 | 0.80 | 0.99 | 1.19 | 1.59 | 1.98 | 2.38 | 2.98 | 3.58 | 4.17 | 4.77 |

| Test Pressure (PSI) | Pipe Diameter (Inches) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 8 | 10 | 12 | 16 | 20 | 24 | 30 | 36 | 42 | 48 |
| 150 | 0.55 | 0.74 | 0.92 | 1.10 | 1.47 | 1.84 | 2.21 | 2.76 | 3.31 | 3.86 | 4.41 |
| l25 | 0.50 | 0.67 | 0.84 | 1.01 | 1.34 | 1.68 | 2.01 | 2.52 | 3.02 | 3.53 | 4.03 |
| 100 | 0.45 | 0.60 | 0.75 | 0.90 | 1.20 | 1.50 | 1.80 | 2.25 | 2.70 | 3.15 | 3.60 |

Notes: If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. When testing against closed metal-seated valves, an additional leakage shall be allowed per closed valve of 0.0078 gallons per hour per inch of nominal valve diameter. When hydrants are located in test sections they shall remain closed. Zero (0) leakage will be allowed on pipeline segments that cross bridges or carrier pipes located in jackings or borings.

D. Acceptance shall be determined on the basis of allowable leakage. If the test of any pipeline segment discloses leakage greater than that specified, the source of leakage shall be located and repaired as necessary to ensure that the allowable leakage is within the specified parameters.

1. All visible leaks are to be repaired regardless of the amount of leakage.

2. All pipeline segments shall be pressure and leakage tested in the presence of the Engineer, in order to qualify for acceptance.

**3.05 - DISINFECTION**

A. The method of disinfection shall be by the Continuous Feed Method of a chlorine solution as described hereinafter, and as approved by the Engineer.

B. Continuous Feed Method of Chlorine Solution. The continuous feed method consists of the following steps:

1. Upon completion of pipeline installation, fill pipeline(s) with potable water, and remove all air from high spots and/or pockets.

2. Flush the completed pipeline(s) in accordance with the requirements specified herein to remove particulates. Following the filling and flushing of the pipeline(s) and before chlorination, complete all hydrostatic testing as specified.

3. Fill the pipeline(s) with chlorinated potable water, having an initial concentration of 25-mg/L free chlorine residual. After a 24-hour period, there shall be a minimum of 10-mg/L free chlorine residual in the pipeline(s). Water from the existing distribution system or other approved source of supply shall be made to flow at a constant measured rate, into the new pipeline(s). In the absence of a meter, the rate may be approximated by methods such as placing a pilot gauge in the discharge or measuring the time to fill a container of known volume.

4. At a point not more than 10 feet downstream from the beginning of the new pipeline(s), water entering the new pipeline shall receive a dose of chlorine solution fed at a constant rate such that the water in the pipeline(s) will have not less than 25-mg/L free available chlorine. To assure that this concentration is achieved, measure chlorine concentration at regular intervals along the pipeline(s), using approved chlorine test kits, or as otherwise described in AWWA M12 - Simplified Procedures for Water Examination.

C. The amount of chlorine required to obtain a concentration of 25-mg/L per 100 feet of various diameter pipes is as follows:

1. Chlorine required to obtain a concentration of 25 mg/L per 100 feet.

| | Sodium Hypochlorite Solution (Gallons per 100 feet) | | | | Calcium Hypochlorite (Ounces) |
|---|---|---|---|---|---|
| **Pipe Diameter (Inches)** | **5% Available Chlorine** | **10% Available Chlorine** | **12-1/2% Available Chlorine** | **15% Available Chlorine** | **65% Available Chlorine** |
| 4 | 0.03 | 0.02 | 0.02 | 0.01 | 0.32 |
| 6 | 0.08 | 0.04 | 0.03 | 0.03 | 0.75 |
| 8 | 0.13 | 0.07 | 0.06 | 0.05 | 1.30 |
| 10 | 0.20 | 0.10 | 0.09 | 0.07 | 2.10 |
| 12 | 0.28 | 0.15 | 0.12 | 0.10 | 2.95 |
| 16 | 0.50 | 0.25 | 0.22 | 0.17 | 5.30 |
| 20 | 0.80 | 0.40 | 0.34 | 0.28 | 8.40 |
| 24 | 1.15 | 0.60 | 0.50 | 0.40 | 12.00 |

2. Prior to injection of a chlorine solution into the section of pipeline being disinfected, the above quantities may be diluted into a known quantity of potable water in order to meet the requirements of the chemical feed equipment. The entire solution shall be injected into the section of pipeline being disinfected at a feed rate that ensures that the residual chlorine concentration is a minimum of 25 mg/L. The chlorine concentration within the pipeline being disinfected shall not exceed 50 mg/L without written approval of the Owner.

3. The quantities shown above are based on concentrations of available chlorine by volume. Extended or improper storage may have caused a loss of available chlorine.

4. For concentrations of 50 mg/L double the quantities listed.

D. During the application of chlorine, valves shall be closed to prevent strong chlorine solution in the new pipeline(s) from flowing into the existing system. Chlorine application shall continue until the entire pipeline(s) is filled with water having 25 mg/L of free available chlorine. The chlorinated water shall be retained in the pipeline(s) for at least 24 hours, during which time all valves and hydrants in the section(s) being treated shall be operated, in order to disinfect the appurtenances. At the end of this 24-hour period, all portions of the pipeline(s) being tested shall have a free available chlorine residual of at least 10 mg/L. If less that 10 mg/L free available chlorine residual is measured, the pipeline(s) shall be reflushed and the entire disinfection procedure repeated.

E. Chlorine solutions shall be applied to the pipeline(s) with chemical feed pump(s) designed for feeding chlorine solutions. Feed lines shall be of such material and strengths as to safely withstand corrosion caused by the concentrated chlorine solutions, and also the maximum pressures that may be created by the pump(s). All connections shall be checked for tightness before the solution is applied to the pipeline.

**3.06 - FINAL FLUSHING**

A. After the specified retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show the concentration in water leaving the pipeline is no higher than that generally prevailing in the water distribution system.

B. Arrangements shall be made with the Owner to flush the pipeline(s) of chlorinated water. Great care shall be exercised in the selection of the rate of flow and the discharge point(s), in order prevent damage to public or private property.

C. The Owner shall approve the environment to which the chlorinated water is to be discharged. If it is determined by the Owner that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to thoroughly neutralize the chlorine residual remaining in the water. If necessary, state, federal, and/or local regulatory agencies shall be contacted to ascertain if there are any special provisions for the disposal of the heavily chlorinated water. No chlorinated water shall be discharged directly into designated wetland areas or water bodies.

**3.07 - PROCEDURES FOR DISINFECTING TAPPING SLEEVES**

A. Before a tapping sleeve is installed, the exterior of the pipeline to be tapped shall be thoroughly cleaned, and the interior surface of the sleeve and valve shall be washed with a one (1) percent chlorine solution.

**3.08 - BACTERIOLOGICAL TESTS**

A. Standard Conditions. Twenty-four hours after final flushing and before a pipeline is placed in service, water samples shall be collected twice (24 hours apart) at each sampling point designated by the Engineer and tested for bacteriological quality in accordance with "Standard Methods for the Examination of Water and Wastewater". Water samples shall show the absence of coliform organisms and background bacteria. A standard heterotrophic plate count may be required at the option of the Engineer at no additional cost to the Owner. Water samples shall be taken at points at least every 1,000 feet along the pipeline, plus one (1) sample from the end of each test section and at least one (1) sample from each branch line.

B. Special Conditions. If, during construction, trench water has entered the pipeline, or if in the opinion of the Engineer excessive quantities of dirt or debris has entered the pipeline, bacteriological samples shall be taken at intervals of approximately 200 feet and shall be identified as to location. Samples shall be taken of water that has stood in the pipeline for at least 24 hours after final flushing has been completed.

C. Sampling Procedure. Samples for bacteriological analysis shall be collected, in the presence of the Engineer, in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in the collection of samples. A corporation cock shall be installed in the pipeline with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed. The Contractor shall sample twice (24 hours apart) at each location designated by the Engineer.

D. The Owner shall deliver all samples to a State approved laboratory for bacterial analysis. Only after each consecutive sample is approved shall the pipeline(s) be incorporated into the water distribution system. In the event that positive reports of contamination are received, the pipeline(s) shall be flushed and disinfected as many times as may be necessary to obtain approved (negative) results at no additional cost to the Owner.

**3.09 - RE-DISINFECTION**

A. If the initial disinfection fails to produce satisfactory bacteriological samples, the pipeline(s) shall be reflushed and resampled. If check samples show the presence of coliform organisms, then the pipeline(s) shall be re-disinfected by the continuous feed method of chlorination, until satisfactory results are obtained.

B. High velocities in the existing system, resulting from flushing the new pipeline(s), may disturb sediment that has accumulated in the existing water system. When check samples are taken, the Contractor shall sample water entering the new pipeline(s).

**3.10 - CHLORINATION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING PIPELINE(S)**

A. The following procedures apply when pipeline(s) are wholly or partially dewatered. After the appropriate procedures have been completed, the pipeline(s) may be returned to service prior to completion of bacteriological testing, in order to minimize the time customers are out of service. Leaks or breaks that are repaired with clamping devices while the pipeline(s) are full of water under pressure present little danger of contamination and require no disinfection.

1. Trench Treatment. When an old pipeline is opened, either by accident or on purpose. Liberal quantities of hypochlorite tablets shall be applied to open trench areas to lessen the danger from pollution.

2. Swabbing with Hypochlorite Solution. The interior of all pipe and fittings used in making a repair (particularly couplings and sleeves) shall be swabbed or sprayed with a one (1) percent chlorine solution before they are installed.

3. Flushing. If valve and hydrant locations permit thorough flushing toward the work location from both directions, it shall be done. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

4. Slug Chlorination. Where practical in addition to the procedures above, a section of pipeline in which the break is located shall be isolated. All service connections shall be shut off, and the section flushed and chlorinated by the slug method, whereby the dose may be increased to as much as 300-mg/L, and the contact time reduced to as little as one (1) hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable chlorine odor.

5. Bacteriological samples shall be taken after repairs. If the direction of flow is unknown, samples shall be taken on each side of the pipeline break. If positive samples are recorded, daily sampling shall be continued until two (2) consecutive negative samples are recorded.

**3.11 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02702**

**CLEANING AND TELEVISION INSPECTION OF SEWER LINES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, materials and equipment required to clean, televise, and video tape the existing and/or new sewer lines during high groundwater conditions as determined by the Owner/Engineer, unless specified otherwise/directed by the Owner/Engineer.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and Payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Contractor's description of all equipment to be used.
2. Contractor's description of its proposed methodology.
3. The Contractor shall submit a typed written report including television inspection logs for all work performed. These logs at a minimum should include: stationing, location of reference points, point of entry of service connections via a clock system, observed running leaks, observed continuously running service connections, bad joints, sags in pipes, and other evidence of potential problems.
4. Color DVDs and Inspection Logs.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA**

A. The work covered by this specification shall be in accordance with the best practice of the industry. The specifications call attention to certain features but do not purport to cover all details entering into the required work.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - CLEANING**

A. Cleaning shall be accomplished with high pressure hydraulic cleaning equipment or mechanical cleaning equipment followed by hydraulic cleaning.

1. "Light Cleaning" as used in these specifications, shall be equivalent to 1 to 2 passes of the hydraulic jet through the sewer lines.
2. “Moderate Cleaning” as used in these specifications shall be equivalent to 3 to 4 passes of the hydraulic jet through sewer lines.
3. “Heavy Cleaning” as used in these specifications shall be equivalent to more than 4 passes of the hydraulic jet through the sewer lines or use of mechanical equipment to remove debris, including substantial root mass, to render the line clean.

B. For existing sewer lines, each method shall be able to remove sufficient material to render the sewer line capable of handling 95 percent of its original design capacity. Each method shall also include root removal using equipment appropriate for the conditions.

C. For new sewer lines, each method shall be able to remove sufficient material to render the sewer line capable of handling 100 percent of its design capacity.

D. Equipment

1. Mechanical equipment shall be equipped with a belt booster clutch or overload clutch so that the pipe will not be damaged. No equipment of a direct drive type shall be permitted.
2. High pressure hydraulic equipment shall not operate under a "head of water" unless written approval is obtained from the Engineer.
3. High pressure hydraulic cleaning equipment shall be capable of producing flows from a fine spray to a solid stream and shall have a selection of two or more high pressure nozzles (approximately 2,000 pounds per square inch).
4. Satisfactory precautions shall be taken to protect the sewer lines at all times. All workmen shall be experienced and skilled in the use of the equipment used.

E. Disposal of Debris

1. All sludge, dirt, sand, gravel, roots, grease and other debris resulting from the cleaning operation shall be placed in a suitable container and legally disposed of by the Contractor.
2. No sewage or materials removed from the sewer shall be dumped or pumped into the streets or into water courses, ditches, catch basins or other drains or sewers.
3. The Contractor shall use suitable equipment to ensure that no solids are permitted to go downstream.

**3.02 - COLOR TELEVISION INSPECTION**

A. General

1. The television camera used for the inspection shall be a 360-degree pan and tilt camera specifically designed and constructed for inspection of sewer lines.
2. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be operative in 100 percent humidity conditions and have a minimum of 600 line-resolutions. Picture quality and definition shall be to the complete satisfaction of the Engineer and if unsatisfactory, the equipment shall be removed and replaced with equipment of satisfactory quality.

B. Sewer Lines

1. The inspection shall be done one section at a time and the section being inspected shall be suitably isolated from the remainder of the sewer system as required.
2. The camera shall be moved through the line in either direction at a uniform slow rate by means of cable winches located at manholes on each side of section being televised.
3. Means of communications shall be set up between the two winches and the monitor control. Photographic pictures shall be taken of the television monitor when directed by the Engineer.

C. Service Connections

1. Existing (If Applicable) - The Contractor shall video tape the entire length of each service connection in order to identify defects that may exist in the lines. This inspection shall occur after the connection has been made by adding a cleanout to each service connection located at the property line.
2. New - The Contractor shall video tape the entire length of each service connection from the main line to the cleanout to each service connection located at the property line.

**3.03 - FLOW CONTROL – Not Used**

**3.04 - REPORTS**

A. Television, inspection logs and cleaning logs cleaning logs shall be furnished to the Engineer.

B. Television inspection of the entire line shall be recorded on DVD. Where deficiencies and leaks are noted, the camera shall be stopped to observe the condition, information recorded and photographs taken as directed by the Engineer. Three copies of color video tapes shall be provided.

C. Television inspection logs shall be prepared and shall include identification of the section of pipe and pipe size. Records shall also include location of reference points, point of entry of service connections via a clock system, observed running leaks, observed continuously running service connections, bad joints, sags in pipes, and other evidence of potential problems. Three copies of inspection logs shall be provided.

D. Cleaning logs shall be prepared and shall include identification of the section of pipe and pipe size. Three copies of inspection logs shall be provided.

**3.05 - CLEAN-UP**

A. The Contractor shall be responsible for the legal disposal of removed materials and general clean-up of the work area as approved by the Engineer.

**3.06 - FINAL ACCEPTANCE**

A. Final acceptance of the sewer line cleaning shall be made upon completion of the television inspection as approved by the Engineer.

B. Final acceptance is based on the existing sewer's ability to carry 95 percent of its original design capacity and based on the new sewer's ability to carry 100 percent of its design capacity.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 02725**

**MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to construct precast concrete manholes, catch basins, handholes, and pull boxes including bases complete with inverts, tables, steps, frames, grates and covers, mancatchers, fittings, piping and concrete encasements for drop manholes as specified herein and as shown on the Contract Drawings

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Precast concrete manholes, catch basins, handholes and pull boxes.
2. Frames, covers, and grates.
3. Horizontal joint sealing material.
4. Pipe connections.
5. Manhole steps.
6. Manhole Encapsulation System.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**PART 2 - PRODUCTS**

**2.01 - PRECAST SECTIONS FOR MANHOLES**

A. Precast reinforced concrete sections for drain manholes, sewer manholes, valve manholes, chemical or process manholes, (hereinafter referred to as "manholes") and catch basins, shall conform to the applicable requirements of ASTM C478. Sections and bases shall have a minimum wall thickness of the dimensions shown on the Contract Drawings. Unless otherwise detailed on the Contract Drawings all sections shall be of precast concrete. Flat top sections to be substituted for conical sections of manholes and catch basins in areas of low cover shall be indicated in submittals and shall conform to the requirements for precast concrete sections for handholes.

B. Unless otherwise shown on the Contract Drawings manholes shall be 4-foot in diameter for pipe up to 24-inches in diameter unless the angle between two 24-inch pipes is less than 120 degrees. In such cases and when the size of the pipe is less than 36-inches a 5-foot inside diameter manhole shall be used. Where the pipe is 36-inches in diameter or greater, the diameter of the structure shall be as shown on the Contract Drawings.

C. Exterior surfaces of all precast manholes shall be given one shop coat of bituminous waterproofing.

D. All lifting holes and areas of the factory coating that have been compromised shall be filled and/or patched with mortar and coated with one coat of bituminous waterproofing.

**2.02 - HORIZONTAL JOINTS**

A. Horizontal joints between sections of manholes, unless otherwise specified herein, shall be sealed with a self-sealing butyl rubber based flexible joint sealant in rope form. Sealant material shall be Kent-Seal No. 2 as manufactured by Hamilton-Kent Mfg. Co., Kent, Ohio; C-S146 as manufactured by Concrete Products Supply Co. Div., Press Seal Gasket Corp., Fort Wayne, Indiana; Ram-Nek as manufactured by K.T. Snyder Co., Inc., Houston, Texas. Sealant shall be installed in accordance with the manufacturers written instructions.

B. Horizontal joints between sections of precast concrete drain manholes and catch basins shall be mortared with mix specified herein.

**2.03 - MANHOLE STEPS**

A. Manhole steps shall be of steel reinforced copolymer polypropylene conforming to ASTM C478, cast-in-place or installed utilizing inserts approved by the Engineer.

B. All steps shall be 12-inches on center with abrasive step surface and safety edge, drop front design, 1-inch diameter and 16-inches wide. Metal items embedded in concrete shall be painted with a zinc chromate primer.

**2.04 - PRECAST SECTIONS FOR ELECTRICAL MANHOLES, HANDHOLES, AND PULL BOXES**

A. Refer to DIVISION 16, ELECTRICAL.

**2.05 - PIPE CONNECTIONS**

A. Premolded elastomeric sealed joints shall be used at the joints between the pipe and sewer manhole sections. Premolded elastomeric sealed joints shall be A-Lok, Res-Seal, Press-Wedge II, Lock Joints Flexible Manhole Sleeve, or Kor-N-Seal Joint Sleeve.

B. Mortar shall be used between pipe and structure in the storm drainage systems. Mortar mix shall be as specified herein.

C. Manholes shall be manufactured with knockout panels for future pipe connections/ extensions at the locations shown on the Contract Drawings.

**2.06 - MANHOLE FRAMES AND COVERS**

A. Manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

B. Bolted and gasketed manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

**2.07 - BRICK**

A. Brick shall conform to ASTM C32 and shall be new, water struck, first quality, whole, sound brick.

B. For tables and inverts, Type SS shall be used with cement mortar (no lime).

**2.08 - MORTAR**

A. Mortar shall be composed of one-part Portland cement to two parts sand with 20 percent hydrated lime.

B. Portland cement shall conform to the requirements of ASTM C150. Sand shall conform to the requirements of ASTM C144. Hydrated lime shall conform to the requirements of ASTM C207.

**2.09 - WATER**

A. Water shall be clean, fresh and free from organic matter, oil, acid, alkali, or deleterious substances.

**2.10 - BEDDING MATERIAL**

A. Bedding material under structures herein shall be as detailed and as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

**2.11 - CONCRETE**

A. Concrete for tables, inverts, paved invert fillings, encasements, floor fillings and similar items shall be as specified in DIVISION 3, CONCRETE.

**2.12 - POLYVINYL CHLORIDE PIPE**

A. Polyvinyl Chloride pipe for drop manhole connections shall conform to ASTM D3034 and shall be SDR35.

**2.13 - MID LEVEL PLATFORM**

A. All manholes with a depth of 20-feet or greater from rim to invert shall have installed at the midpoint of the manhole a mid-level platform. The mid-level platform shall be installed in accordance with the details on the Contract Drawings.

**2.14 - MANHOLE ADJUSTING RINGS – Not Used**

**2.15 - MANHOLE ENCAPSULATION SYSTEM**

A. All manholes shall be installed with an external manhole encapsulation system that seals: (1) the interface between the precast concrete manhole and the frame and cover and (2) all manhole joints which are located below groundwater.

B. The manhole encapsulation system shall be designed to prevent leakage of water into the manhole and shall be either one of the following:

1. The manhole encapsulation system shall be a heat shrinkable wraparound sleeve system and shall have an overall thickness of 0.100-inches with a minimum width of 12-inches. The manhole encapsulation shall be "Wrapid Seal Manhole Encapsulation System" as manufactured by Canusa, A Division of Shaw Pipe Resources, Riser-Wrap as manufactured by Pipeline Seal and Insulator, Inc. or equal.

2. The manhole encapsulation system shall be a rubber sleeve made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils with a minimum width of 12-inches. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of ¼-inch. The manhole encapsulation shall be "Infi-Shield Seal Wrap" as manufactured by Sealing System, Inc. or equal.

**2.16 - CARBON ODOR CONTROL UNIT – Not Used**

**PART 3 - EXECUTION**

**3.01 - PRECAST REINFORCED CONCRETE STRUCTURES**

A. Precast Reinforced Concrete Structures shall be installed as shown on the Contract Drawings and at a maximum spacing of 300 linear-feet. Precast sections shall be installed so that the entire structure is vertically plumb and the steps are in a true line. All erection holes and horizontal joists shall be filled solid with non-shrinking grout. The top uppermost precast section shall be set at a grade that will allow for the installation of a minimum of two courses and a maximum of five courses of manhole adjusting rings prior to setting the cast iron frame and cover. Furnish and use suitable slings, hooks and cables for the proper handling of the sections.

B. Surfaces of sewer pipe to be bonded to cast-in-place concrete bases shall be cleaned of all dust, dirt, grease, laitance, and loose or spalling concrete and given, where applicable, a coat of bonding compound in conformance with the sealant or gasket manufacturer's recommendations.

C. Tables and inverts shall be constructed of brick and concrete for sewer manholes, and of concrete for drain manholes as shown on the Contract Drawings. The size and shape of the invert shall accurately conform to the adjoining sewer or drains pipes. Any change in size or direction shall be even and as gradual as possible. Concrete floor filling for chemical or process pullbox sumps shall be as shown on the details.

D. Knockout panels for future sewer extensions shall be manufactured into precast manhole, as specified above, at the locations shown on the Contract Drawings. Stubs shall not be used.

**3.02 - MANHOLE COVERS AND FRAMES**

A. In paved surfaces, grates, covers and frames shall be set 1/4-inch below the finish grade of the roadway utilizing cement mortar to hold the frame in place, as shown of the Contract Drawings.

B. The temporary roadway surface elevation shall be maintained and the grates, frames, and covers shall be set 3/4-inch above the grade of the temporary resurfacing utilizing either cement mortar or bituminous concrete to hold the frame in place. A slope, constructed of bituminous concrete pavement, shall be placed around the entire grate, frame and cover for a distance of 6-inches from the grate, frame and cover.

C. Any voids created in the road gravel or pavement when raising the grate, frame and cover from its temporary elevation to its permanent elevation shall be filled with concrete.

**3.03 - DROP CONNECTIONS**

A. Drop connections shall be installed for manholes, which have invert elevation differences greater than 3-feet. No exterior drop connections are allowed.

B. Drop connections for manholes shall be constructed utilizing polyvinyl chloride pipe, elastomeric sealed joints, and Type 316 stainless steel mounting hardware and materials. Drops shall be constructed in accordance with the Contract Drawings.

C. The size of the drop piping shall be 8-inches when the size of the sewer main is less than 24-inches. When the sewer main is equal to or larger than 24-inches, the drop piping shall be 12-inches in diameter.

**3.04 - LEAKAGE TESTS**

A. Leakage tests shall be made and observed by the Engineer on each sewer manhole. The test shall be an exfiltration, infiltration test or vacuum test made as described below:

1. Preparation for Testing

a. After the manhole has been assembled in place, all lifting holes and horizontal joints shall be filled and pointed with a non-shrinking mortar. The test shall be made prior to placing the tables and invert and before filling and pointing the horizontal joints.

b. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and plugs braced to prevent blow out.

2. Backfilling

a. The test may be conducted before backfilling around the manhole.

b. There will be adjustment in the leakage allowance for unknown causes including, but limited to, leaking plugs and absorption. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3. The Contractor has the option of test method depending upon the actual field conditions. The following are acceptable test methods:

a. If the measured ground water table is above the highest joint in the manhole, and if there is not leakage into the manhole as determined by the Engineer, the Contractor may perform an infiltration or vacuum test as described herein.

b. If the measured ground water table height is lower than the invert of the manhole, the Contractor may perform an exfiltration or a vacuum test.

**3.05 - TEST PROCEDURES**

A. Infiltration Test

1. The manhole interior shall be visually inspected. The manhole shall be considered acceptable for use when no infiltration of ground water is observed on the interior surfaces of the manhole.

B. Exfiltration Test

1. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole shall be considered satisfactorily watertight.

2. If the test as described above is unsatisfactory as determined by the Engineer or if the manhole excavation has been backfilled the test shall be continued. A period of time may be permitted, if the Contractor so wishes, to allow for absorption.

3. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least 8 hours shall begin. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period.

4. If the test fails, but the leakage does not exceed 3 gallons per vertical foot per day, repairs shall be made in accordance with industry standard repair methods as to bring the leakage within the allowable rate of 1 gallon per vertical foot per day. If the leakage exceeds 3 gallons per vertical foot per day, it shall be the Contractor's responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it as required, at no cost to the Owner. The manhole shall then be retested.

C. Vacuum Test

1. If the vacuum test is performed in lieu of the infiltration or exfiltration test the Contractor shall take any and all steps necessary to assure the Engineer that the water table is below the invert of the manhole throughout the test. Any and all measures necessary by the Contractor to lower the ground water table below the invert of the manhole will be at the Contractor's expense. The vacuum test shall be based on the following criteria:

   a. Manhole test pressures and time shall be as follows:

      (1) Initial test pressure, 10-inches Hg (i.e., 20-inch absolute).

      (2) Test time, 1-inch Hg drop to 9-inch Hg in 2 minutes minimum allowable, for 0 to 10-foot-deep manholes; 2-1/2 minutes minimum allowable for 10 foot to 15 foot deep manholes; 3 minutes minimum allowable for manholes greater than 15 foot in depth.

   b. If the pressure drop exceeds 1-inch Hg in 2 minutes the manhole shall be repaired and retested.

   c. If a manhole fails to meet a 1-inch Hg drop in 1 minute after repair, the manhole shall be water exfiltration tested and repaired as necessary.

   d. Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal. Vacuum testing draws together the joint and applies high pressure to the elastomeric joint material. Properly placed and sized elastomeric joint material must be used to avoid leakage or to enable sections to be separated if necessary to affect a repair.

**3.06 - MANHOLE ADJUSTING RINGS – Not Used**

**3.07 - MANHOLE ENCAPSULATION SYSTEM**

A. The external manhole encapsulation system shall be installed in accordance with the manufacturer’s written instructions. All surfaces shall be free of dirt, sharp points and preheated to remove moisture.

B. The Contractor’s personnel shall be trained by the manufacturer in the proper method of application of the external manhole encapsulation system. The Contractor shall have the manufacturer’s field service representative present during the application of external manhole encapsulation system on the first two manholes encapsulated.

**3.08 - VISUAL INSPECTION**

A. At the conclusion of the work, all manholes, catch basins, handholes and pull boxes shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All manholes, catch basins, handholes and pull boxes that are not straight and plumb shall be removed and replaced.

**3.09 - CLEANUP**

A. Upon completion, of all construction and testing, and prior to final acceptance all debris shall be removed from manholes and the tables cleaned.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 02890**

**TRACER WIRE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide tracer wire as specified and/or as shown on the drawings.

B. Tracer wire shall be installed on the 8-inch Raw Wastewater, 8-inch Effluent and Fiber Optic Conducts from Structure 10 – Wastewater Treatment Facility to the Limit-of-Work with Contract 2019-02, Downtown Area Collection System and Pumping Stations.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

D. The Work of this section shall be provided by the General Contractor.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Brochures and/or Catalogue Cuts including materials of construction, dimensions, minimum submergence requirements, etc.

2. Shop Drawings, including all equipment and components

3. Installation instructions

4. Manufacturer's Data

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

## PART 2 - PRODUCTS

### 2.01 - GENERAL

A. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.

B. All trace wire shall have HDPE insulation intended for direct bury, green color coated per APWA standard for a sewer utility being marked.

### 2.02 - TRACER WIRE

A. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

B. Directional Drilling/Jacking/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

### 2.03 - CONNECTORS

A. All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

B. Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure.

C. Non locking friction fit, twist on or taped connectors are prohibited.

### 2.04 - TERMINATION/ACCESS

A. All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

B. All grade level/in-ground access boxes shall be appropriately identified with “sewer” cast into the cap and be color coded.

C. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.

D. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.

E. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

F. Gravity Sewers and Force Mains - Trace wire must terminate at grade level/in- ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway as approved by the Engineer.

G. Long-runs of Force Main, in excess of 500 linear feet. Trace wire access must be provided with a grade level/in-ground trace wire access box, located at the edge of the road right-of- way, and out of the roadway as approved by the Engineer. The grade level/in-ground trace wire access box shall be delineated using a minimum 48-inch polyethylene marker post, color coded green per APWA standard for the specific utility being marked.

### 2.05 - GROUNDING

A. Trace wire must be properly grounded at all dead ends/stubs

B. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum

C. 1.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.

D. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.

E. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.

F. Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. All materials and equipment shall be installed in a neat, workmanlike manner. The Contractor shall unpack all items and dispose of all unwanted packing materials.

B. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

C. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

D. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

E. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5’ intervals.

F. Trace wire must be properly grounded as specified.

G. Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace wire Termination/Access)

H. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)

I. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead- end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.

J. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

K. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.

L. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

M. Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.

N. Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.

**3.02 - PROHIBITED PRODUCTS AND METHODS**

A. The following products and methods are:

1. Uninsulated trace wire;
2. Trace wire insulations other than HDPE;
3. Trace wires not domestically manufactured;
4. Non locking, friction fit, twist on or taped connectors;
5. Brass or copper ground rods;
6. Wire connections utilizing taping or spray-on waterproofing;
7. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another;
8. Trace wire wrapped around the corresponding utility;
9. Brass fittings with trace wire connection lugs;
10. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.; and
11. Connecting trace wire to existing conductive utilities.

**3.03 - TESTING**

A. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

B. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

C. Continuity testing in lieu of actual line tracing shall not be accepted.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700 – CONTRACT CLOSEOUT.

**END OF TEXT**

See Attached Figures

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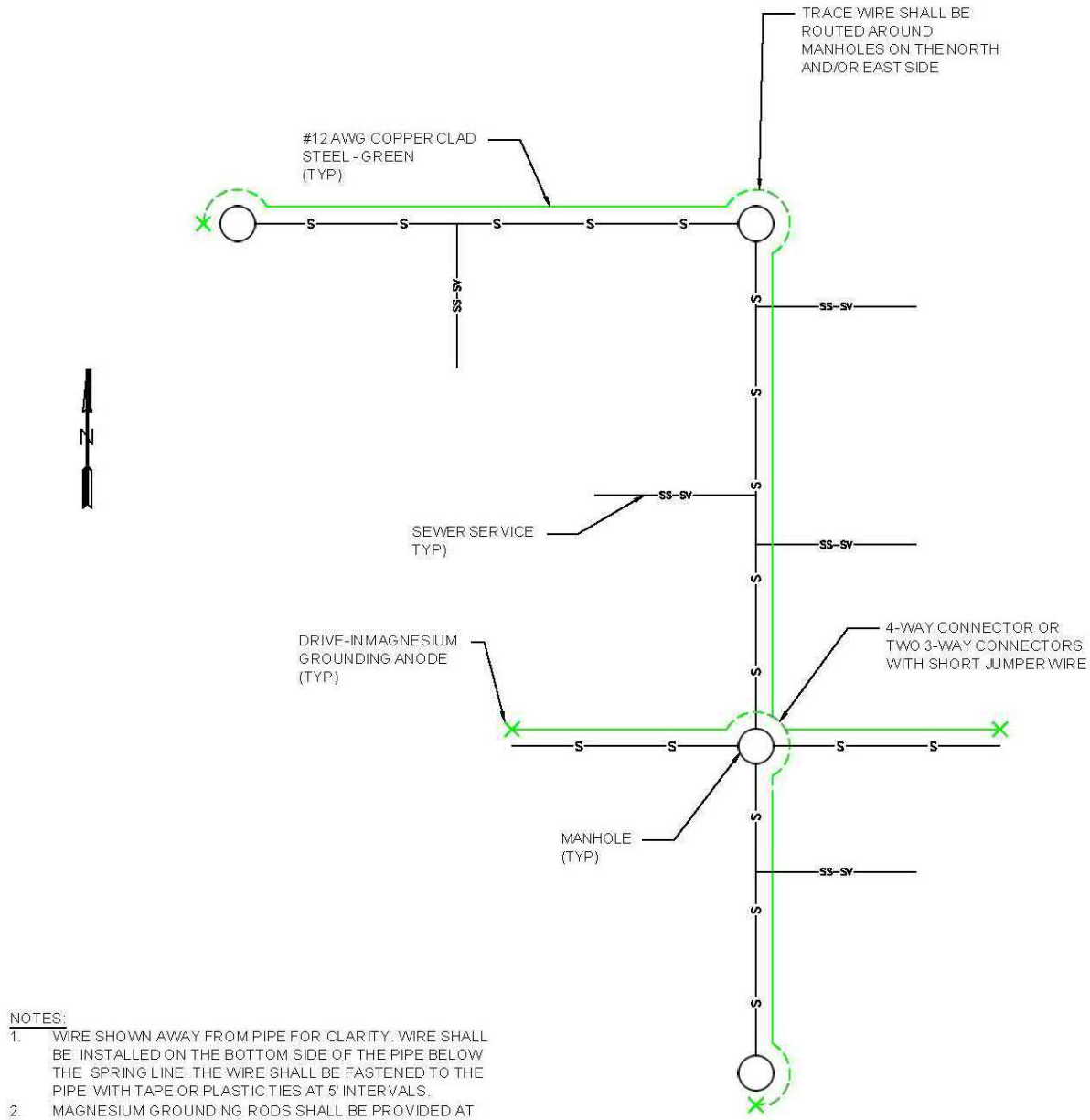
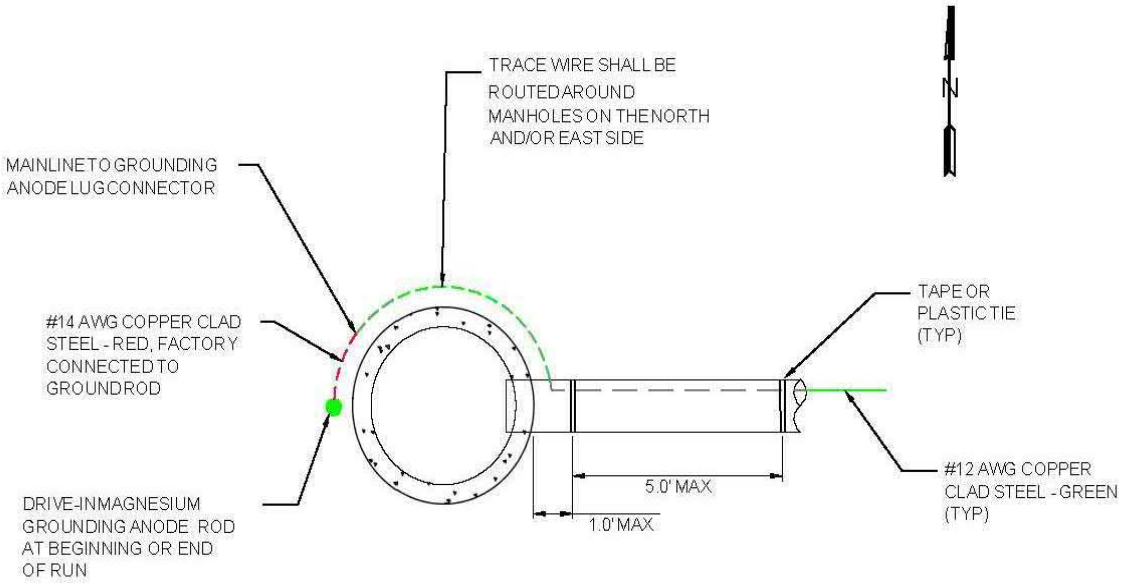


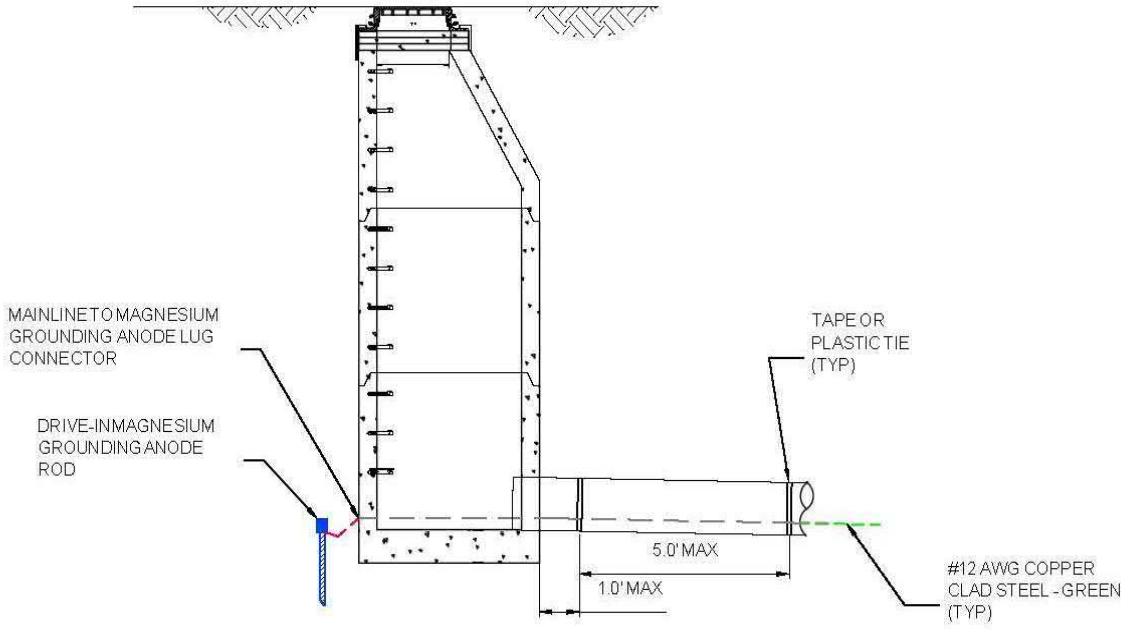

NOTES:
1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE BOTTOM SIDE OF THE PIPE BELOW THE SPRING LINE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.
2. MAGNESIUM GROUNDING RODS SHALL BE PROVIDED AT THE END OF EACH PIPE RUN.
3. MAXIMUM DISTANCE BETWEEN ACCESS BOXES SHALL BE 500 L.F.
4. SIMILAR FOR FORCE MAINS AND LOW-PRESSURE SEWER LINES.

TRACE WIRE PLAN (SEWER)
NO SCALE




SEWER MANHOLE - PLAN VIEW

NO SCALE




SEWER MANHOLE - SECTION VIEW

NO SCALE

**SECTION 03100**

**CONCRETE FORMWORK**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Provide design and furnish materials for fabricating, erecting and removing formwork, false work and shoring for cast-in-place concrete as shown on the contract drawings and specified herein for a complete installation. The use of stay-in-place forms is expressly prohibited.

B. Use formwork to cast all cast-in-place concrete structures.

C. Provide and remove all formwork for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under specified under those disciplines.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Layout of panel joints and tie hole pattern for architectural formwork.
2. Form Ties: Submit data sheets for form ties proposed for use.
3. Form Ties-Tapered Through-Bolts: Proposed method of sealing and patching form tie holes.
4. ANSI/NSF 61 Certification that form release agents proposed for use in structures to contain potable water are non-toxic and have no adverse effect on the quality or appearance of potable water.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Contractor shall arrange deliveries of materials and equipment in accordance with construction Progress Schedule, coordinate to avoid conflict with Work and conditions at Project site.

C. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the work.

D. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure.

**1.06 - DESIGN CRITERIA**

A. Design formwork in conformance with methodology of ACI 347R for anticipated loads, lateral pressures, depth of concrete placement and rate of concrete placement. Design shall consider any special requirements due to the use of self consolidating, plasticized and/or retarded set concrete. All forms and shoring shall be designed at the contractor's expense.

B. Qualifications

1. Formwork Designer: Formwork, false work, and shoring design shall be by an engineer licensed in the state where the Project is located.

C. Quality Assurance

1. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

2. Design of Formwork

a. The Contractor shall assume responsibility for the design, engineering and construction of formwork. Forms shall be designed to produce concrete members identical in shape, lines and dimensions to members shown on the Contract Documents.

b. When high range water reducer (superplasticizer) is used in concrete mix or when self consolidated concrete is specified, forms shall be designed for full hydrostatic pressure per ACI 347.

c. The formwork shall be designed for the loads and lateral pressures in accordance with ACI 347 and wind loads as specified by the local building code.

d. Construction and contraction joints, openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, waterstops, anchorages, inserts, and other features shall be provided.

e. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

f. The maximum panel deflection shall be L/360 of the span between structural members.

3. Unless otherwise specified herein, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.

4. Materials, fabrications and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional cost to the owner.

**1.07 - REFERENCES**

A. American Concrete Institute (ACI):

1. 117/117R: Standard Tolerances for Concrete Construction and Materials.
2. 309.2R: Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces.
3. 318/318R: Building Code Requirements for Structural Concrete and Commentary.
4. 347: Guide to Formwork for Concrete.
5. 350/350R: Code Requirements for Environmental Concrete Structures and Commentary.

B. Engineered Wood Association (APA)

C. National Institute of. Product Standards and Technology

1. Voluntary Product Standard PS 1 Structural Plywood

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - LUMBER**

A. Lumber used in form construction shall be Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.

**2.02 - PLYWOOD**

A. Only grade-marked plywood conforming to APA shall be provided.

B. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS 1 Structural Plywood.

C. Thickness shall be sized to maintain alignment and surface smoothness, but not less than 5/8-inch thick.

**2.03 - STEEL FORMS**

A. Commercial grade sheets not less than 16 gage shall be provided.

B. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

**2.04 - FORM MATERIAL LOCATIONS**

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

B. Column Forms:

1. Rectangular Columns: As specified for walls.
2. Circular Columns: Fabricated steel or fiber reinforced plastic with bolted together sections or spirally wound laminated fiber form internally treated with release agent for height of column.

C. All Other Forms: Materials as specified for wall forms.

D. Rustication Grooves and Chamfer Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

**2.05 - FORM TIES**

A. Locate form ties on exposed surfaces in a uniform pattern. Place form ties so they remain embedded in the concrete except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Construct form ties so that no metal is within 1 1/2 inches of the concrete surface when the forms, inserts, and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

B. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 1/2 inches and sufficient dimensions to permit patching of the tie hole.

C. Tapered form ties shall be tapered through-bolts or through-bolts that utilize a removable tapered sleeve.

D. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

1. Integral steel water stop 0.103-inch thick and 0.625 inch in diameter tightly and continuously welded to tie.

2. Neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.

E. Elastic Vinyl Plug:

1. Design and size of plug shall allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal forming watertight seal.

2. Manufacturer:

a. Dayton Superior; A58 Sure Plug.

b. Or equal.

F. Mechanical EPDM Rubber Plug:

1. Mechanical plug for taper tie

2. Manufacturers:

a. Sika Greenstreak, St. Louis, MO; X-Plug

b. Or equal.

3. Friction fit plugs will not be allowed.

**2.06 - BOND BREAKER**

A. Bond breaker shall be a V.O.C.-compliant nonstaining type that will provide positive bond prevention.

B. Manufacturers:

1. Edoco Burke; Clean Lift 90 W.B..

2. Nox-Crete, Inc.; Silcoseal 97EC.

3. Or equal.

**2.07 - FORM LINERS**

A. Form liners shall be provided as shown on documents.

B. Products:

1. Dura-Tex; Symons Corporation.

2. Or equal.

**2.08 - RUSTICATIONS**

A. Rustications shall be provided as shown on documents.

B. Products:

1. Rustications; Symons Corporation.

2. Or equal.

**2.09 - FORM CAULKING**

A. Form caulking shall be a one-component, gun-grade silicone sealant that is capable of producing flush, watertight and non-absorbent surfaces and joints. Sealant shall be compatible with the type of forming material and concrete ingredients used.

B. Products:

1. Series 1200 Construction Caulking; GE Silicones.

2. Dow Corning 999-A; Dow Corning Co..

3. Or equal.

**2.10 - CHAMFER STRIPS**

A. Provide 3/4-inch by 3/4-inch chamfer strips milled from clear, straight-grain pine, surfaced each side or extruded vinyl type with or without nailing flange unless otherwise shown on the Contract Documents.

**2.11 - INSERTS**

A. Provide galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps.

**2.12 - DOVETAIL ANCHOR SLOTS**

A. Provide dovetail anchor slots manufactured from 22 gage, galvanized steel with removable felt or polyurethane.

**2.13 - FORM RELEASE AGENT**

A. Form release agent shall not bond with, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces. Form release agent shall be a ready-to-use water-based material formulated to reduce or eliminate surface imperfections and containing no mineral oil or organic solvents.

B. Certified as meeting the requirement of ANSI/NSF 61 for contact with potable water.

C. Manufacturers and Products:

1. BASF; MBT, Rheofinish 211.

2. Cresset Chemical Company; Crete-Lease 20-VOC.

3. Unitex Chemicals; Farm Fresh.

4. Symons Corporation: Magic Kote

5. Or equal.

## PART 3 - EXECUTION

### 3.01 - FORM TOLERANCES

A. Comply with the requirements of ACI 117 for tolerances for formed surfaces except as specified in Table 03100-1.

| TABLE 03100-1 | |
|---|---|
| Vertical alignment (plumbness) | 1/4 inch in any 10 feet and 1 inch maximum for entire length |
| Variation in the lines and surfaces of foundation mats, base slabs and walls | 1/4 inch in any 10 feet and 1 inch max. for entire length |
| Variation from the level or from the grades indicated on the drawings | 1/4 inch in any 10 feet |
| Variation of the linear building lines from established position in plan | 1/2 inch in any 20 feet and 1 inch maximum for entire length |
| Variation of distance between walls | 1/4 inch in any 10 feet and 1 inch maximum for entire length and height |
| Variation in the sizes and locations of sleeves, floor openings and wall openings | Minus 1/4 inch<br>Plus 1/2 inch |
| Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls | Minus 1/4 inch<br>Plus 1/2 inch |
| Offset between adjacent panels of formwork facing material | 1/2 inch (ACI 117 Class C finish). |
| Offset between adjacent panels of formwork facing material for exposed surfaces where appearance is of importance | 1/8 inch (ACI 117 Class A finish). |

B. Tolerances are not cumulative

C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

### 3.02 - PREPARATION

A. Clean form surfaces to be in contact with concrete of foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.

C. Keep form coatings off steel reinforcement, items to be embedded, and previously placed concrete.

D. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

E. Form liners for architectural concrete finish shall be installed in accordance with the manufacturer’s recommendations.

**3.03 - ERECTION AND INSTALLATION**

A. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise indicated on the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits in ACI 117 and herein specified.

B. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.

C. Provide one cleanout and inspection opening 12 inches wide by 18 inches high every 7 feet at the bottom of each lift of forms.

D. Provide exterior corners of concrete members with chamfers as specified.

E. Provide means for removing forms without injury to the surface of finished concrete.

F. Do not embed any form-tying device or part thereof other than metal in the concrete.

G. Locate large end of taper tie on the "wet" side of the wall.

H. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.

I. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add 2 inches of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

J. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with additional reinforcement as shown in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

K. Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

**3.04 - PROTECTION**

A. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

**3.05 - PIPES AND WALL CASTINGS CAST IN CONCRETE**

A. Install wall castings, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall castings or anchors to the reinforcing steel.

B. Pipes or wall castings located below operating water level shall have water stop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast unless permitted, authorized or directed by the Engineer. Pipes fitted with thrust rings shall be cast in place.

**3.06 - REMOVAL OF FORMS**

A. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties and bracing shall not be removed without specific permission of the Contractor's Registered Professional Engineer.

B. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed; during which the air surrounding the concrete is above 50 degrees F.

| TABLE 03100-2 | |
|---|---|
| Sides of footings and encasements;<br>Walls;<br>Vertical sides of slabs, beams, girders; Columns;<br>Similar members not supporting loads. | 24 hours |
| Bottom forms of slabs, beams, and girders; and shoring for slabs, beams, and girders with immediate reshoring. | Until concrete strength reaches 70 percent specified 28-day strength |
| Bottom forms of slabs, beams, and girders; and shoring for slabs, beams, and girders without reshoring | Until concrete strength reaches specified 28-day design strength |

C. Removal times will be increased if the concrete temperature following placement is permitted to drop below 50 degrees F.

D. Do not remove supports and reshore.

**3.07 - PATCHING OF TAPERED TIE HOLES**

A. Clear tie hole of all loose debris with a taper tie void brush and flush debris from tie hole with air or water.

B. Install plug from larger tie hole end in accordance with manufacturer’s instructions using an insertion tool as recommended by the manufacturer.

C. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.

**3.08 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03200**

**CONCRETE REINFORCEMENT**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Concrete Reinforcement as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide concrete reinforcement as indicated and specified including:

1. Reinforcement bars.
2. Welded wire reinforcement.
3. Reinforcement accessories.

D. Provide concrete reinforcement for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under those disciplines.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit bar lists and placing drawings for all reinforced concrete and masonry structures in accordance with SECTION 01300, SUBMITTALS.
2. Detail reinforcement in conformance with ACI 315.
3. Clearly indicate bar sizes, spacing, locations, quantities and total weight of reinforcement steel and wire reinforcement, bending schedules, and supporting and spacing devices. Show joints, with applicable joint reinforcement and waterstops.
4. Coordinate bar splicing and placement with Contractor’s concrete placing schedule and joint locations. Do not add or delete joints without permission from the Engineer.
5. Show wall reinforcement in elevation. Show entire elevation of wall from top to bottom and end to end. Do not show partial elevations. Show all dowels, joints and pockets in walls.
6. Show slab reinforcement in plan view. Show all dowels, joints, openings and recesses in slabs.
7. Show location and size of all penetrations greater than 12-inches in diameter or least dimension of the opening with the corresponding added reinforcement around the penetrations.
8. Clearly show marking for each reinforcement item.
9. Indicate locations of reinforcement bar cut-offs, splices and development lengths.

C. Submit certified copies of mill test reports of reinforcement analysis dated within the last three months for each shipment of reinforcement with specific lots in shipments identified.

D. Chemical composition of reinforcement steel: Ladle analysis indicating percentage of carbon, phosphorous, manganese and sulfur present in steel.

E. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit Manufacturer's literature that contains instructions and recommendations for installation for each type of coupler used; certified test reports that verify the load capacity of each type and size of coupler used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

F. Unless otherwise acceptable to the Engineer, each submittal shall include reinforcement only for a single structure or part thereof. Shop drawings depicting multiple structures on the same sheet are not acceptable.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. Keep reinforcement steel free from mill scale, rust, dirt, grease or other foreign matter.

C. Ship and store reinforcement steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placing drawings.

D. Store reinforcement steel off the ground, protected from moisture and kept free from dirt, oil or other injurious contaminants.

**1.06 - DESIGN CRITERIA**

A. Do not fabricate reinforcement until shop and placement drawings have been reviewed and accepted by the Engineer.

B. Perform concrete reinforcement work in accordance with CRSI Manual of Practice and ACI 315**.**

C. An independent testing agency accepted by Engineer shall visually inspect and test reinforcing steel welds in accordance with AWS D1.4/D1.4M.

D. An independent testing agency accepted by Engineer shall inspect each mechanical coupler and verify each component is installed in accordance with Manufacturer's instructions and ICC Evaluation Services Report or equivalent code agency report.

**1.07 - REFERENCES**

A. ASTM International (ASTM)

1. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
4. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
5. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. ASTM A1064/A1064M - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

B. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 350 - Building Code Requirements for Environmental Engineering Concrete Structures

C. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI Manual of Standard Practice.

2. CRSI Placing Reinforcing Bars.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - INSPECTION AND TESTING**

A. In no case shall any reinforcement steel be covered with concrete until the installation of the reinforcement has been observed by the Engineer and the Engineer's authorization to proceed with the concreting has been obtained. The Engineer shall be given a minimum of 48 hours prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished observations of the reinforcement steel.

B. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement. Notify Engineer of commencement and duration of shop fabrication, in sufficient time to allow for proper inspection.

**PART 2 - PRODUCTS**

**2.01 -REINFORCEMENT STEEL**

A. Reinforcement Steel: ASTM A615/A615M, 60 ksi yield grade; deformed billet steel bars.

B. Reinforcement Steel to be Welded: ASTM A706/A706M, 60 ksi yield strength; deformed low-alloy steel bars.

C. Reinforcement Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A1064, Grade 60; steel bars or rods, unfinished.

D. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A1064.

E. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

F. Welded Wire Reinforcement:

1. Provide welded wire reinforcement conforming to ASTM A1064 in flat sheets.

2. Provide deformed welded wire reinforcement conforming to ASTM A1064 in flat sheets.

3. Provide support bars and reinforcement bar supports as specified herein to obtain the concrete cover indicated.

**2.02 - ACCESSORY MATERIALS**

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: sized and shaped for strength and support of reinforcement during concrete placement including load bearing pad on bottom of base slabs and slabs on grade to prevent puncturing the vapor retarder.

C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel, stainless steel or plastic type; size and shape as required.

D. Provide 3-inch by 3-inch plain precast concrete blocks, precast concrete doweled blocks or concrete brick for support of bottom reinforcement in foundation mats, base slabs, footings, pile caps, grade beams and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated.

E. Mechanical Couplers

1. Reinforcement Tension Bar Splicers:

a. Cadweld or Lenton rebar splicers by Erico Products, Inc. and Dayton Barsplice, Inc., or equal.

b. DB-SAE splicer system by Richmond Screw Anchor Company, Inc., C2D rebar flange coupler by Williams Form Engineering Corporation and Lenton Form Saver by Erico Products, Inc., or equal.

c. Develop minimum 125 percent of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and A615.

F. Reinforcement Compression Bar Splicers:

1. Manufacturers: G-Loc splicers by Gateway Building Products Division

2. Speed-Sleeve by Erico Products, Inc.

G. Provide epoxy for grouting reinforcement bars specifically formulated for such application for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in SECTION 03600, GROUT.

**2.03 - FABRICATION**

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Standard Practice, ACI 315 and ASTM A184/A184M.

B. Weld reinforcement in accordance with AWS D1.4 only when permitted by the Engineer.

C. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.

D. Cold bend bars. Do not straighten or rebend bars.

E. Do not heat reinforcement steel to bend or straighten.

F. Bend bars around a revolving collar having a diameter of not less than that recommended by ACI 318.

G. Cut bar ends that are to be butt spliced, or threaded by saw cutting. Terminate such ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

B. Do not displace or damage vapor retarder.

C. Position dowels accurately. Rigidly support, align and securely tie dowels normal to the concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.

D. Position wall dowels projecting from base slabs on grade with templates or guides held in place above the concrete placement line. Position the templates to obtain the required clearance between the dowels and the face of the walls.

E. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.

F. Do not extend continuous reinforcement or other fixed metal items through expansion joints. Provide 2 inches clearance from each face of expansion joint.

G. Provide additional reinforcement bars to support top reinforcement in slabs. Do not shift reinforcement bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.

H. Support reinforcement steel in accordance with CRSI “Placing Reinforcement Bars” with maximum spacing of 4-feet-0-inches.

I. Tie reinforcement steel at intersections in accordance with CRSI “Placing Reinforcement Bars”:

1. Maximum tie spacing for footings, walls and columns: every third intersection or 3 feet.

2. Maximum spacing for slabs and other work: every fourth intersection or 3 feet.

3. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, pile caps, slabs on grade and elevated slabs.

4. Secure all dowels in place before placing concrete.

5. Tie wires shall be bent away from the forms and from finished concrete surfaces in order to provide the required concrete coverage.

J. Locate reinforcement to avoid interference with items drilled in later, such as concrete anchors.

K. Extend welded wire reinforcement to within 2 inches of edges of slab or section. Lap sheets at least 12 inches or two wire spaces, whichever is greater, at ends and edges and wire tightly together. Stagger end laps.

L. Unless shown otherwise on Drawings, place welded wire reinforcement in slabs on grade between the upper third point and mid-point of slab. Placing welded wire reinforcement on the subgrade and pulling it up during concrete placement is not permitted.

M. Support welded wire reinforcement placed over the ground on wired concrete blocks spaced not more than 3 feet on centers in any direction.

N. Support welded wire reinforcement placed over horizontal forms on slab bolsters spaced not more than 30 inches on center.

O. Mechanical coupler systems may be substituted for dowels at Contractor's option when permitted by Engineer.

P. Provide additional reinforcement bars to support ties and stirrups in beams where top reinforcement is not continuous.

Q. Securely support and tie reinforcement steel to prevent movement during concrete placement.

R. Unless otherwise shown on the Drawings or permitted by the Engineer, do not bend reinforcement bars that project from in-place concrete.

S. Do not weld reinforcement steel bars (including tack welded) either during fabrication or erection. Immediately remove bars that have been welded, including tack welds, without such permission from the work.

T. Reinforcement steel interfering with the location of other reinforcement steel, conduits or embedded items may be moved up to 3 inches. Make greater displacement of bars to avoid interference only with the permission of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior permission from the Engineer.

U. Setting bars and welded wire reinforcement on layers of fresh concrete as the work progresses or adjusting reinforcement during the placement of concrete is prohibited.

V. Provide and place safety caps on all exposed ends of vertical reinforcement that pose a danger to injury or life safety.

**3.02 - REINFORCEMENT AROUND OPENINGS AND PENETRATIONS**

A. Accommodate placement of formed openings and penetrations.

B. Unless specific additional reinforcement around openings and penetrations is shown on the Drawings, provide additional reinforcement steel on each side of opening or penetration equivalent to one half of the cross-sectional area of the reinforcement steel interrupted by an opening or penetration. The bars shall have sufficient length to be fully developed at each end beyond the opening or penetration.

C. Refer to details on Drawings for additional diagonal bars around openings or penetrations and bar extension length on each side of openings or penetrations.

**3.03 - SPLICING OF REINFORCEMENT**

A. Splices may be used to provide continuity due to bar length limitations. Do not splice reinforcement that is detailed to be continuous in the Drawings.

B. Provide tension lap splices at all laps in compliance with ACI 318. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Use Class B splices at all other locations.

C. Except as otherwise indicated on the Drawings, stagger splices in circumferential reinforcement in circular walls using Class B tension splices. Do not splice adjacent bars within the required lap length.

D. Make splices for reinforcement in tension tie members, with a full mechanical splice and staggered at least 30 inches.

E. Make splices in column spiral reinforcement, when necessary, by a lap of 1-1/2 turns.

F. Reinforcement shall be continuous through construction joints.

G. Reinforcement may be spliced at construction joints provided that entire lap is placed within only one concrete placement.

**3.04 - ACCESSORIES**

A. Provide accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcement steel is to be supported over soil.

C. Provide stainless steel bar supports or steel chairs with plastic tips where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity or liquid (including bottom of slabs over liquid containing areas) unless otherwise noted on contract documents.

D. Do not use metal chairs, ferrous clips, nails, etc. that extend to the surfaces of the concrete. Do not use stones, brick or wood block supports.

E. Do not use alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcement steel fastened to the bottom and top mats unless permitted by the Engineer.

F. Mechanical Couplers:

1. Couplers that are located at a joint face can be a type that can be set either flush or recessed from the face as indicated.

2. Seal couplers during concrete placement to completely eliminate concrete or cement paste from entering.

3. Recess couplers intended for future connections a minimum of 1/2 inch from the concrete surface. After the concrete is placed, plug the coupler with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

4. Unless indicated otherwise, provide mechanical coupler spacing and size to match the spacing and size of the reinforcement indicated for the adjacent section.

**3.05 - FIELD QUALITY CONTROL**

A. Remove reinforcement with kinks or bends not shown on shop or placement drawings. Remove such reinforcement from job site and replace with new fabricated steel. Do not field bend of reinforcement unless reinforcement is indicated or specified to be field bent.

B. Protect reinforcement from rusting, deforming, bending, kinking and other injury. Clean in-place reinforcement that has rusted, or been splattered with concrete using sand or water blasting prior to incorporation into the Work.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03250**

**CONCRETE JOINTS AND ACCESSORIES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Concrete Joints and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.
2. Submit one sample of each type of water stop.
3. Submit layouts for joints.
4. Certification that materials used within the joint system are compatible with each other.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

E. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

F. Store expansion joint compounds in a dry location where they cannot freeze.

G. Store plastic products under cover in a dry location, out of direct sunlight.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

B. Do not add, relocate or omit joints without written permission from the Engineer.

C. Reject material exceeding expiration date for use.

D. Clean concrete surfaces to receive expansion joint compound in accordance with the printed instructions of the joint compound manufacturer.

E. In structures to contain potable water, use joint materials that are ANSI/NSF 61 approved for contact with potable water.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.
2. C920: Specification for Elastomeric Joint Sealants
3. C1193: Guide for Use of Joint Sealants
4. D1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Environmental Protection Agency (EPA):

1. 40 CFR 59: National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

C. Corps of Engineers:

1. CRD-C 572: Specifications for Polyvinylchloride Waterstop.

D. Federal Specifications:

1. TT-S-00230C: Sealing Compound: Elastomeric Type, Single Component

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - MANUFACTURER'S SERVICES**

A. Prior to joint preparation for joints receiving sealant materials, require joint manufacturer's technical representative to demonstrate, on site, joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

**PART 2 - PRODUCTS**

**2.01 - ELASTOMERIC JOINT SEALANT**

A. Federal Specification TT-S-00230C Type 1, Class A, single component, cold applied, pourable, polyurethane.

1. Products:

a. Euclid Chemical Corp; Eucolastic 1

b. Mameco ; Vulkem 45

c. Or equal.

**2.02 - JOINT SEALANT FOR CONCRETE STRUCTURES**

A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water. Troweling of sealants into joints will not be permitted. Sealant shall meet requirements in Table 03250-1.

**TABLE 03250-1**

| Characteristic or Parameter | Technical Requirements |
|---|---|
| Pot life | 1 to 3 hours |
| Hardness | 35 Shore A, +/- 5 |
| Elongation | 650 percent, ASTM D412 |
| Tensile strength | 200 psi, ASTM D412 |
| Peel strength on concrete | No adhesion loss at 25 pounds |
| Temperature service range | 40 to 167 degrees F |
| Immersion in water | Continuous |

B. Products:

1. Tremco; Vulkem 227 or Vulkem 245 (for Type M, Grade P, Class 25)

2. Sika Corporation; Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL

3. Or equal.

C. For applications on walls and surfaces inclined more than 30 degrees from the horizontal, use multi-component chemical resistant polysulfide sealant conforming to ASTM C920, Type M, Grade NS, Class 25.

1. Sonneborn ; Sonolastic Two-part
2. Tamms; Hornflex-L
3. DuPont; Cormax PSC
4. Or equal.

**2.03 - EPOXY JOINT SEALANT**

A. 100 percent solids per ASTM D1259, two-part epoxy with an instantaneous Shore D hardness of 50 to 65 per ASTM D2240.

1. Metzger-McGuire Co.; MM80 or Edge Pro50
2. Euclid Chemical Corp. ; Euco700
3. Or equal.

**2.04 - BACKING ROD FOR EXPANSION JOINTS**

A. Provide an extruded closed-cell polyethylene foam rod. The rod shall be 1/4-inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices.

1. Industrial Systems Department; Minicel backer rod
2. Hercules, Inc.; Plastic Products Group
3. Or equal.

**2.05 - BOND BREAKER TAPE**

A. Provide an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

**2.06 - PREFORMED CONTROL JOINT**

A. One-piece, flexible, PVC joint former.

1. Vinylex Corp.; Kold-Seal Zip-Per Strip KSF-150-50-50
2. Or equal.

B. One-piece steel strip with preformed groove

1. Burke Concrete Accessories, Inc.; Keyed Kold Retained Kap
2. Or equal.

C. Provide the preformed control joint material in full-length unspliced pieces.

**2.07 - PREMOLDED JOINT FILLER FOR PAVEMENTS AND SLABS**

A. Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I

B. Bituminous-type preformed expansion joint filler conforming to ASTM D994.

**2.08 - PREMOLDED JOINT FILLER FOR LIQUID CONTAINMENT STRUCTURES**

A. Self-expanding cork per ASTM D1752, Type III.

B. Sponge Rubber per ASTM D1752, Type I. Preformed, nonextruded type constructed of closed-cell neoprene.

**2.09 - EXPANSION JOINT DOWELS**

A. Stainless steel bar dowels conforming to ASTM A276, Type 316.

B. Thoroughly grease expansion joint dowels prior to placing adjoining (2nd placement) wall or slab concrete.

### 2.10 - STYROFOAM FILLER BLOCK

A. Styrofoam filler blocks for future construction and expansion joints.

1. Products:

a. Dow Chemical Company; Styrofoam SM brand

b. Or equal.

### 2.11 - VOC LIMITS FOR SEALANTS, AND SEALANT PRIMERS

A. VOC limits for sealants, and sealant primers to comply with content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or applicable state and local codes containing more stringent requirements.

### 2.12 -BOND BREAKER FOR JOINT COMPOUNDS

A. Provide polyethylene tape.

## PART 3 - EXECUTION

### 3.01 - JOINTS

A. Make joints only at locations shown on the contract drawings or as permitted by the Engineer. Any addition or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written permission.

B. Relocate additional joints where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. If a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footing or floor slabs.

C. Cast slabs and beams monolithically without horizontal joints unless specifically indicated on the drawings.

D. Do not use horizontal joints within foundation mats, base slabs, footings, pile caps, slabs on grade or elevated beams and slabs.

E. Provide joints in concrete fills and toppings at the same location as the joints in the supporting concrete.

F. Provide waterstops in all wall and slab joints in liquid containment structures and at locations shown on the contract Drawings. Do not provide metal waterstops unless permitted by Engineer.

G. Construction Joints

1. Provide flat ribbed waterstops at construction joints where shown on contract drawings and specified herein.

2. Allow 72 hours between placements of adjacent slabs.

3. Where joint key ways are shown on contract drawings form keyways by beveled strips or boards placed at right angles to the formed face. Except where otherwise shown on contract drawings or specified, keyways shall be at least 1-1/2 inches in depth over at least 25 percent of the width of the section.

4. After the placement has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose concrete, foreign material, and expose clean aggregate by sandblasting or waterblasting the surface of construction joints before placing the new concrete. Cover horizontal construction joints with mortar. Spread uniformly and work thoroughly into irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.

5. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint.)

H. Contraction Joints:

1. Do not use of control joints in liquid contain structures.
2. Provide 6-inch, center-bulb waterstop at contraction joints where shown on contract drawings and specified herein.
3. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.
4. Full contraction joints
    a. Do not extend reinforcement or other embedded items bonded to the concrete (except stainless steel dowels bonded on only one side of joint) continuously through any expansion joint.
    b. Where shown on contract drawings provide stainless steel expansion joint dowels. Secure stainless steel dowels tightly in forms with rigid ties. Orient dowels to permit joint movement.
5. Partial contraction Joints
    a. Extend every other bar of reinforcement steel through partial contraction joints or as indicated on the drawings.

I. Control Joints:

1. Do not use of control joints in liquid containment structures.
2. Locate control joints as shown on the Contract Drawings.
3. Form control joints with control joint inserts or sawcuts.
4. For sawcutting:
    a. Using early entry saws, saw joints in slabs before the formation of uncontrolled cracking (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing.
    b. Fill saw cut to full depth with elastomeric joint sealant for joints not exposed to vehicular traffic. Fill joints to full depth with epoxy joint sealant for joints exposed to vehicular traffic.
5. Unless noted otherwise on the Contract Drawings, total reduction in concrete member thickness shall be at least 1/4 the member thickness.

J. Expansion Joints:

1. Size and location of expansion joints shall be as shown on the Contract Drawings.
2. Provide 9 inch, center-bulb waterstop at expansion joints where shown on contract drawings and specified herein.
3. Do not extend reinforcement or other embedded items bonded to the concrete (except stainless steel dowels bonded on only one side of joint) continuously through any expansion joint.
4. Install stainless steel expansion joint dowels parallel to wall or slab face, perpendicular to the joint face, and in true horizontal position. Secure stainless steel expansion joint dowels tightly in forms with rigid ties. Orient dowels to permit joint movement.

**3.02 - INSTALLATION OF JOINT SEALANTS**

A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.

B. Apply masking tape along the edges of the exposed surface of the exposed joints.

C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

D. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.

E. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.

F. After the sealant has been applied, remove the masking tape and any sealant spillage.

G. Sealants used in water retaining structures shall achieve final cure at least seven days before the structure is filled with water.

**3.03 - LEAKAGE TESTING**

A. Test hydraulic structures in accordance with SECTION 03800, LEAKAGE TESTING OF CONTAMINAT STRUCTURES.

**3.04 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 03255**

**NON-EXPANDING WATERSTOPS**

PART 1 – GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 3
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PART 2 - PRODUCTS ..... 3
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PART 3 - EXECUTION ..... 6
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3.03 - CLOSEOUT ACTIVITIES ..... 7

## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide polyvinyl chloride (PVC) waterstops in construction and expansion joints between dry areas and sources of liquid, between dry areas and the ground, and between sources of liquid and the ground as specified herein and/or as shown on the Contract Drawings.

1. Waterstops shall form a continuous watertight diaphragm to prevent leakage.
2. Provide 9-inch bulbed waterstops in expansion joints and 6-inch ribbed waterstops in construction joints.
3. Provide 9-inch split bulbed waterstops in joints against existing structures.
4. Provide 4-inch ribbed waterstops for containment curbs.

B. Provide TPE-R waterstops for ozone and chemical containment applications.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

E. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

F. Store plastic products under cover in a dry location, out of direct sunlight.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

B. Reject waterstops containing scrap or reclaimed material or pigment.

C. Position waterstops in construction and expansion joints as indicated.

D. Use factory made and tested crosses, tees and ells at corners and intersections.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. D412: Standard Test Methods or Vulcanized Rubber and Thermoplastic Elastomers – Tension.
2. D570: Standard Test Method for Water Absorption of Plastics
3. D624: Standard Test method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
4. D638: Standard Test Method for Tensile Properties of Plastics
5. D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
6. D747: Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
7. D792: Standard Test Methods for Density and Specific Gravity of Plastics by Displacement.
8. D1171: Standard Test Method for Rubber Deterioration – Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
9. D1259: Standard Test Methods for Nonvolatile Content of Resin Solutions.
10. D2240: Standard Test Method for Rubber Property – Durometer Hardness

B. Corps of Engineers:

1. CRD-C 572: Specifications for Polyvinylchloride Waterstop.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - PVC WATERSTOP**

A. Provide polyvinyl chloride waterstops manufactured from virgin polyvinyl chloride plastic compound conforming to Corps of Engineers Specification CRD-C572.

B. Provide waterstops of type, shape and size indicated with looped galvanized steel wire or grommets spaced at 12 inches on center along both edges.

C. Provide factory-made crosses, tees and ells fabricated by the waterstop manufacturer using thermostatically controlled electric heat source.

D. Provide waterstops resistant to chemical action with Portland cement, alkalis, acids, and not affected by mildew or fungi. It shall show no effect when immersed for 10 days in a 10 percent solution of sulfuric or hydrochloric acid, saturated lime solution or salt water. Water stops shall be such that any cross section will be dense, homogeneous, and free from porosity and other imperfections. They shall be symmetrical in shape.

E. The material shall meet the requirements in Table 03255-1.

**TABLE 03255-1**

| Property | Test Method | Limit |
|---|---|---|
| Water Absorption | ASTM D 570 | 5% maximum |
| Tear Resistance | ASTM D 624 | 250 #/inch minimum |
| Ultimate Elongation | ASTM D 638 | 300% minimum |
| Tensile Strength | ASTM D 638 | 1750 psi minimum |
| Low Temperature Brittleness | ASTM D 746 | No Failure at -35ºF |
| Stiffness in Flexure | ASTM D 747 | 600 psi minimum |
| Ozone Resistance | ASTM D 1149 | No Failure |
| Volatile Loss | ASTM D 1203 | 0.50% maximum |
| Hardness, Shore A | ASTM D 2240 | 65 to 80 |
| Tensile strength after accelerated extraction | CRD C 572 | 1500 psi minimum |
| Elongation after accelerated extraction | CRD C 572 | 280% Minimum |
| Effect of Alkalis after 7 days - Weight Change | CRD C 572 | -0.10% to +0.25% |
| Effect of Alkalis after 7 days - Hardness Change | CRD C 572 | +5 maximum |

F. PVC waterstops for containment curbs: flat ribbed type, 4 inches wide, with a minimum thickness of 3/16 inches.

1. Products:
    a. Greenstreak; Model 781
    b. Vinylex; Model R4316
    c. BoMetals, Inc.; Model TFR-4316
    d. Or equal.

G. PVC waterstops for construction joints: Flat ribbed type, 6 inches wide with a minimum thickness of 3/8 inches.

1. Products:
    a. Greenstreak: Model 679
    b. Vinylex; Model R638
    c. BoMetals, Inc.; Model TFR-638
    d. Or equal.

H. PVC waterstop for contraction joints shall be ribbed with a center bulb, 6 inches wide with a minimum thickness of 3/8 inches. The center bulb shall have an O.D. not less than 7/8 inches.

1. Products:

a. Greenstreak; Model 732

b. BoMetals, Inc.; Model RCB-638LB

c. Vinylex; Model RB638H

d. Or equal.

I. PVC waterstop for expansion joints shall be ribbed with a center bulb, 9 inches wide with a minimum thickness of 3/8-inches. The center bulb shall have an O.D. not less than 1 3/8 inches.

1. Products:

a. Greenstreak; Model 738

b. BoMetals, Inc.; Model RCB-938VLB

c. Vinylex; Model RLB938

d. Or equal.

J. PVC waterstops for sealing construction joints between existing concrete structures and new concrete placement shall be retro-fit type, 6 inches wide and 3 3/16 inches height with a minimum thickness of 3/8 inches.

1. Products:

a. Greenstreak; Model 609

b. BoMetals, Inc.; Model RF-638

c. Vinylex; Model RET638

d. Or equal.

**2.02 - THERMOPLASTIC ELASTOMERIC RUBBER (TPE-R) WATER STOP**

A. TPE-R waterstop for construction joints shall be flat ribbed type, 6 inches wide, with a minimum 3/16-inch thickness.

1. Products:

a. BoMetals; Model TFR-6316)

b. JP Specialties; Model JP 636

c. WESTEC Barrier Technologies; Model 619

d. Or equal.

B. TPE-R waterstop for contraction joints shall be ribbed with a center bulb, 6 inches wide with a minimum 3/16-inch thickness. The center bulb shall have an outside diameter not less than 7/16-inch.

1. Products:

a. BoMetals, Inc.; Model TCB-6316

b. JP Specialties, Inc.; Model JP 636

c. WESTEC Barrier Technologies; Model 619

d. Or equal.

C. TPE-R waterstop for expansion joints shall be ribbed with a center bulb, 9 inches wide with a minimum 3/16-inch thickness as shown below. The center bulb shall have an outside diameter not less than 7/16-inch.

1. Products:

a. BoMetals, Inc.; Model TCB-9316

b. JP Specialties, Inc.; Model JP 936

c. WESTEC Barrier Technologies; Model 620

d. Or equal.

D. TPE-R waterstops for sealing between existing concrete structures and new concrete placement shall be retro-fit type, 4 1/2 inches wide and 3 3/16 inches height with a minimum thickness of 3/16 inch. Attach waterstop to existing concrete using 1/4-inch by 2 1/4-inch stainless steel sleeve expansion bolt with stainless steel batten bars.

1. Products:

a. BoMetals, Inc.; Model TRF-6316

b. JP Specialties, Inc.; Model JP450T

c. Or equal.

**PART 3 - EXECUTION**

**3.01 - FABRICATION**

A. Make all splices on a bench following manufacturer's printed instructions and splicing procedures.

B. Use miter guide and portable power saw to cut spliced ends.

C. Maintain continuity of characteristic features of waterstop cross section including ribs and center bulb through splice.

D. Remove looped steel wire along both edges of waterstop adjacent to saw cut prior to splicing.

E. Make splices by heat sealing adjacent surfaces using a thermostatically controlled electric heat source in conformance with manufacturer's printed instructions.

F. Reform waterstop at splices using a remolding iron having a pattern matching the waterstop.

G. If splice shows any separation or lack of fusion, reject the splice, re-cut back at least one inch from rejected splice each side, re-weld.

H. Replace or repair damaged or punctured waterstops in conformance with manufacturer's printed instructions at no additional cost to the Owner.

I. Clean waterstops of curing compound, foreign materials and protrusions of hardened concrete and mortar.

J. Provide waterstops with an integral fastening system consisting of grommets or pre-punched holes.

**3.02 - INSTALLATION**

A. Place waterstop to form a continuous watertight diaphragm in joints.

B. Center waterstops in joints unless otherwise indicated. Do not embed center bulb in concrete.

C. Install waterstops in continuous lengths to minimize field splices.

D. Maintain 1-inch minimum clearance between waterstop and reinforcement and embedded items.

E. Use factory-made crosses, tees and ells at all corners and intersections.

F. Do not fold waterstops against bulkhead forms.

G. Secure waterstops in position with tie wire from loops to adjacent reinforcement on both sides every 12 inches along each edge.

H. Consolidate concrete during placement in vicinity of waterstop without damaging or dislodging waterstop.

I. Protect exposed waterstop from damage.

J. Terminate vertical waterstops three inches below top of concrete walls in open tanks, at the underside of elevated framed slabs that are above maximum process liquid levels and above finish grade in exterior foundation walls.

K. Do not use split waterstops unless specifically indicated.

L. Attach waterstop to existing concrete using 1/4-inch by 2 1/4-inch stainless steel sleeve expansion bolt with stainless steel batten bars

**3.03 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03256**

**EXPANDING WATERSTOPS**

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1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
1.07 - QUALITY ASSURANCE ..... 3
1.08 - REFERENCES ..... 3
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2.01 - HYDROPHILIC GASKET WATERSTOP ..... 3
2.02 - HYDROPHILIC PASTE WATERSTOPS ..... 4
PART 3 - EXECUTION ..... 4
3.01 - INSTALLATION ..... 4
3.02 - HYDROPHILIC GASKET WATERSTOPS ..... 4
3.03 - CLOSEOUT ACTIVITIES ..... 5

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Expanding Waterstops as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

E. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

F. Store hydrophilic waterstops under cover in a dry location, out of direct sunlight.

G. Waterstop shall be maintained in a dry condition until concrete placement.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

B. Reject and replace waterstops which have become wet or exhibit swelling prior to concrete placement.

C. Position waterstops in joints as indicated.

D. Provide waterstops in maximum practical lengths to minimize joints.

E. Use adhesives manufactured by or recommended by the waterstop manufacturer for attachment of the waterstop to concrete.

F. Waterstops shall be positioned to provide a minimum of 3 inches concrete cover.

G. In structures to contain potable water, use joint materials that are ANSI/NSF 61 approved for contact with potable water

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. D638: Test Method for Tensile Properties of Plastic.
2. D1149: Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
3. D1203: Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods.
4. D2240: Standard Test Method for Rubber Property – Durometer Hardness

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - HYDROPHILIC GASKET WATERSTOP**

A. Provide a bentonite free rubber waterstop. Waterstop shall expand by a minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast. Provide minimum concrete cover as recommended by the waterstop manufacturer.

B. Provide hydrophilic rubber gasket waterstops fabricated of non-vulcanized rubber, chloroprene rubber, urethane polymers, vinylester polymers or combinations of these materials.

C. Provide waterstop as recommended by manufacturer for specific installation.

D. Provide hydrophilic gasket waterstops which meet the criteria in Table 03256-1.

**Table 03256-1**

| Property | Test Method | Limit |
|---|---|---|
| Ultimate Elongation | ASTM D 638 | 70% minimum |
| Tensile Strength | ASTM D 638 | 25 psi minimum |
| Ozone Resistance | ASTM D 1149 | No Failure |
| Volatile Loss | ASTM D 1203 | 0.50% maximum |
| Hardness, Shore A | ASTM D 2240 | 20 to 60 |

E.

F. Provide hydrophilic rubber gasket waterstops as manufactured by:

1. Duroseal Gasket Waterstop manufactured by BBZ USA;
2. Adeka Ultraseal MC-2010M manufactured by Adeka North America;
3. Swellseal 8 manufactured by de neef Construction Chemicals, Inc.;
4. Or equal.

**2.02 - HYDROPHILIC PASTE WATERSTOPS**

A. Provide hydrophilic rubber paste waterstops of urethane paste, thixotropic vinyl monomer or similar materials.

B. Hydrophilic rubber paste shall be compatible with gasket waterstop material.

C. Hydrophilic paste shall be 100% solids.

D. Provide hydrophilic paste waterstops which meet or exceed the criteria in Table 03256-2.

**Table 03256-2**

| Property | Test Method | Limit |
|---|---|---|
| Ultimate Elongation | ASTM D 638 | 50% minimum |
| Tensile Strength | ASTM D 638 | 25 psi minimum |
| Ozone Resistance | ASTM D 1149 | No Failure |
| Volatile Loss | ASTM D 1203 | 0.50% maximum |
| Hardness, Shore A | ASTM D 2240 | 20 to 60 |

E. Provide hydrophilic rubber paste as manufactured by:

1. Duroseal Paste manufactured by BBZ USA;
2. Adeka Ultraseal P-201 manufactured by Adeka North America;
3. De neef; Swellseal WA
4. Or equal.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide hydrophilic rubber gasket and paste waterstops where specifically indicated.

B. Center waterstops in joints unless otherwise indicated.

C. Consolidate concrete during placement in vicinity of waterstop without damaging or dislodging waterstop.

D. Clean joint surface of dirt, dust, debris and laitence immediately before applying waterstop and remove standing water.

E. Protect waterstops from moisture until concrete is placed. Waterstops which exhibit swelling prior to concrete placement shall be removed and replaced at the contractor's expense.

**3.02 - HYDROPHILIC GASKET WATERSTOPS**

A. Install hydrophilic gasket waterstops in continuous lengths to minimize joints. Provide waterstop in one continuous length insofar as practicable. Butt ends at joints of waterstop or overlap a minimum of 2 inches per manufacturer's instructions.

B. Seal joints in hydrophilic gasket waterstops with a hydrophilic rubber paste compound as recommended by the manufacturer.

C. Do not bend hydrophilic gasket waterstop. Cut square and butt joints at corners.

D. Waterstop shall be in continuous contact with the concrete surface.

E. Attach hydrophilic gasket waterstop to concrete surface by one of the following methods:

1. Fix hydrophilic gasket waterstop to concrete surface with continuous bead of hydrophilic rubber paste or adhesive. Paste or adhesive shall be provided by or as recommended by the waterstop manufacturer.

2. Fix hydrophilic gasket waterstop to concrete surface with masonry or concrete nails or power activated fasteners at a maximum 12 inch spacing.

F. Provide one fastener one inch from the top and a second fastener four inches from the top of vertical hydrophilic gasket waterstops regardless of which fastening method is used.

G. Do not compress or otherwise deform hydrophilic gasket waterstop when fastening to concrete.

H. Do not wrap hydrophilic gasket waterstops around pipes less than the minimum diameter recommended in the manufacturer's printed instructions.

**3.03 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03300**

**CAST-IN-PLACE CONCRETE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Cast-in-Place Concrete as specified herein and/or as shown on the Contract Drawings.

B. Provide cast-in-place concrete for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under specified under those disciplines.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

C. Product Data:

1. Manufacturer's specifications and instructions for all admixtures, and curing materials. Manufacturer’s certification of compatibility of all admixtures.

D. Shop Drawings:

1. Certification that cement used complies with ASTM C150 and these specifications.
2. Certification that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.
3. Certification of compliance with these specifications from the manufacturer of the concrete admixtures.
4. Prepare mix designs in accordance with ACI 318, except as modified herein.
    a. Submit concrete mix designs, laboratory 7-day and 28-day compressive test results and laboratory shrinkage test results for review and approval by the Engineer.
    b. Alternatively, submit test reports of 7- and 28-day compressive tests and shrinkage test results of the proposed mix where that same mix has been used on two previous projects in the past twelve months.
    c. Do not use any concrete mixes in the work that have not been approved by the Engineer.
5. Plant Qualification: Submit certification from the National Ready Mixed Concrete Association indicating compliance with the specified qualification requirements.

E. Test and Evaluation Reports

1. Results of drying shrinkage tests from trial concrete mixes by the Contractor's testing laboratory firm.

F. Manufacturers' Instructions

1. Epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's certifications as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

G. Field Quality Control Submittals

1. Delivery tickets for ready-mix concrete or weigh masters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of placements. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate and liquid admixtures.
2. Batch tickets shall include the following information:
    a. Load number, truck number and driver's name
    b. Strength of concrete (compression strength)
    c. Amount of concrete (cu. yds.)
    d. Time truck was charged with cement
    e. Revolution counter reading at first addition of water
    f. Type, brand and amount of cement
    g. Type, brand and amount of admixtures
    h. Amount of water withheld at the plant (if any)
    i. Information necessary to calculate total mixing water
    j. Maximum size of aggregate
    k. Weights of fine and coarse aggregates
    l. Signature of ready-mix representative
    m. Concrete temperature at batching plant
    n. Type and amount of fly ash, other pozzolan or slag cement.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide in conformance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

D. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water- cementitious materials ratio, slump, air entrainment, temperature and homogeneity.

E. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE.

B. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

C. Perform concrete work in conformance with ACI 301 unless otherwise specified.

D. Do not use calcium chloride or admixtures containing calcium chloride.

E. Do not place concrete until design mix, material tests and trial concrete batch mix compression and shrinkage test results are approved by the Engineer. Approvals shall be obtained at least 30 days prior to the need for use on the job site.

F. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to develop concrete mix designs and testing.

G. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to test the conformity of materials proposed for use in the concrete mixes to the project specifications and to design and test concrete mixes proposed for use. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. The Contractor shall allow free access to obtain test samples.

H. The Owner shall employ an independent testing laboratory, acceptable to the Engineer, to test conformity of materials placed into the work during construction. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. The Contractor shall allow free access to obtain test samples.

I. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C 172
2. Specimen Preparation: ASTM C 31
3. Compressive Strength: ASTM C 39
4. Air Content: ASTM C 231

5. Slump: ASTM C 143
6. Temperature: ASTM C 1064
7. Unit Weight: ASTM C 138
8. Obtaining Drilled Cores: ASTM C 42
9. Drying Shrinkage: ASTM C 157

J. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

K. Hot weather concrete to conform to ACI 305 and as specified herein.

L. Cold weather concrete to conform to ACI 306 and as specified herein.

M. Reject concrete delivered to job site that exceeds the time limit specified.

N. Reject concrete delivered to job site that exceeds the concrete temperature limitations specified.

O. Do not place concrete in water or on frozen or uncompacted ground.

**1.08 - REFERENCES**

A. American Concrete Institute (ACI):

1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
2. ACI 301: Specifications for Structural Concrete
3. ACI 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
4. ACI 304.2R: Placing Concrete by Pumping Methods
5. ACI 305.1: Specification for Hot Weather Concreting
6. ACI 306.1: Standard Specification for Cold Weather Concreting
7. ACI 308.1: Specification for Curing Concrete
8. ACI 318: Building Code Requirements for Structural Concrete
9. ACI 350: Code Requirements For Environmental Engineering Concrete Structures

B. ASTM International (ASTM) Publications:

1. A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. A 153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. C 31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
4. C 33: Standard Specification for Concrete Aggregates
5. C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
6. C 40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
7. C 42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
8. C 87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
9. C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
10. C 94: Standard Specification for Ready-Mixed Concrete
11. C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or (50-mm) Cube Specimens)
12. C 123: Standard Test Method for Lightweight Particles in Aggregate

13. C 136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
14. C 138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
15. C 143: Standard Test Method for Slump of Hydraulic Cement Concrete
16. C 150: Standard Specification for Portland Cement
17. C 157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete
18. C 171: Standard Specification for Sheet Materials for Curing Concrete
19. C 172: Standard Practice for Sampling Freshly Mixed Concrete
20. C 192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
21. C 231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
22. C 260: Standard Specification for Air-Entraining Admixtures for Concrete
23. C 289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
24. C 295: Standard Guide for Petrographic Examination of Aggregates for Concrete
25. C 309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
26. C 311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
27. C 494: Standard Specification for Chemical Admixtures for Concrete
28. C 595: Standard Specification for Blended Hydraulic Cements
29. C 618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
30. C 881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete
31. C 882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
32. C 989: : Standard Specification for Slag Cement for Use in Concrete and Mortars
33. C 1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
34. C 1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
35. C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
36. C 1116: Standard Specification for Fiber Reinforced Concrete
37. C 1240: Standard Specification for Silica Fume Used in Cementitious Mixtures
38. C 1602: Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
39. D 75: Standard Practice for Sampling Aggregates
40. E 154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
41. E 329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

**1.09 - SHRINKAGE TESTS**

A. The testing laboratory shall perform drying shrinkage tests for the trial batches as specified herein. Shrinkage limitations apply only to concrete for liquid containing structures.

B. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows:

1. Remove specimens from molds at an age of 23 hours +/- 1 hour after trial batching, place immediately in water at 70 degrees F +/- 3 degrees F for at least 30 minutes, measure within 30 minutes thereafter to determine original length, and then submerge in saturated lime water at 73 degrees F +/- 3 degrees F.

2. At age seven days, take measurements to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).

3. Immediately place specimens in a humidity-controlled room maintained at 73 degrees F +/- 3 degrees F and 50 percent +/- 4 percent relative humidity for the remainder of the test.

4. Report measurements to determine shrinkage expressed as percentage of the base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age.

1. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age.

2. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen.

3. Report results of the shrinkage test to the nearest 0.001 percent of shrinkage.

D. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project.

E. Acceptance of Test Results: The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.028 percent or 0.032 percent, respectively.

1. Use only mix designs for construction that have first met the trial batch shrinkage and compression requirements.

2. If the trial batch specimens do not meet both the strength and shrinkage requirements, revise the mix designs and/or materials and retest.

**1.10 - WORKABILITY**

A. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.

**1.11 - SITE CONDITIONS**

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. Cement:

1. Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type IP (MS).
2. Type IP (MS) shall not be used for concrete to come in contact with potable water.
3. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.
4. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalis shall not exceed 0.6 percent.

B. Fly Ash:

1. Provide fly ash conforming to the following requirements:
    a. Class F fly ash conforming to ASTM C 618 for chemical and physical properties.
    b. Supplemental requirements in percent:
        (1) Maximum carbon content: 3%
        (2) Maximum sulfur trioxide (SO3) content: 4%
        (3) Maximum loss on ignition: 3%
        (4) Maximum water requirement (as a percent of control): 100%
        (5) Fineness, maximum retained on No. 325 sieve: 25%

C. Slag Cement:

1. Slag cement, when used, shall meet the requirements of ASTM C989, Grade 100 or better.

D. Silica Fume:

1. Silica fume, when used, shall meet the requirements of ASTM C1240.
    a. Products:
        (1) BASF Corporation; MasterLife SF 100.
        (2) Sika Corporation; Sikacrete 950DP
        (3) Euclid Chemical Company; Eucoshot MSA
        (4) Or equal.

E. Fine Aggregates:

1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.50 and 3.0.
2. Aggregates sourced from locations known to contain Pyrrhotite or other deleterious materials shall not be acceptable.

F. Coarse Aggregate:

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.
2. Limit deleterious substances in accordance with ASTM C33, Table 3, Severe Weathering Regions, limit clay lumps not to exceed 1.0 percent by weight, and limit loss when tested for soundness using magnesium sulfate to 12 percent.

3. Test conformity of aggregate and confirm that aggregates intended for use in concrete are potentially non-reactive when tested in conformance with ASTM C 289.

4. Aggregates sourced from locations known to contain Pyrrhotite or other deleterious materials shall not be acceptable.

G. Water and Ice:

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C1602.

2. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305.1 and ACI 306.1.

H. Color Additive for Exterior Electrical Duct Encasement:

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes.

I. Concrete Admixtures:

1. Maintain compressive strength and maximum water-cementitious materials ratios specified in Table 03300-1 when using admixtures. Include all admixtures in solution form in the water-cementitious materials ratio calculations. Do not use any admixture that contains intentionally-added chlorides or other corrosive elements. Admixtures shall be used in compliance with the manufacturer's printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix. Do not use admixtures in greater dosages than recommended by manufacturer.

2. Air Entrainment:

a. Air-entraining admixture shall conform to ASTM C260.

b. Products:

(1) BASF Corporation – MasterAir AE 90, MasterAir VR 10, or MasterAir AE 200

(2) Sika Corporation, AER.

(3) WR Grace & Co.; Darex II-AEA

(4) Or equal.

c. Adjust the admixture content to accommodate fly ash or other pozzolan requirements, and other admixtures when used, in order to obtain the specified air content.

3. Water Reducing:

a. Water-reducing admixture shall conform to ASTM C494, Type A and be compatible with the air-entraining admixture.

b. Products:

(1) BASF Corporation; MasterPozzolith Series or MasterPolyHeed Series

(2) Sika Corporation, Plastocrete 161

(3) WR Grace & Co.; Daracem 65

(4) Euclid Chemical Company; Eucon NW

(5) Or equal.

4. Water Reducing and Retarding:
    a. Water-reducing and retarding admixture shall conform to ASTM C494, Type D and compatible with the air-entraining admixture.
    b. Products:
        (1) BASF Corporation; MasterPozzolith Series
        (2) Sika Corporation; Plastiment
        (3) WR Grace & Co.; WRDA 64
        (4) Or equal.
5. Accelerating:
    a. The use of accelerating admixtures is not permitted.
6. High-Range Water-Reducing Admixture (Superplasticizer):
    a. High-Range water-reducing admixture shall conform to ASTM C494, Type F or ASTM C1017, Type I.
    b. Products:
        (1) BASF Corporation; MasterRheobuild 1000 or MasterGlenium Series
        (2) WR Grace & Co.; Daracem 100
        (3) Euclid Chemical company; Eucon SPC
        (4) Or equal.
7. Workability-Retaining Admixture:
    a. Workability-enhancing admixture shall conform to ASTM C 494, Type S.
    b. Products:
        (1) BASF Corporation – MasterSure Z 60
        (2) WR Grace & Co.; Adva XT2
        (3) Or equal.
8. Shrinkage Reducing Admixture:
    a. Shrinkage-reducing admixture is permitted to be used in the mix to meet shrinkage limitations provided that specified strength are met and there is no reduction in sulfate resistance and no increase in permeability. Quantity of shrinkage-reducing admixture used in the mix shall be added to the quantity of water for purposes of determining the water/cementitous materials ratio.
    b. Products:
        (1) BASF Corporation; MasterLIFE SRA 20
        (2) WR Grace & Co.; Eclipse 4500
        (3) Euclid Chemical company; Eucon SRA
        (4) Or equal.

K. Fiber Reinforcement:
1. Fiber reinforcing shall conform to ASTM C 1116, Type III.
2. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement

3. Dosage Rate: Volume of fibers shall be a minimum of 3 pounds per cubic yard.
4. Physical Characteristics:
    a. Specific gravity: 0.91
    b. Tensile strength: 40,000 to 110,000 psi
    c. Minimum Fiber length: 1/2 inch
5. Fibrous concrete reinforcement materials provided in this section shall produce concrete conforming to the requirements for strength of concrete specified.
    a. Products:
        (1) BASF Corporation: “MasterFiber MAC” Series
        (2) WR Grace & Co.: STRUX 90/40
        (3) Propex Operating Company,LLC: Enduro 600
        (4) Or equal.

L. Epoxy Bonding Agent:
1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.
2. Products:
    a. Sika Corp.; Sikadur 32 Hi-Mod
    b. Euclid Chemical Company; Duralcrete
    c. BASF Corporation; MasterEmaco ADH 326
    d. Or equal

M. Vapor Retarder: 10 mil polyethylene sheet conforming to ASTM E 154

N. Curing Compound:
1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C 309.
2. Products:
    a. BASF Corporation; MasterKure EC 1315
    b. Euclid Chemical Company; Super Diamond Clear VOX
    c. W. R. Meadows, Inc.; VOCOMP-30
    d. Dayton Superior Corp; Safe Cure and Seal 30% J23UV
    e. Or equal.

O. Burlap Mats:
1. Conform to AASHTO M182.

P. Sisal-Kraft Paper and Polyethylene Sheets for Curing:
1. Conform to ASTM C171.

**2.02 - MIXES**

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231:

5 ± 1 1/2 percent for concrete using 1 1/2-inch maximum aggregate size.

6 ± 1 1/2 percent for concrete using 3/4-inch maximum aggregate size.

C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

**Table 03300-1**

| **Type of Work** | **28-Day Minimum Compressive Strength (in psi)** | **Maximum Water/Cement Ratio** |
|---|---|---|
| Concrete for liquid containing | 4,500 | 0.42 |
| Precast concrete | 5,000 | 0.40 |
| Prestressed concrete | 6,000 | 0.40 |
| Concrete (fiber reinforced) fill, topping and miscellaneous unreinforced concrete | 4,000 | 0.54 |
| Pavement | 3,000 | 0.54 |
| Mud mats and concrete under foundations | 1,500 | 0.76 |
| Concrete not otherwise specified | 4,000 | 0.44 |

D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4 inches. A tolerance of up to 1 inch above the indicated maximum is allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

2. Mixes containing water reducers shall have a maximum slump of 6 inches after the addition of a mid-range water reducer and maximum slump of 8 inches after the addition of a high range water reducer.

E. Pozzolan Content:

1. Fly ash shall not exceed 20 percent of the total cementitous content.

2. Slag cement will be permitted as a substitute for fly ash at no additional cost to the Owner, in the event that Class F Fly Ash is not available. The slag substitution shall be in the same proportions and percentages of the total cementitious material as shown for fly ash.

3. Use silica fume concrete where indicated on the drawings. Silica fume not to exceed 10 percent of the total weight of the silica fume plus cement.

F. Aggregate Size:

1. The maximum aggregate size shall be:

a. 1 1/2 inches for walls greater than 18 inches in thickness, grade beams, footings, foundation mats, and base slabs.

b. 3/8 inches for floor fill in clarifiers, in congested areas where approved by the engineer, for fireproofing around structural steel beams and columns and to fill cored holes.

c. 3/4 inches for all other concrete.

2. Combined aggregate grading shall be as specified in Table 03300-2:

**Table 03300-2**

| Maximum Aggregate Size | 1 1/2-inch | 1-inch | 3/4-inch | 3/8-inch |
|---|---|---|---|---|
| Aggregate Grade per ASTM C33 | 467 | 57 | 67 | 8 |

## PART 3 - EXECUTION

### 3.01 - INSPECTION

A. Contractor shall examine the substrate and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected in a manner acceptable to the engineer.

### 3.02 - MIXING AND TRANSPORTING CONCRETE

A. General: Conform to concreting procedures set forth in ASTM C 94, ACI 304R and as specified herein.

1. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

3. Do not add water at the jobsite unless permitted by the engineer. If it is necessary to add water to obtain the specified slump, add water per ASTM C 94, but do not exceed the amount of water that has been held back at the plant. Added water shall be incorporated by additional mixing of at least 35 revolutions. Quality control sampling shall be done after the water has been added and the batch thoroughly mixed.

4. Do not add water to concrete containing high range water reducing admixture.

5. Keep a record showing time and place of each placement of concrete, together with transit-mix delivery slips certifying the contents of the placement.

6. Concrete temperature at the time of discharge shall be less than 90 Degrees F. Concrete over 90 Degrees F shall be removed from jobsite and discarded.

B. Conveying: Convey concrete from agitator or mixer truck to place of final deposit in forms by one of the following methods:

1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third the maximum interior horizontal area or five times the maximum aggregate size being used, whichever is greater, and side slopes of not less than 60 degrees to horizontal.

2. Buggies or wheelbarrows equipped with pneumatic tires.

3. Round bottom, metal or metal-lined chutes with inclined slope of between two to three feet horizontally to one foot vertically and of sufficient capacity to avoid overflow.

4. Circular drop pipes with a top diameter of at least eight times the maximum aggregate size, but not less than 6 inches, or tapered to not less than six times maximum aggregate size.

**3.03 - CONCRETE ACCEPTANCE**

A. The Contractor shall accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. The signature of a Contractor's authorized representative on the delivery batch ticket shall indicate concrete acceptance.

B. The Contractor shall reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete which exceeds the maximum barrel revolution of 300, the limits in Table 03300-3 or concrete that has water content exceeding the specified water-cement ratio.

E. The Contractor shall reject concrete not conforming to specification before discharging into the forms.

**3.04 - PREPARATION AND COORDINATION**

A. Contractor shall notify the Engineer or the Engineer's Representative of readiness to place concrete in any portion of the work a minimum of 48 hours prior to concrete placement. Failure to provide this notification will be cause for delay in placing until inspections can be completed and arrangements for testing established.

B. All reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork shall be inspected by the Engineer or the Engineer's representative prior to concrete placement.

C. Coordinate the sequence of placement to assure that construction joints will occur only where indicated on the drawings.

D. Schedule sufficient equipment for continuous concrete placement. Provide for backup equipment and procedures to be implemented in case of an interruption in placement.

E. Compact the subbase and/or bedding. The subbase and/or bedding shall be uniformly moist at the time of concrete placement. Spraying water on the subbase and/or bedding may be necessary prior to placement of concrete. Concrete shall not be placed on standing water, mud, and foreign matter.

F. Provide mud slabs to obtain a dry and stable working platform for placement of slabs on grade and foundation mats as indicated on the drawings or as may be required.

G. Install a granular base beneath slabs on ground where shown on contract drawings, Place granular material on a compacted subgrade and compact the granular base.

H. Place vapor retarder under structural slabs and buildings and where shown on contract drawings. Install material with 6-inch lap at joints and seal joints with tape as recommended by the vapor retarder manufacturer. Tape material cut for slab penetrations to the pipe, conduit or other items passing through the slab. Use tape recommended by the vapor retarder manufacturer.

I. Install vapor retarder without punctures or tears and protect against punctures and breaks.

J. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

**3.05 - JOINTS AND EMBEDDED ITEMS**

A. Provide construction and expansion joints as specified in SECTION 03250, CONCRETE JOINTS AND ACCESSORIES :

1. Clean all construction joints to remove loose concrete and laitance before placing adjoining concrete. Do not damage exposed concrete edges, key grooves, waterstops or reinforcement.
2. Intentionally roughen surfaces of set concrete to receive new concrete to 1/4-inch amplitude in a manner to expose bonded aggregate uniformly at joints.
3. Do not place concrete against construction joints for at least 72 hours after initial concrete set.

B. Embedded Items:

1. Secure castings, inserts, conduits and other metalwork encased in concrete to prevent them from being displaced or deformed during concrete work. Use templates to secure items in place.
2. Clean embedded items of oil and all foreign matter.
3. Install inserts, anchors, sleeves and other items into formwork where indicated or specified under other sections of these specifications.
4. Build dovetail anchor slots into new concrete against which facing brick, concrete masonry units, tile, stone or any type ashlar is to be installed. Provide vertically at 16-in. centers where facing brick, etc., passes by concrete. Provide one continuous anchor slot where facing brick, etc., abuts the concrete work.
5. Aluminum embedded in concrete shall be coated to prevent galvanic corrosion with a zinc chromate primer and one of the following products:
    a. Bitumastic Super Service Black by Koppers Co., Inc.
    b. Tarmastic 100 by Porter Coatings Division, Porter Paint Co.
    c. 450 Heavy Tnemecol by Tnemec Company.
    d. Or equal.
6. Check location and support of piping, electrical conduits and other embedded items before depositing concrete. Correct locations as required and secure in place.
7. Complete required tests on embedded piping before starting concrete placement.

C. Embedded Pipes And Conduit:

1. Embedded pipes and conduit in concrete shall conform to the requirements and limitations of ACI 318, ACI 350 and these specifications and shall be as approved by the engineer.
2. Conduits, pipes, and sleeves of any material not harmful to concrete and within the limitations specified herein shall be permitted to be embedded in concrete with the approval of the Engineer.
3. Conduits and pipes of aluminum shall not be embedded in concrete.
4. Pipes passing through walls of a liquid-containing structure shall include an integral waterstop.
5. Conduits, pipes, and sleeves passing through a slab, wall, or beam shall not impair significantly the strength of the construction.
6. Conduits and pipes, with their fittings, embedded within a column shall not displace more than 4 percent of the area of cross section.

7. Except when drawings for conduits and pipes are approved by the structural engineer, conduits and pipes embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:
    a. Conduits and pipes shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which they are embedded.
    b. Conduits and pipes shall not be spaced closer than 3 times the outside diameters on center.
    c. Conduits and pipes shall be placed within the middle third of the element and between reinforcement layers. Do not install runs of piping or conduit between formwork and reinforcement.
    d. Avoid crossing pipes and conduit in concrete.
8. Pipes and fittings shall be designed to resist the effects of the material, pressure, and temperature to which they will be subjected.
9. No liquid, gas, or vapor, except water not exceeding 90 F or 50 psi pressure, shall be placed in the pipes until the concrete has attained its design strength.
10. Reinforcement with an area not less than 0.002 times area of concrete section shall be provided perpendicular to piping or conduit at a maximum spacing of 12 inches.
11. Piping and conduit shall be so fabricated and installed that cutting, bending, or displacement of reinforcement from its proper location will not be required.
12. Close ends of conduits, piping and sleeves embedded in concrete with caps or plugs prior to concrete placement.

**3.06 - CONCRETE PLACEMENT**

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Intentionally roughen surfaces of set concrete to receive new concrete to ¼" amplitude in a manner to expose bonded aggregate uniformly at joints.

C. Do not place adjacent sections of walls and slabs until seven days after placement of the previously placed concrete.

D. Do not place concrete until all free water has been removed from the forms, clear of the work. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

E. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

F. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

G. Deposit concrete continuously and in level layers 1 to 2 feet thick. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

H. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove all partially hardened concrete from site at no additional compensation.

I. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet. Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

J. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

K. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

L. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

M. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete. Use not less than one vibrator with crew for each 35 to 40 cubic yards of concrete placed per hour.

N. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

O. Use additional vibration with pencil vibrators on vertical surfaces and on all exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:

1. Reduce distance between internal vibration insertions and increase time for each insertion.
2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.
3. Thoroughly vibrate area immediately adjacent to waterstops without damaging the waterstop.
4. Use spading as a supplement to vibration where particularly difficult conditions exist.

P. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.
2. Use equipment and procedures and schedule deliveries to maintain steady flow of concrete at the discharge end of pipe.
3. Maintain concrete properties of slump, air content and temperature. Make adjustments in concrete proportions as necessary to provide concrete properties in accordance with the approved concrete design mix and as specified herein.
4. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 4 inches.
5. Do not use aluminum pipes for delivery of concrete to the forms.
6. Take samples at the point of agitator or mixer truck discharge.
7. Furnish labor and assistance as required by the testing laboratory in obtaining and handling test specimens.

**3.07 - CURING AND PROTECTION**

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.
2. Comply with curing procedures set forth in ACI 301, ACI 308.1 and as specified herein.
3. Perform hot weather concreting in conformance with ACI 305.1 and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.
4. Perform cold weather concreting in conformance with ACI 306.1 and as specified herein when the ambient atmospheric temperature is 40 degrees F or below.
5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.

3. Avoid rapid drying at the end of the final curing period

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Liquid containing and below grade structures: Moist cure by the application of water to maintain the surface in a continually wet condition. Use water that is free of impurities that could etch or discolor exposed concrete surfaces.

4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods:

1. Water Curing: Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:

   a. Keeping the surface of the concrete continuously wet by ponding or immersion.

   b. Continuous water-fog spray or sprinkling.

   c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface, as necessary.

2. Sealing Materials:

   a. Use common sealing materials such as plastic film or waterproofing (kraft) paper when permitted by the Engineer.

   b. Lap adjacent sheets a minimum of 12 inches. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.

   c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.

   d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound:

   a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment

   b. Do not use curing compounds on construction and expansion joints or on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings or other applications requiring positive bond.

   c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F in any one hour and 50 degrees F in any 24-hour period.

F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

G. Protection from Deicing Agents: Do not apply deicing chemicals to concrete.

**3.08 - FIELD QUALITY CONTROL**

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305.1 and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F.

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306.1 and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F. All materials shall be free from ice, snow, and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F for the first five days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

2. Do not backfill the walls of structures that will be laterally restrained or supported by suspended slabs or slabs on grade until the slab is placed and the concrete has reached the specified compressive strength.

D. Concrete Testing

1. Concrete Quality Test Specimen:

a. Perform sampling and curing of test specimen in accordance with ASTM C31.

b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.

c. For each 50 cu. yd. of each mix design of concrete but not less than once a day nor less than once for each 5,000 sq. ft. of surface area of foundation mats, base slabs, footings, pile caps, slabs on grade, grade beams, walls, or elevated slabs, the testing agency will cast a minimum of:

(1) One set of four (4) 6”x12” test specimens or

(2) One set of seven (7) 4”x8” test specimens

d. Once a cylinder size has been selected, the size and number of specimens representing a strength test for each concrete mix shall remain constant.

e. For 6”x12” test cylinders:

(1) The testing agency will compression test one (1) of each set of four 6”x12” specimens at 7 days.

(2) Test two (2) of the remaining cylinders at 28 days for concrete strength acceptance.

(3) The fourth cylinder shall be held for testing at 56 days only if the 28 day cylinder strengths are deficient. The fourth cylinder of each set shall be discarded if the 28 day strengths meet or exceed the specified minimum strength.

f. For 4”x8” test cylinders:

(1) The testing agency will compression test two (2) of each set of seven 4”x8” specimens at 7 days.

(2) Test three (3) of the remaining cylinders at 28 days for concrete strength acceptance.

(3) The last two cylinders shall be held for testing at 56 days only if the 28 day cylinder strengths are deficient. The 6th and 7th cylinders of each set shall be discarded if the 28 day strengths meet or exceed the specified minimum strength.

2. The laboratory firm shall immediately notify the Contractor and the Engineer if the seven day strength is deficient.

3. The acceptance test result is the average of the strengths of the two specimens tested at 28 days.

4. The laboratory firm shall submit compression test results to both the Contractor and the Engineer. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.

5. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

E. Concrete Coring:

a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 4 inches in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.

b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.

c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C 39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.

e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

**3.09 - REPAIRS**

A. Provide in accordance with SECTION 03730, CONCRETE REPAIR.

**3.10 - CONCRETE FINISHES**

A. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other toppings or adhesive will be applied.

B. Do not sprinkle with dry cement or add water when finishing concrete surfaces.

C. Finish concrete surfaces in accordance with the following schedule:

| Table 03300-4 | |
|---|---|
| **Finish Designation** | **Area Applied** |
| F-1 | Beams, columns, and exterior walls not exposed to liquids or view. |
| F-2 | Walls, beams, and columns exposed to liquids EXCEPTION: surfaces that are to be coated. |
| F-3 | Walls, beams, and columns exposed to view and to 1 foot below liquid level or finished grade. Underside of formed floors or slabs. EXCEPTION: surfaces that are to be coated. Minimum liquid level elevation of the SBR's is 69.00 |
| F-4 | Exterior and interior surfaces to be coated. |
| S-1 | Slabs and floors to be covered with concrete or grout. |
| S-2 | Slabs and floors not liquid containing. |
| S-3 | Slab surfaces on which mechanical equipment moves. Slab surfaces to receive sealer or hardener shall be prepared in accordance with product manufacturer's requirements. |
| S-4 | Slabs and floors exposed to view, which are liquid containing, or are to receive crystalline waterproofing. |
| S-5 | Slabs and floors at slopes greater than 10% and stairs. |
| E-1 | Exposed edges. |
| E-2 | Top of walls, beams, and similar unformed surfaces. |

1. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.
2. Finish F-2: Repair defective concrete, remove fins, fill depressions 1/4 inch or deeper, and fill tie holes.
3. Finish F-3: In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
4. Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch.
5. Finish S-1: Screed to grade without special finish unless otherwise shown on contract documents. Roughen and/or apply bonding agent where shown on contract drawings.
6. Finish S-2: Smooth steel trowel finish.
7. Finish S-3: Steel trowel finish free from trowel marks and all irregularities.
8. Finish S-4: Steel trowel finish without local depressions or high points. For liquid containing slabs apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.
9. Finish S-5: Steel trowel finish without local depressions or high points. Apply a stiff bristle broom finish. Leave broom lines parallel to the direction of slope drainage.
10. Finish E-1: Provide 3/4-inch chamfer on external corners of exposed concrete walls, beams columns, equipment pads and exposed edges of construction joints. Do not chamfer columns flush with concrete block walls.
11. Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

D. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water.

E. The following concrete fill locations do not require the use of an epoxy bonding agent:

1. WWTF Basement Floor
2. Pre-Equalization Tanks
3. SBR Tanks
4. Post-Equalization Tank
5. Waste Activated Sludge Storage Tanks
6. Thickened Sludge Storage Tank
7. Plant Water Tank

**3.11 - FINISHING OF FORMED SURFACES**

A. Cure surfaces until finishing and repairing are completed.

B. Perform finish work in accordance with the schedule in Table 03300-4 as soon as possible after forms are removed.

C. Conform to the requirements specified in SECTION 03100, CONCRETE FORMWORK for tolerances for formed surfaces.

**3.12 - FINISHING OF UNFORMED SURFACES**

A. Perform finish work in accordance with the schedule in Table 03350-1.

B. Provide S-3 steel-trowel finish to all top, horizontal and inclined surfaces not otherwise specified or indicated. This includes concrete fills and toppings and floors. Provide hand steel-trowel finish to all surfaces such as weirs or walls over which liquids will flow.

C. Provide S-5 broom finish to exterior walkways, exterior stairs, entrance platforms and loading docks.

**3.13 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03345**

**CONCRETE FLOOR TREATMENT**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Concrete Floor Treatment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The Work of this section shall be provided by the General Contractor.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 – SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's product data.
2. Submit manufacturer's surface preparation and application instructions.
3. Submit manufacturer's color charts.
4. VOC Content Submittal:
    a. Product data for interior concrete floor treatment including printed statement of VOC content.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE:**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. D4263: Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - LIQUID HARDENER (LQH) – Not Used**

**2.02 - DUSTPROOF/SEALER (DPS)**

A. Manufacturers:

1. Armorseal Rexthane 1 manufactured by Sherwin Williams.
2. Duraguard 300HS manufactured by ChemMasters.
3. Eucothane manufactured by the Euclid Chemical Company.
4. Or acceptable equivalent product.

B. Provide a high solids, single component, moisture cure urethane with VOC compliance.

C. Provide surface primer in accordance with manufacturer's printed instructions.

D. Colors to be selected by Engineer.

**2.03 - EPOXY FLOOR COATING (EFC)**

A. Manufacturers:

1. Duraltex manufactured by the Euclid Chemical Company.
2. Tneme-Glaze 280 manufactured by Tnemec Company.
3. ArmorSeal 650/33 manufactured by the Sherwin Williams Company.

B. Provide a 100 percent solids, self-leveling, single or multicomponent epoxy.

1. Primer: As recommended by manufacturer.

C. VOC Content: 100 g/L or less.

D. See finish schedule for color.

## PART 3 - EXECUTION

### 3.01 - SURFACE PREPARATION

A. General:

1. Prepare concrete surfaces in accordance with manufacturer's printed instructions. Concrete shall be cured for a minimum of 28 days prior to application of floor treatment.
2. Acid etching will not be allowed.
3. Concrete surfaces shall be free of dirt, oil, wax, sealers, grease, rust stains, curing and parting compounds and other foreign matter.

### 3.02 - APPLICATION

A. Liquid Hardener (LQH) – Not Used:

B. Epoxy Floor Coating (EFC):

1. Perform testing for vapor drive on concrete floors in accordance with ASTM D4263 prior to application. Do not apply epoxy floor coating until test results have been approved by Contractor.
2. Apply primer in accordance with manufacturer’s printed instructions.
3. Give particular attention to priming of concrete substrate and time laps between coats when more than one conditioning coat is required.
4. Mix colored surface treatment and apply to sound, fully cured, dry and thoroughly clean concrete slabs in strict accordance with manufacturer's printed instructions.
    a. Total dry film thickness for dustproof/sealer: 4 mils. (primer and topcoat).
    b. Total dry film thickness for epoxy floor coating: 8-10 mils. (primer and topcoat).

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 03350**

**CONTROLLED LOW STRENGTH MATERIAL (CLSM)**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and install Controlled Low Strength Material as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.03 – SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. CLSM mix design and results of strength tests from trial mixes by the Contractor's testing laboratory firm.

2. Submit manufacturer’s Stable-Air Generator Admixture product data, installation instructions and recommendations for material use.

3. Test and Performance - Submit the following data:

a. Any required deviations from prescribed tests and special handling instructions for test specimens.

b. Controlled Low Strength Material shall have a maximum strength of 200 psi according to ASTM C39 at 56 days after placement.

c. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a final bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4” per foot of depth) as measured in Section 10 of ASTM C940.

d. Controlled Low Strength Material shall have a unit weight of 90 - 110 lbs./$ft^3$ measured at the point of placement.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Order CLSM from batching plant so that trucks arrive at discharge locations when material is required.

E. Deliver CLSM to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

F. Reject CLSM not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Sustainability Standards Certifications.

C. Do not place CLSM until design mix, material tests and trial batch mix compression test results are approved by the Engineer. Approvals are required at least 30 days before placing any production CLSM.

D. Employ an independent testing laboratory, acceptable to the Engineer to test conformity of materials to specifications and to design CLSM mixes.

E. Furnish, pay for and deliver representative samples of sufficient quantity of cement, aggregates and admixtures required for trial batch mixes to the testing laboratory. Obtain materials from the batching plant that will be supplying production CLSM in conformance with ASTM D75.

F. Measure all materials for CLSM, including water, with equipment and facilities suitable for accurate measurement and capable of being adjusted in conformance with ASTM C94. Use scales certified by local Sealer of Weights and Measures within one year of use and accurate when static load tested to plus or minus 0.4 percent of total capacity of scale. Batch all materials by weight except admixtures that may be batched by volume.

G. The testing laboratory will take control test specimens; conduct slump tests and measure air content and temperature in the field.

H. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172.
2. Specimen Preparation: ASTM C31.
3. Compressive Strength: ASTM C39.
4. Air Content: ASTM C231.
5. Slump: ASTM C143.
6. Temperature: ASTM C1064.
7. Unit Weight: ASTM C138.

**1.08 - REFERENCES**

A. American Concrete Institute (ACI):

1. 229R: Controlled Low-Strength Materials
2. 301: Specifications for Structural Concrete
3. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
4. 305R: Hot Water Concreting.
5. 306R: Cold Water Concreting
6. 308: Standard Practice for Curing Concrete
7. 318: Building Code Requirements for Structural Concrete and Commentary

B. ASTM International (ASTM):

1. C31: Practice for Making and Curing Concrete Test Specimens in the Field
2. C33: Specification for Concrete Aggregates
3. C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. C94: Standard Specification for Ready-Mixed Concrete
5. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
6. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. C150: Standard Specification for Portland Cement.
8. C172: Practice for Sampling Freshly Mixed Concrete
9. C231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
10. C494: Standard Specification for Chemical Admixtures for Concrete.
11. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
12. C940: Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
13. C1064: Test Method for Temperature of Freshly Mixed Portland Cement Concrete
14. D75: Practice for Sampling Aggregates

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PROJECT/SITE CONDITIONS**

A. Do not place CLSM until conditions and facilities for making and curing control test specimens are in compliance with ASTM C31 and as specified herein.

**PART 2 - PRODUCTS**

**2.01- MATERIALS**

A. Furnish Portland cement conforming to ASTM C150. Use one approved brand from one mill throughout the contract term unless otherwise approved by the Engineer. Use Type II for all work, unless otherwise specified.

B. Water:

1. Use water that is potable and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conforms to the requirements for water in ASTM C94, and as specified herein.
2. The maximum water-soluble chloride ion in the water shall not exceed 0.060 percent by weight of cement.

C. Aggregates:

1. Use aggregates for CLSM conforming to ASTM C33 and to the following requirements.

D. Admixtures:

1. General Requirements: ASTM C494.

E. Fly Ash: Provide fly ash conforming to the following requirements:

1. Class F fly ash conforming to ASTM C618 for chemical and physical properties.

2. Supplemental requirements in percent:

| | | |
|---|---|---|
| a. | Maximum carbon content | 3 percent |
| b. | Maximum sulfur trioxide ($SO_3$) content | 4 percent |
| c. | Maximum loss on ignition | 3 percent |
| d. | Maximum water requirement (as a percent of control) | 100 percent |
| e. | Fineness, maximum retained on No. 325 sieve | 25 percent |

**2.02 - MIXES**

A. Mix design shall produce a consistency that will result in a flowable product at the time of placement that does not require manual means to move it into place.

B. Provide mix with compressive strength of maximum 200 psi when measured 56 days after placement

C. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940 “Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory”.

D. The fresh unit weight shall be 90 - 110 lbs./$ft^3$, except where specified, and in the absence of strength data the cementitious content shall be a maximum of 150 lbs./cy.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Batch, mix and deliver CLSM in conformance with ASTM C94. Batch all constituents at a central batching or mixing plant.

B. Seasonal Conditions:

1. Conform to ACI 305R and as specified herein for hot weather concreting. Do not add retarder admixture to any concrete.

2. Conform to ACI 306R and as specified herein for cold weather concreting. Do not add accelerator admixture to any concrete.

**3.02 - TRANSPORTING AND MIXING**

A. Conform to concreting procedures set forth in ACI 304R and as specified herein.

B. Transport CLSM to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

**3.03 - FIELD TESTING**

A. General:

1. The testing laboratory will use concrete samples taken at the point of agitator or mixer truck discharge to perform slump, air content, and temperature tests and for field control test specimens.

B. Notification of Delivery:

1. Notify the Engineer of concrete deliveries a minimum of 48 hours in advance of the scheduled placement. Include within this notification, the mix design and quantity of concrete, method and location of placement, frequency of trucks, ordered slump and time of initial delivery.

2. Furnish delivery batch ticket to the representative from the owner's testing laboratory or to the Engineer representative in the field with each batch delivered to the discharge locations in conformance with ASTM C94.

C. Test Measurements at Discharge:

1. The testing laboratory firm will take measurement of concrete slump, air content and temperature for each 50 cubic yards of each mix design but not less than once a day. The laboratory will conduct the slump, air content and temperature test measurements in conformance with ASTM C143, ASTM C231, and ASTM C1064, respectively.

2. The testing laboratory will submit test reports of field measurements specified above to the Contractor and to the Engineer.

D. Control Test Specimens:

1. The testing laboratory will cast a minimum of one set of three field control test specimens in conformance with ASTM C31 for each 150 cubic yards of each mix design of concrete but not less than once a day.

2. Laboratory personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content, temperature and truck driver's name.

3. Furnish tightly constructed nonabsorbent test cylinder molds. Use molds of same type and manufacture for all test specimens. Leave molds on cylinders until received in testing laboratory.

4. Furnish boxes for initial curing of test cylinders in conformance with ASTM C31 from time of fabrication until they are transported to the testing laboratory.

5. The testing laboratory will compression test one of each set of three specimens at seven days. Immediately notify the Contractor and the Engineer if the seven-day strength is deficient. Test the two remaining cylinders at 65 days for concrete strength acceptance. The acceptance test result is the average of the strengths of the two specimens tested at 56 days. The laboratory firm will submit compression test results of the control test specimens to both the Contractor and the Engineer. Evaluation and acceptance of concrete shall conform to ACI 301 and ACI 318.

**3.04 - CURING AND PROTECTION**

A. Protect CLSM from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

B. Comply with curing procedures set forth in ACI 301, applicable portions of ACI 308 and as specified herein.

C. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.

D. Perform cold weather concreting in conformance with ACI 306R and as specified herein when the ambient atmospheric temperature is 40 degrees F or below.

E. Protect Controlled Low Strength Material from traffic until sufficient strength has been achieved for further construction operations

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 03450**

**PRECAST ARCHITECTURAL CONCRETE (Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 03450, PRECAST ARCHITECTURAL CONCRETE is a part of DIVISION 04, MASONRY which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 04120, STONE VENEER.

B. The Work of SECTION 03450, PRECAST ARCHITECTURAL CONCRETE requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Precast Architectural Concrete for Masonry Copings and Sills as specified herein and/or as shown on the Contract Drawings. The precast cap at the top of the cultured stone veneer shall have dimensions of 3 1/2-inches x 3 1/2-inches.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: For each type of product indicated.
2. Design Mixes: For each concrete mix.
3. Shop Drawings: Detail fabrication and installation of precast architectural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish, and types of reinforcement, including special reinforcement.
    a. Indicate separate face and backup mix locations and thicknesses.

b. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.

c. Indicate locations and details of anchorage devices to be embedded in other construction.

d. Indicate locations of anchors and treatment of joints.

4. Samples: For type of finish indicated on exposed surfaces of precast architectural concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12” x 12” x 2”.

5. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

a. Concrete materials.

b. Reinforcing materials.

c. Admixtures.

d. Bearing pads.

e. Water-absorption test reports.

6. Structural Performance:

a. Submit shop drawings as specified herein signed and stamped by a Massachusetts Registered Structural Engineer responsible for its preparation.

b. Precast concrete elements to withstand dead, live, wind and seismic loads in accordance with the Massachusetts Building Code.

7. Testing Agency Qualifications as specified in Paragraph 1.04.C.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

D. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Manufacturers Qualifications: A firm that complies with the following requirements:

1. Professional Engineer Qualifications: A professional engineer registered in The Commonwealth of Massachusetts and who has five years experience in the design of precast architectural concrete that are similar to those indicated for this Project in material, design, and extent within the past 10 years.
2. The precast concrete supplier shall be either a PCI-plant certified for Group A, Category A1--Architectural Cladding and Load Bearing Units or in AAA's Plant Certification Program for Production of Architectural Precast Concrete Products and is designated an APA – certified plant.

C. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

F. Mockups: Provide mockup to:

1. Engineer to review mockup before starting fabrication.
2. In the presence of Engineer, damage part of an exposed Architectural Precast Concrete and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM):

1. A239 – Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles.
2. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
3. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
4. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
5. PCI MNL 117, Manual for Quality Control for Plants and Product of Architectural Precast Concrete.
6. PCI, MNL 120, Design Handbook – Precast and Prestress Concrete.
7. PCI MNL, 122 Architectural Precast Concrete.

B. Commonwealth of Massachusetts Building Code.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

**1.09 - SEQUENCING**

A. Furnish anchorage items to be embedded in or attached to other masonry without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

**PART 2 – PRODUCTS**

**2.01 - MOLD MATERIALS**

A. Molds: Provide molds and, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete to produce continuous and true precast concrete surfaces within fabrication tolerances and for specified finishes.

**2.02 - REINFORCING MATERIALS**

A. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:

1. Steel Reinforcement: ASTM A 615, Grade 60.

B. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice," PCI MNL 117:

**2.03 - CONCRETE MATERIALS**

A. Portland Cement: ASTM C 150, Type I or Type III, white, of same type, brand, and source throughout the Work.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S.

1. Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining and of color and size to achieve finish of precast.

C. Coloring Admixture: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. No admixtures other than those specified shall be used.

**2.04 - STAINLESS STEEL CONNECTION MATERIALS**

A. Stainless-Steel connections, ASTM A666, Type 304.

**2.05 - GROUT MATERIALS**

A. Sand-Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

**2.06 - CONCRETE MIXES**

A. Prepare design mixes as specified.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M).

C. Normal-Weight Concrete Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

D. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL 117.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

**PART 3 – EXECUTION**

**3.01 – FABRICATION**

A. Cast-in Anchors, Inserts and Other Anchorage Hardware: Fabricate anchorage hardware with anchorage and embedment to comply with specified requirements. Position for attachment of loose hardware, and secure in place during precasting operations.

B. Install stainless steel connections consisting of anchors and other hardware shapes for securing precast architectural concrete units to supporting and adjacent masonry construction.

C. Cast-in slots, holes, and other accessories in precast architectural concrete units to receive anchors and other similar work as indicated.

D. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcement to maintain at least 1-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.

F. Mix concrete according to PCI MNL 117 and as specified herein. After concrete batching, no additional water may be added.

G. Consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 117.

H. Comply with ACI 306.1 procedures for cold-weather concrete placement.

I. Comply with ACI 305R recommendations for hot-weather concrete placement.

J. Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast architectural concrete unit on a surface that will not show in finished structure.

K. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

L. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or other-wise defective.

**3.02 - FABRICATION TOLERANCES**

A. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

**3.03 - FINISH, TEXTURE, QUALITY AND COLOR**

A. Finish exposed-face surfaces of precast architectural concrete units with a light sandblast finish. Color to be selected by Engineer.

1. Profiles as indicted on the Drawings.

**3.04 - SOURCE QUALITY CONTROL**

A. Quality-Control Testing: Test and inspect precrete according to PCI MNL 117 requirements.

B. Defective Work: Precast architectural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements at no additional cost to Owner.

**3.05 - WORKMANSHIP**

A. Precast units shall be true to dimensions, in perfect plane with no twists or bends. Form pockets for anchors and provide inserts. Joints shall be as indicated and shall be clean and accurate.

B. Exposed surfaces shall be hard and uniform in quality and finish, as specified.

C. Before removal from forms, concrete shall have attained a minimum compressive cube strength (using 4 by 8-in. cylinders) of 4,200 lbs/sq. in., as proven by simultaneously cast control cylinders.

**3.06 - REPAIRS**

A. Repairs, shall be indistinguishable from surrounding surfaces. Repairs may be made after providing a written request to Engineer for review. Mix formulae shall be determined by trial to obtain a color match when both patch and concrete are cured and dry. Employ same source of cement, sand and color as used in the parent concrete. After initial set, surfaces of patches shall be dressed mechanically or manually to obtain the same texture as surrounding surfaces. Repair technique, curing and final appearance of patches shall be subject to Engineer's review of samples.

B. Damaged, cracked, or spalled, concrete shall be cut away to expose sound, virgin concrete surfaces. Edges of area to be repaired shall be cut square to a minimum depth of 1/2-inches so that there will be no feathered edges.

C. Moist cure by keeping repair concrete and adjacent parent concrete in a continually damp condition. This may be accomplished by promptly covering with a double "poultice" of clean damp flannel, in turn covered with polyethylene taped to the concrete, being careful not to wash-out the patch. Cure as described for seven (7) days above 50 degrees F.

**3.07 - INSTALLATION AND CLEANING**

A. Installation and cleaning of the precast concrete units shall be included in SECTION 04200, UNIT MASONRY AND ACCESSORIES.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03600**

**GROUT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide all grout as specified herein and/or as shown on the Contract Drawings.

B. The Work of this section Includes:

1. Material for grouting reinforcing bars, anchor bolts into existing or newly placed concrete.
2. Material for grouting under bearing plates for columns or beams.
3. Materials for grouting under equipment.
4. Materials for grouting under and around steel tanks.
5. Materials for miscellaneous grouting including but not limited to railing posts, equipment guides, bollards, precast concrete joints and supports etc.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Commercially manufactured non-shrink, non-metallic cementitious grout:

   a. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

2. Commercially manufactured non-shrink epoxy grout:

   a. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM Standards and Material Safety Data Sheet.

3. Cement grout:

   a. Include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.

4. Concrete grout:

   a. Include data for concrete as delineated in SECTION 03300, CAST-IN-PLACE CONCRETE. This includes the mix design, constituent quantities per cubic yard, and the water/cement ratio.

5. Bonding Agent:

   a. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

C. Laboratory Test Reports.

1. Submit laboratory test data as required under SECTION 03300, CAST-IN-PLACE CONCRETE for concrete to be used as concrete grout.

D. Mill test reports for each shipment of cement, regardless of quantity, prior to incorporation into the work.

E. Manufacturer's specifications and instructions for all admixtures, curing materials, adjustable inserts and non-shrink non-metallic grout. Manufacturer’s certification of compatibility of all admixtures.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.

E. Store materials in accordance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to six months or the manufacturer's recommended storage time, whichever is less.

F. Reject material that becomes damp, lumpy or otherwise unacceptable and immediately remove from the site and replace with acceptable material at no cost to the Owner.

G. Deliver non-shrink cement based grouts as pre-blended, prepackaged mixes requiring only the addition of water.

H. Deliver non-shrink epoxy grouts as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All equipment shall be provided by the same manufacturer. The equipment shall be as manufactured by ##, ##, or ##. No other manufacturers are permitted.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Qualifications

1. Grout manufacturer to have a minimum of 5 years of experience in the production and use of the type of grout proposed for the Work.

B. Field Testing

1. Field testing and inspection services required will be provided by the Owner. Provide assistance in the sampling of materials and provide any ladders, platforms, etc. for access to the Work. Comply with the applicable ASTM Standards for testing.

2. The field testing of concrete grout will be as specified for concrete in SECTION 03300, CAST-IN-PLACE CONCRETE.

3. Take compression test specimens from the first placement of each type of grout to ensure compliance with these Specifications.

a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing one at seven days and two at 28 days.

b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B. A set of three specimens will be made for testing at seven days.

**1.08 - WARRANTY**

A. Warrant the materials and products specified in this Section against defective materials and workmanship with the manufacturer's standard warranty, but for no less than one year from the date of substantial completion.

B. Warrant the work against defects for one year from the date of substantial completion.

**1.09 - REFERENCES**

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Burlap Cloth made from Jute or Kenaf

B. American Petroleum Institute (API):

1. RP 686: Recommended Practice for Machinery Installation and Installation Design

C. ASTM International (ASTM):

1. C33: Standard Specification for Concrete Aggregates

2. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or (50-mm) Cube Specimens)

3. C150: Standard Specification for Portland Cement

4. C531: Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

5. C579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

6. C827: Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixes

7. C939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

8. C1107: Standard Specification for Packaged Dry, Hydraulic, Cement Grout (Non-shrink)

9. D695: Standard Test Method for Compressive Properties of Rigid Plastics

D. U.S. Army Corps of Engineers Standard (CRD):

1. C621: Corps of Engineers Specification for Non-shrink Grout

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - RESPONSIBILITIES**

A. Assist the Owner in obtaining specimens for testing and furnish all materials necessary for fabricating the test specimens.

B. The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of defective work, and re-testing all at no cost to the Owner.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Provide materials produced by one manufacturer or supplier in order to provide standardization of appearance.

**2.02 - APPLICATION**

A. Unless indicated otherwise, provide grouts as listed below:

**Table 03600-1**

| **Type of Grout** | **Application** |
|---|---|
| Cement Grout | Surface repairs |
| Non-Shrink – Class I | Storage tanks and other non-motorized equipment. |
| | Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (Where placement time is less than 20 min.). |
| | Repair of holes and defects in concrete members that are not water bearing and not in contact with soil or other fill material. |
| Non-Shrink – Class II | Column base plates. |
| | Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (where placement time exceeds 20 min.) |
| | Under precast concrete elements. |
| Non-Shrink Epoxy | Machinery subject to severe shock loads and high vibration. |
| Concrete Grout | Toppings and concrete/grout fill. |

**2.03 - MATERIALS**

A. Non-shrink Class I Grout:

1. Non-shrink Class I Grout shall have a minimum 28-day compressive strength of 5,000 psi, when mixed at a fluid consistency.

2. Non-shrink Class I grout shall meet the requirements of ASTM C1107, Grade B or C, when mixed to fluid, flowable and plastic consistencies.

3. Products:
    a. Sika Corporation; SikaGrout 212
    b. BASF Corporation; MasterFlow 713
    c. Euclid Chemical Comany; Euco NS
    d. Or equal.

B. Non-shrink Class II Grout:
1. Non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
2. Grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C1107.
3. Non-shrink grouts shall meet the requirements of ASTM C1107; Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.
4. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Products:
    a. BASF Corporation; Masterflow 928
    b. Euclid Chemical Co.; Hi-Flow Grout
    c. Sika Corporation; SikaGrout 212
    d. Or equal.

C. Cement Grout:
1. Cement grouts shall be a mixture of one part Portland cement conforming to ASTM C150 types I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout, but not to the degree that it will allow the grout to flow.
2. Cement grout materials shall be as indicated in SECTION 03300, CAST-IN-PLACE CONCRETE.

D. Concrete Grout:
1. Concrete grout shall conform to the requirements of SECTION 03300, CAST-IN-PLACE CONCRETE except as specified herein. Proportion with cement, coarse and fine aggregates, water, water reducer, and air entraining agent to produce a mix having an average strength of 4,000 psi at 28 days. Coarse aggregate size shall be 3/8-inch maximum. Keep the W/C ratio as low as practical while still retaining sufficient workability.

E. Non-shrink epoxy-based grout:
1. Provide a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in seven days when tested in conformity with ASTM D695 and have a maximum thermal expansion of $30 \times 10^{-6}$ when tested in conformity with ASTM C531.
2. Products:
    a. BASF Corporation; MasterFlow 648
    b. Five Star Products, Inc.; HP Epoxy Grout
    c. Sika Corporation; Sikadur 42 Grout-Pak
    d. Euclid Chemical Company; High Strength Epoxy Grout
    e. Or equal.

F. Dry Pack Grout:

1. Dry pack (to be packed or tamped in place) shall be mixed to a zero slump consistency.
2. When mixing the batch, add only enough water to the dry materials to produce a rather stiff mixture. Additions of water shall be made in small increments until the desired consistency is obtained.

G. Non-epoxy Bonding Compound:

1. Provide non-epoxy bonding compound that is re-wetable for up to two weeks.
2. Products:
   a. Larsen Products Corporation; Weld-Crete
   b. Sta-Dry Manufacturing Corporation; Link
   c. Euclid Chemical Company; Euco Weld
   d. Or equal.

**2.04 - CURING MATERIALS**

A. Curing materials for cement grout shall be as specified in SECTION 03300, CAST-IN-PLACE CONCRETE and as recommended by the manufacturer for prepackaged grouts.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Grout shall not be placed until base concrete or masonry has attained its design strength.

B. Prepare surfaces for curing, and protection of cement grout in accordance with SECTION 03300 CAST-IN-PLACE CONCRETE.

C. Shade the work sites from sunlight for at least 24 hours before and 48 hours after grouting.

D. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

**3.02 - PREPARATION**

A. Clean concrete surfaces to receive grout free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose or unsound material or foreign matter that may affect the bond or performance of the grout.

B. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

C. Remove all loose rust, oil or other deleterious substances from metal embedments prior to the installation of the grout.

D. Wash concrete surfaces clean and keep them moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturate by covering the concrete with a plastic sheet or using either a soaker hose, flooding the surface or other method acceptable to the Engineer. Remove visible water from the surface upon completion of the 24-hour period prior to grouting. Use an accepted adhesive bonding agent in lieu of surface saturation when accepted by the Engineer for each specific location of grout installation.

E. Epoxy based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

F. Construct grout forms or other leak proof containment. Forms shall be lined or coated with release agents recommended by the grout manufacturer.

G. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other accepted means. Prevent the shims, wedges, and blocking devices from bonding to the grout by appropriate bond breaking coatings and remove them after grouting unless otherwise accepted by the Engineer.

**3.03 - GROUTING MACHINERY FOUNDATIONS**

A. After the machinery has been set in position and placed at the proper elevation by steel wedges, the space between the bottom of the machinery base and the original placement of concrete shall be filled with a pourable non-shrink grout. Grout and grouting procedure shall be in accordance with API 686.

**3.04 - INSTALLATION**

A. Cement Grouts and Non-shrink Cementitious Grouts:

1. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the grout manufacturer and the Engineer.

2. Avoid mixing by hand. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the additional water required to obtain workability. However, do not exceed the manufacturer's maximum recommended water content.

3. Place grout into the designated areas in a manner that will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner that will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (re-temper) after initial stiffening.

4. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise accepted by the Engineer.

5. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer.

B. Non-shrink Epoxy Grouts:

1. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not over mix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate. Partial mixes will be rejected and will require the suspect grout to be removed and be replaced.

2. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.

3. Place grout into the designated areas in a manner that will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

4. The extension of grout horizontally beyond base plate shall be less than or equal to the grout thickness.

5. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

C. Concrete Grout:

1. Provide the underlying concrete surface with a broomed finish. Protect and keep the surface clean until placement of concrete grout.

2. Remove the debris and clean the surface of all dirt and other foreign materials.

3. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16- to 1/8-inch thick cement paste.

D. Dry Pack:

1. Dry pack consistency shall be such that the grout is plastic and moldable but will not flow.
2. The use of pneumatic pressure for dry-packed grouting requires acceptance of the Engineer.

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 03730**

**CONCRETE REPAIR**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to Repair Concrete as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Complete concrete repair operations in accordance with these specifications and the various system manufacturers' instructions regarding surface preparation, application, inspection and requirements for safety.

D. Complete crack repair work in accordance with these specifications and crack repair material manufacturer's instructions.

E. Complete joint repair work in accordance with these specifications and the joint repair material manufacturer's instructions.

F. The areas of concrete repair shall be determined by the Contractor and the Engineer and shall include any location where acidic attack of the concrete surfaces has reached a depth of ½" or deeper and at any air voids, bug holes or poorly consolidated concrete areas where the specified filler/surfacer materials cannot be used for filling or surfacing of the concrete.

G. If repair work is required for an area indicated to receive protective lining or coating, provide such repair in accordance with the requirements of this specification and the related lining or coating specifications.

H. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 4-inch. If after blasting and cleaning, an area is discovered that requires a repair greater than 4-inch deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Engineer so that details may be provided to the Contractor to complete the repair.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Crack Repair: The quantities in linear feet to be measured for payment shall be the actual length of cracks repaired by the methods and materials specified under.

1. Epoxy crack repair.
2. Flexible polyurethane crack repair.
3. Rigid polyurethane crack repair.

C. Spall Repair Depth 4-inch or less: The quantities in square feet to be measured for payment shall be the actual square footage of spalled concrete repaired by the method and materials specified under spall repair.

D. Spall Repair Depth Greater Than 4-inch: The quantities in cubic feet to be measured for payment shall be the actual cubic footage of spalled concrete repaired by the method and materials specified under spall repair.

E. Crystalline Waterproofing Crack and Joint Repair: The quantities in linear feet to be measured for payment shall be the actual length of joints repaired by the methods and materials specified under crystalline waterproofing crack and joint repair.

F. Pipe Penetrations: The quantities in linear feet to be measured for payment shall be the actual circumference repaired by the methods and materials specified under pipe penetrations.

G. Waterproofing Treatment: The quantities in square feet to be measured for payment shall be the actual square footage of concrete surface to which the coating shall be applied specified under waterproofing treatment.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS.

1. Procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.

2. Manufacturer's recommendations and product data sheets for all repair materials including performance criteria, surface preparation, ambient condition requirements and applications, curing requirements, volatile organic compound (VOC) data, and safety requirements.

3. Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents and abrasive blast media.

4. Qualifications of foreman and epoxy gun operators and demonstration of meeting the minimum requirements specified.

5. Design Mixes: Provide concrete and cement mortar in conformance with SECTION 03300, SUBMITTALS and as specified herein.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Comply with the requirements in SECTION 01610, DELIEVERY, STORAGE AND HANDLING.

D. Provide shelter to store materials in area or areas designated by the Owner solely for this purpose. Confine mixing, thinning, clean-up and associated operations and storage of repair mortar materials debris before authorized disposal, to these areas.

E. Mix all specified materials in the sheltered mixing operation and materials from direct sunlight and inclement weather. Protect facilities from staining and damage.

F. Do not dispose of waste materials on-site.

G. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in Contractor's area longer than 24 hours.

H. Deliver all materials to the job site in new, unopened containers. Each container shall bear the manufacturer's name and label. Labels on all material containers shall contain the following information:

1. Name of product.
2. Federal Specification Number if applicable.
3. Manufacturer's batch number.
4. Manufacturer's name.
5. Generic type of material.
6. Hazardous material identification label.
7. Shelf life date.

I. Clearly mark all containers indicating any safety hazards associated with the use of or exposure to the materials.

J. Handle and store materials to prevent damage or loss of label. Protection of materials is the Contractor's responsibility.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Furnish the names of all subcontractors proposed for use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

C. Include in accepted applicator qualifications:

1. A minimum of five years experience in applying epoxy, polyurethane and polymer-modified and cement-based compounds, and crystalline waterproofing repair systems similar to those specified in this Section.
2. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

D. Adhere strictly to the manufacturer's printed recommendations supplied with the product regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the ambient temperature is below 50 degrees F 24 hours before, during, or for a period of 48 hours after the completion of the repair. Do not use crystalline waterproofing materials when either the temperature of the concrete to be repaired or the ambient temperature is below 40 degrees F 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.

E. Use new materials and use within the shelf life limitations set forth by the manufacturer. Clearly mark the shelf life limitations of each container.

F. The Contractor is ultimately responsible for the concrete repair work. Inspections by the Engineer or others do not limit the Contractor's responsibility.

G. Make all parts of the work accessible for inspections by the Engineer. Correct any conditions not in conformance with the specifications at no additional cost to the Owner.

H. Provide a Representative on site at all times when work is ongoing to represent the Contractor and to have authority to receive and execute all instructions given by the Engineer.

I. Allow changes in the specified repair work methods only with the permission of the Engineer.

J. Provide technical field support or training services required by the accepted material manufacturers at no additional cost to the Owner.

K. Provide materials from a single manufacturer for all components of a single repair.

**1.08 – REFERENCES**

A. National Association of Corrosion Engineers (NACE):

1. 6D-173: "A Manual for Painter Safety"
2. 6F-163: "Surface Preparation of Steel or Concrete Tank Interiors"
3. TPC2: "Coatings and Linings for Immersion Service"

B. American Concrete Institute (ACI):

1. 503.4: Standard Specification for Repairing Concrete with Epoxy Mortars

C. ASTM International (ASTM ):

1. C33: Standard Specifications for Concrete Aggregates
2. C150: Standard Specification for Portland Cement
3. C321: Standard Test Method for Bond Strength of Chemical-Resistant Mortars
4. C882: Test Method for Bond Strength of Epoxy Resin Systems
5. D570: Test Method for Water Absorption of Plastics
6. D638: Test Method for Tensile Properties of Plastics
7. D695: Test Method for Compressive Properties of Rigid Plastics
8. D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
9. D4262: L.R. Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces
10. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
11. E337: L.R. Standard Practice Test Method for Measuring Humidity with a Psychrometer.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SERVICES OF MANUFACTURERS REPRESENTATIVES**

A. Provide the services of a qualified manufacturer's technical representative to instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane, polymer-modified, crystalline repair systems and cement-based compounds.

B. Provide written certification from the manufacturers' representative that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. Provide on-site time required for the manufacturer's representative to achieve a successful installation at no additional cost to the Owner.

**1.10 - PROJECT/SITE CONDITIONS**

A. Environmental Requirements:

1. Comply with the repair material manufacturer's recommendations as to environmental conditions under which materials can be applied and cured.
2. Do not apply materials when dust is being generated.

B. Protection:

1. Cover or otherwise protect finish work or other surfaces not being repaired.

C. Ventilation:

1. Provide ventilation to meet product requirements prior to, during, and after application.

**PART 2 - PRODUCTS**

**2.01 - WATER**

A. Use water free from injurious amounts of ice, oil, acid, alkali, salt, organic matter, or other deleterious substances and conforms to requirements of ASTM C1602.

B. Water shall not contain more than 500 mg of chlorides or more than 500 mg of sulfates.

C. Heat or cool water to obtain concrete repair product temperatures in accordance with manufacture's printed recommendations, and in accordance with ACI 305.1 and ACI 306.1.

**2.02 - AGGREGATE**

A. All aggregates shall conform to ASTM C33 and SECTION 03300, CAST-IN-PLACE CONCRETE.

**2.03 - EPOXY BONDING AGENT**

A. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.

B. Products:

1. Sika Corporation; Sikdur 32 Hi-Mod
2. Euclid Chemical Company; Duralcrete
3. BASF Corporation; MasterEmaco ADH 326
4. Or equal.

**2.04 - ANTI-CORROSION COATING**

A. Anti-corrosion coating shall be a three-component, solvent free, and moisture tolerant epoxy-modified cementitious material.

B. Products:

1. Sika Corporation; Sika Armatec 110
2. Sto Corporation; CR 246
3. Euclid Chemical Company; Duralprep A.C.
4. Or equal.

**2.05 - EPOXY CRACK REPAIR BINDER**

A. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection or gravity feed.

B. Products:

1. Sika Corporation; Sikadur 52
2. Euclid Chemical Company; Duralcrete LV
3. BASF Corporation; MasterInject 1380
4. Or equal.

**2.06 - FLEXIBLE POLYURETHANE CRACK REPAIR MATERIAL**

A. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

B. Products:

1. Prime Resins; Prime Flex 900 XLV
2. Sika Corporation; Sikafix HH Hydrophilic
3. Euclid Chemical Company; Dural Aqua-Fil
4. Or equal.

**2.07 - RIGID POLYURETHANE CRACK REPAIR MATERIAL**

A. Rigid polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophobic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough rigid foam seal that is impenetrable to water.

B. Products:

1. Euclid Chemical Company; Dural Aqua-Dam LV
2. Prime Resins; Prime Flex 920
3. Sika Corporation; Sikafix HH LV
4. Or equal.

**2.08 - EPOXY REPAIR MORTAR**

A. Epoxy Repair Mortar shall be two-component, 100 percent solids, and 100 percent reactive epoxy resin system.

B. Spall repair mortar for use in horizontal applications.

1. Products:
   a. BASF Corporation; MasterEmaco ADH 327
   b. Sika Corporation; Sikadur 22 Lo-Mod
   c. Euclid Chemical Company; Euco #4565 Mortar
   d. Or equal.

C. Spall repair mortar for use in vertical and overhead applications.

1. Products:
   a. Sika Corporation; Sikadur 23 Lo-Mod Gel
   b. BASF Corporation; MasterEmaco ADH 327
   c. Or equal.

**2.09 - SPALL REPAIRS USING NON-SHRINK CEMENTITOUS MORTAR**

A. Products:

1. BASF Corporation; MasterEmaco S 488CI
2. Sika Corporation; Sika Repair 224
3. Sauereisen, Inc.; Restokrete Underlayment No. F-120
4. Or equal.

**2.10 - SPALL REPAIRS USING POLYMER MODIFIED CEMENTITOUS MORTAR**

A. Repair spalls repair not requiring formwork using a two-component, polymer-modified cementitious mortar having a minimum 28-day compressive strength of 6,000 psi.

B. Spall repair mortar for use in horizontal applications.

1. Products:

a. Sika Corporation; Sikatop 122 Plus

b. Euclid Chemical Company; Duraltop Flowable Mortar

c. BASF Corporation; MasterEmaco T302

d. Or equal.

C. Spall repair mortar for use in vertical applications.

1. Products:

a. Sika Corporation; Sikatop 123 Plus

b. Euclid Chemical Company; Duraltop Gel

c. BASF Corporation; MasterEmaco N 423RS

d. Or equal.

**2.11 - SPALL REPAIRS REQUIRING FORMWORK**

A. Repair spalls repair requiring formwork using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 5,000 psi. Mix each unit of mortar with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

B. Products:

1. Sika Corporation; Sikatop 111 Plus

2. Euclid Chemical Company; Duraltop Flowable Mortar

3. BASF Corporation; MasterEmaco N 1500HCR Self Consolidated-Extended

4. Or equal.

**2.12 - CRYSTALLINE WATERPROOFING CRACK AND JOINT REPAIR**

A. Repair cracks and joints using a crystalline waterproofing crack and joint repair system consisting of a three stage application of filling a square or U-shaped routed out crack or joint in equal lifts followed by a surface applied slurry over a 12-inch width of the crack.

B. Products:

1. Kryton International; Krystol T1 and Krystol T2.

2. Xypex Chemical Corporation; Xypex Concentrate and Xypex Concentrate (Dry-Plug).

3. Penetron International; Penetron and Penecrete Mortar

4. Or equal.

**2.13 - PIPE PENETRATIONS EXTERIOR OF CELL**

A. Repair pipe penetrations using a crystalline waterproofing crack and joint repair system consisting of a three stage application of filling a square or U-shaped routed out area at the pipe/concrete interface in equal lifts.

B. Products:

1. Kryton International; Krystol T1 and Krystol Bari-Cote.
2. Xypex Chemical Corporation; Xypex Concentrate and Xypex Concentrate (Dry-Plug).
3. Penetron International; Penetron and Penecrete Mortar
4. Or equal.

**2.14 - WATERPROOFING TREATMENT**

A. Waterproofing treatment shall be a surface applied crystalline waterproofing system shall be a brush or spray applied two coat system.

B. Products:

1. Kryton International; Kryton T1 and Kryton T2.
2. Xypex Chemical Corporation; Xypex Concentrate.
3. Penetron International; Penetron.
4. Or equal.

**2.15 - WATERPROOF MEMBRANE PATCH**

A. Waterproof membrane patch shall be a hypalon sealing strip secured to the concrete substrate with an epoxy adhesive.

B. Install sealing system per manufacturer's recommendations.

C. Products:

1. Sika Corporation; Sikadur Combiflex SG System
2. Trelleborg Engineered System; Waterproofing Band
3. Or equal.

**2.16 - CEMENT BASED TEXTURED COATING**

A. Products:

1. Sika Corporation; Sikatop 144
2. Euclid Chemical Company; Duraltop Coating
3. BASF Corporation; MasterSeal 581
4. Or equal.

**2.17 - EXPANSION JOINT FILLER**

A. Expansion joint filler shall be as specified in SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

**PART 3 - EXECUTION**

**3.01 - GENERAL REQUIREMENTS**

A. Perform exterior work during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. Protect unfinished work during inclement weather with tarpulins or heavy gage polyethylene sheeting.

B. Perform work in spaces within structures at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

C. Coordinate concrete rehabilitation work with other work being performed.

D. Remove scaling, broken, loose and disintegrating materials by use of hand tools or power driven saws, down to solid unyielding material.

E. Clean surfaces thoroughly of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

**3.02 - EPOXY BONDING AGENT**

A. Use epoxy bonding agent to adhere fresh mortar to existing concrete. Roughen existing concrete surfaces prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Place repair material while bonding agent is still tacky or per the written instructions of the manufacturer. Reapply bonding agent if bonding agent cures prior to placement of repair material.

B. Conform to all the requirements of ACI 503.4, and as specified herein.

**3.03 - ANTI-CORROSION COATING**

A. Sandblast, clean and coat reinforcing steel that is cut or exposed during alteration and/or repair operations with an anti-corrosive coating.

B. Cover all exposed parts of the steel with the coating and apply according to manufacturer's recommendations.

**3.04 - EPOXY CRACK REPAIR**

A. Cracks on horizontal surfaces: When permitted by the Engineer repair existing cracks by gravity feeding an epoxy crack repair binder into the prepared crack.

1. Rout concrete surface at the crack to form a minimum 1/4-inch wide by 1/4-inch deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.

2. As binder penetrates into crack, apply additional binder to the V-notch.

B. Cracks on vertical or horizontal surfaces: Repair cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per manufacturer's recommendations.

1. Do not damage reinforcement steel when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.

2. Inject crack with epoxy crack repair binder once the surface sealing material has cured as directed by the manufacturer.

3. Remove injection ports upon satisfactory completion of crack injection and patch with epoxy mortar.

**3.05 - RIGID AND FLEXIBLE POLYURETHANE CRACK REPAIR**

A. Repair leaking cracks by pressure injecting with a waterproof hydrophilic or hydrophobic injection grout as directed by the Structural Engineer of Record. Seal crack surfaces and install injection ports per manufacturer's recommendations.

B. Do not damage rebar when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and patch immediately with epoxy mortar flush with the surface of the existing concrete.

C. Inject crack with hydrophilic or hydrophobic injection grout as directed once the surface sealing material has cured, as directed by the manufacturer.

**3.06 - SPALL REPAIR**

A. Saw cut the perimeter of the repair area to a minimum depth of 1/4-inch below the surface of the concrete. Chip all loose concrete in the repair area to remove loose and degraded concrete to a minimum of 1/4-inch or until a sound substrate is reached. Clean the area to be repaired and restore to the original dimensions with spall repair patching material according to the manufacturer's recommendations.

B. Make final finished surface of patches flat, level and even with the existing concrete surface. Do not feather repair mortar to meet existing concrete surface.

C. Finish final patches on horizontal surfaces consistent with the finish on the existing structure.

**3.07 - JOINT REPAIR**

A. Remove sealant, bond breaker and joint filler.

B. Remove unsound concrete on the joint faces.

C. Remove laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following the manufacturer's instructions.

E. Restore surface to original dimensions by trowelling epoxy mortar onto the existing substrate in a manner to ensure bonding following the manufacturer's instructions.

F. Cure repair in accordance with the manufacturer's instructions.

G. Install new joint filler, bond breaker and sealant.

**3.08 - WATERPROOF MEMBRANE PATCH**

A. Clean and install waterproof membrane textured patches on existing concrete areas requiring a textured patch according to manufacturer's recommendations.

**3.09 - CEMENT BASED TEXTURED COATING**

A. Clean existing concrete areas requiring a textured coating and apply the cement based textured coating according to manufacturer's recommendations.

B. Complete other concrete rehabilitation prior to applying coating.

**3.10 - CRYSTALLINE WATERPROOFING CRACK AND JOINT REPAIR**

A. Identify all cracks and joints to be repaired prior to commencing repair operations.

B. Using a concrete saw or angle grinder, create a 1/4 inch deep groove 1/2 inch to either side of the crack or joint to create a vertical seam for chipping operations. Using a 1 inch square chisel, chip a 1 inch wide chase along all cracks and joints to a minimum depth of 1.5 inches. The chase must be square or U-shaped.

C. Clean the chase of dust and loose concrete.

D. Pre-wet the surface to a saturated-surface-dry (SSD) condition. Do not leave any standing, pooled, or puddled water.

E. Fill one-third of the depth of the chase with the first lift of repair material. Cure the material per manufacturer’s printed instructions.

F. Fill the next one-third of the chase with the second lift of repair material. Cure the material per manufacturer’s printed instructions.

G. Fill the remaining one-third of the chase with the third and final lift of repair material. Cure the material per manufacturer’s printed instructions.

H. If the surface of the concrete is not receiving a complete Waterproofing Treatment, apply a slurry coat of waterproofing treatment to 6-inch to either side of the crack or joint.

**3.11 - PIPE PENETRATIONS**

A. Identify all pipe penetrations to be repair prior to commencing pipe penetration repairs.

B. Pipe penetration repairs shall not be performed against flowing or seeping water.

C. Prepare a recessed chase using a 1 inch square chisel to chip a 1 inch wide chase to a minimum depth of 1.5 inches. The chase must be square or U-shaped.

D. Prepare the pipe surface so that the repair products will adhere to the pipe in accordance with manufacturer printed instructions. Remove all grease, oil, corrosion, and scale. Abrade the pipe surface within the chase by coarse sanding to achieve a coarse surface profile.

E. Clean the chase of dust and loose concrete.

F. Fill one-third of the depth of the chase with the first lift of repair material. Cure the material per manufacturer's printed instructions.

G. Fill the next one-third of the chase with the second lift of repair material. Cure the material per manufacturer's printed instructions.

H. Fill the remaining one-third of the chase with the third and final lift of repair material. Cure the material per manufacturer's printed instructions.

**3.12 - WATERPROOFING TREATMENT**

A. Repair surface defects in accordance with Section 3.06, Spall Repair.

B. Clean existing concrete areas by high pressure water blasting (3,000 psi minimum) to remove loose concrete and surface contaminants. Wash and rinse with a detergent or concrete degreaser if required to remove contaminants prior to water blasting. Sand blasting, scarifying, shot blasting, other mechanical methods, or acid-etching are not permitted.

C. Apply first coat of waterproofing treatment to a surface saturated dry surface. Apply at the recommend rate in accordance with manufacture's printed instructions for the surface orientation. Cure the material in accordance with the manufacturer's printed instructions.

D. Apply second coat of waterproofing treatment to a surface saturated dry surface following the recommended cure time for the first coat. Apply at the recommend rate in accordance with manufacture's printed instructions for the surface orientation. Cure the material in accordance with the manufacturer's printed instructions.

E. Wait a minimum of 14 days following completion of final curing prior to cleaning and filling tanks that are to contain potable water.

**3.13 - CURING**

A. Cure repair materials in accordance with manufacturer's printed instructions.

**3.14 - CLEANING**

A. Mechanically remove excess material from walls, floors, etc. after material has cured.

B. Clean excess materials caused by work under this Section from existing surfaces by the use of power sanders. Vacuum surfaces to receive final cleaning and finishing specified under other sections of the specifications. Sand cracks (except those repaired by crystalline waterproofing crack and joint repair methods) flush to adjacent surfaces.

C. Remove misplaced sealants using methods and materials recommended by the manufacturers. Leave finished work and work area in a neat and clean condition.

D. Rinse tanks containing drinking water with potable water following completion of repairs.

**3.15 - LEAKAGE TESTING**

A. Provide leakage testing in accordance with SECTION 03800, LEAKAGE TESTING OF CONTAINMENT STRUCTURES.

B. Leak test all cells in the single test. Do not test cells individually.

**3.16 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 03800**

**LEAKAGE TESTING OF CONTAINMENT STRUCTURES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide method of testing concrete containment structures for leakage as specified herein and/or as shown on the Contract Drawings.

B. All containment structures shall be leak tested unless specifically exempted by the Engineer.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

A. American Concrete Institute (ACI):

1. 350.1: Tightness Testing of Environmental Engineering Concrete Structures and Commentary.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Provide piping and equipment to test concrete structures for leakage as described herein.

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. Hydrostatically test reinforced concrete structures which will contain fluids to determine that they conform to leakage criteria specified herein and are free of detectable leaks. Do not hydrostatically test walls that are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.

B. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means other than washing through plant piping. All potential leakage points shall be identified and repaired prior to filling the tank with water for the tightness test. Methods for repairing concrete shall be as described in SECTION 03730, CONCRETE REPAIR WORK.

C. No backfilling, floor finish, concrete or mortar fill, wall insulation, gas proofing or protective coatings shall be applied to or installed in any new containment structures until they have been subjected to loading for settlement and tested for leakage. Testing shall not be done until the concrete has reached its specified design strength.

### 3.02 - PRELOADING TEST

A. For the Preloading Test the Contractor shall maintain the liquid level in the structures at the design maximum water level for 72-hours. If the characteristics of settlement of the structure so require, the loading shall continue for a longer period to permit the necessary consolidation of the foundation material, in which case the Contractor shall be entitled to no extra compensation, but a commensurate extension of time for completion of the whole work under this contract shall be allowed.

### 3.03 - LEAK TEST PROCEDURE

A. Leakage testing shall meet the provisions of ACI 350.1 – Tightness Testing of Environmental Engineering Concrete Structures. The test criterion shall be HST-050 (0.050 percent per day) [or HST-NML (no measurable loss) or HST-100 (0.100 percent per day] as defined by ACI 350.1

B. During the test period, the excavation around the structure shall be kept dewatered by the Contractor. Dewatering shall maintain the groundwater level to below the top of the base slab. The Contractor shall temporarily seal all bottom openings and wall openings below maximum water level in the structures, furnish and fill the structures to the design maximum water level with clean water. The Contractor shall make his own arrangements for handling the water for testing and its transfer from one structure to another and its final disposal.

C. Filling rate shall not exceed a 4 feet per hour or as permitted by the Engineer. Filling shall be at a uniform rate with continuous monitoring.

D. During the leakage test period, the Engineer will inspect the structure for leakage or change in volume. If moist spots become visible, indicating the existence of minor leaks, or if the water level indicates hidden leakage, the Contractor shall furnish all materials and do all work necessary to locate the leaks and make the structure watertight to the complete satisfaction of the Engineer. No additional compensation will be allowed for such work.

E. If, in the opinion of the Engineer, during the course of the test weather conditions are such that it becomes difficult to accurately monitor the water level in the tank, the test shall be stopped, and started over again when weather permits, at no additional cost to the Owner.

F. On conclusion of the test, the Contractor shall pump or drain the water from the structure and dispose of it without damage to structures or surrounding facilities.

G. The structure will be considered as passing the water tightness test when no wet spots are observed on the exterior surfaces of the containment structure during the water tightness test period and when the measured loss is less than the maximum specified

### 3.04 - REPAIR METHODS

A. Methods for repairing concrete not passing the leakage test shall be as described in SECTION 03730, CONCRETE REPAIR WORK.

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 04120**

**STONE VENEER**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 4, MASONRY shall include the complete Work specified in all of the following Sections:

1. SECTION 04120, STONE VENEER
2. SECTION 04200, UNIT MASONRY AND ACCESSORIES
3. SECTION 03450, PRECAST ARCHITECTURAL CONCRETE

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 04120, STONE VENEER for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-101 | 10 A-102 | 10 A-103 | 10 A-201 | 10 A-202 | 10 A-301 |
| 10 A-302 | 10 A-303 | 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 |
| 10 A-404 | 10 A-406 | 10 A-407 | 10 A-408 | 10 A-501 | 10 A-503 | 10 A-504 |
| 10 A-505 | 10 A-604 | 10 A-605 | 10 A- 606 | 10 A-607 | 99 A-607 | 00 S-001 |
| 00 S-001 | 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 S-303 |
| 99 S-501 | 99 S-502 | 99 S-502 | 99 S-504 | 99 S-505 | 99 S-506 | 00 D-001 |
| 00 D-002 | 10 D-100 | 10 D-104 | 10 D-105 | 10 D-301 | 10 D-302 | 10 D-303 |
| 10 D-304 | 10 D-305 | 10 D-306 | 10 D-307 | 10 D-308 | | |

2. The Work of SECTION 04120, STONE VENEER for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-102 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 |
| 20 A-401 | 20 A-501 | 20 A-601 | 20 A-602 | 20 A-603 | 99 A-607 | 00 S-001 |
| 00 S-002 | 20 S-101 | 20 S-102 | 99 S-501 | 99 S-502 | 99 S-505 | 99 S-506 |
| 00 D-001 | 00 D-002 | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 04120, STONE VENEER and
SECTION 04200, UNIT MASONRY AND ACCESSORIES

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Stone Veneer as specified herein and/or as shown on the Contract Drawings.

1. Stone cladding, siding and veneer of exterior walls as indicated.

2. Thin stone veneer on thin set.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data:

a. Preparation instructions and recommendations.

b. Storage and handling requirements and recommendations.

c. Installation methods.

2. Selection Samples: Submit mortar color samples.

3. Verification Samples: Submit 2 manufacturer’s full-size samples of natural veneer stone for each pattern specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Store stone on pallets or wooden crates. Pallet shall be shrink-wrapped.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Stone Producer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

C. Stone Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.

D. Mock-Up: Provide a mock-up for evaluation of stone, mortar color and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until Architect approves workmanship, color, and sheen.
3. Refinish mock-up area as required to produce acceptable work.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. ASTM C91: Standard Specification for Masonry Cement.
2. ASTM C144: Standard Specification for Aggregate Masonry Mortar.
3. ASTM C150: Standard Specification for Portland Cement.
4. ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes.
5. ASTM C270: 08a Standard Specification for Mortar for Unit Masonry.
6. ANSI A118.4: Latex Portland Cement Mortar

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PROJECT CONDITIONS**

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install natural stone veneer under environmental conditions outside manufacturer's limits.

B. Hot and Cold Weather Requirements: ACI 530.1/ASCE 6/TMS 602.

C. Air Temperature: 40 degrees F or above during installation.

D. Mortar Mixing Water: Heat mortar mixing water when air temperature falls below 50 degrees F.

## PART 2 - PRODUCTS

### 2.01 - MANUFACTURERS

A. Acceptable Manufacturers for stone veneer:

1. STONEYARD® - 265 Foster Street; Littleton, MA 01460; Tel: 978-742-9800; Fax: 978-742-9898; Email: sales@stoneyard.com. Web: www.stoneyard.com
2. Natural Stone Veneer International (NSVI), 390 W Rolling Meadows Drive, Fond du Lac, WI 54937; Tel: 920-923-2800. Web: www.NSVI.com
3. Fieldstone Veneer - 49-1/2 Summer St. Milford, MA 01757; Tel: 844-983-6337. Web: www.fieldstoneveneer.com

### 2.02 - NATURAL VENEER STONE

A. Physical Characteristics:

1. Fieldstone: Collected stone from farms and fields in Massachusetts, Connecticut, Rhode Island, New Hampshire, Vermont, and Maine.
2. Color and Veining Range: Earth tones of brown, tan, gray, buff, pink, yellow, white, and black.
3. Density: 153.0 pcf.
4. Bulk Specific Gravity: 2.46.
5. Water Absorption: 0.54 percent.
6. Modulus of Rupture Perpendicular: 1,854 psi.
7. Modulus of Rupture Parallel: 2,692 psi.
8. Compressive Strength Perpendicular: 19,958 psi.
9. Compressive Strength Parallel: 17,307 psi.

B. Sizes and Shapes:

1. Natural Stone Veneer. Broad range of colors including brown, tan, gray, buff, pink, yellow, white and black.
2. Natural aged and split faces. Commonly used as an architectural stone siding for interior and exterior veneer applications.
3. Adhered Thin Veneer - 1.0-inch thick (plus or minus 0.25-inches). Lightweight (less than 14 lbs per square foot), natural stone, does not require a supporting masonry shelf. Used for exterior applications:
   a. Flats.
   b. Pre-Cut Corners for the appearance of full depth stone
   c. Mosaic Thin Veneer: style Boston Blend Ashlar from Stoneyard or equal.
      (1) Primarily natural weathered faces with some split faces
      Thickness: 1.0 inch (plus or minus 0.25 inch)
      (2) Facing area: 0.25 to 1.25 sf
      (3) Pre-cut corners present full size stone shape in a thin veneer

**2.03 - ACCESSORIES**

A. Building Paper: ASTM D226, No. 30 asphalt saturated felt.

B. House Wrap: Air/vapor barrier polymeric membrane as specified in SECTION 07270, AIR/VAPOR BARRIER MEMBRANE.

C. Concrete Bonding Agent: Water-based polyvinyl acetate type or concrete adhesive emulsion formulated for use as an admixture.

D. Joint Sealants and Joint Fillers: As specified in SECTION 07900, JOINT SEALANTS.

**2.04 - ADHERED MASONRY VENEER INSTALLATION MATERIALS AND ACCESSORIES**

A. Air and Water Barrier Membrane: Air & Water Barrier to be thin, cold applied, single component liquid and load bearing. Waterproofing Membrane to be non-toxic, non-flammable, and non-hazardous during storage, mixing, application and when cured:

1. Air Barrier Test (AC 212): Pass
2. Air Permeance (ASTM E2178): Pass
3. Elongation @ break (ASTM D751): 20-30 percent
4. 7 day Tensile Strength (ANSI A118.10): >265 psi (1.8 MPa)
5. 7 day Shear Bond Strength (ANSI A118.10): >200 psi (1.4 MPa)
6. 28 Day Shear Bond Strength (ANSI A118.4): >214 psi (1.48 – 2.4 MPa)
7. Service Rating (TCA/ASTM C627): Extra Heavy
8. Total VOC Content: < 0.05 mg/m3

B. Epoxy Waterproofing Flashing Mortar: Waterproof Flashing Mortar to be 3 component epoxy, trowel applied specifically designed for use under adhered masonry veneer:

1. Breaking Strength (ANSI A118.10): 450-530 psi (3.1-3.6 MPa)
2. Waterproofness (ANSI A118.10): No Water penetration
3. 7 day Shear Bond Strength (ANSI A118.10): 110-150 psi (0.8-1 MPa)
4. 28 Day Shear Bond Strength (ANSI A118.10): 90-120 psi (0.6–0.83 MPa)
5. 12 Week Shear Bond Strength (ANSI A118.10): 110-130 psi (0.8-0.9 MPa)
6. Total VOC Content: <3.4 g/L

C. Cementitious backer board units: size, thickness and installation as specified by cement backer board manufacturer, complying with ANSI A118.9.

D. Latex-Portland Cement Mortar for leveling beds and scratch/plaster coats: Mortar Bed to meet the following physical requirements:

1. Compressive Strength (ANSI A118.4 Modified): >4,000 psi (27.6 MPa)
2. Water Absorption (ANSI A118.6): ≤ 5 percent
3. Service Rating (TCA/ASTM C627): Extra Heavy
4. Smoke & Flame Contribution (ASTM E84 Modified): 0
5. Total VOC Content: < 0.05 mg/m3

E. Latex Portland Cement Mortar: Bond Veneer Mortar to be weather, frost, shock resistant, non-flammable and meet the following physical requirements:

1. Compressive strength (ANSI A118.4): >2,500 psi (17.2 MPa)
2. Bond strength (ANSI A118.4): >450 psi (3.1 MPa)
3. Smoke & Flame Contribution (ASTM E84 Modified): 0
4. Total VOC Content: < 0.05 mg/m3

F. Latex Portland Cement Pointing Mortar / Grout: Pointing Mortar to be weather, frost and shock resistant, as well as meet the following physical requirements:

1. Compressive Strength (ASTM C91): 3,500 psi (24.1 MPa)
2. Smoke & Flame Contribution (ASTM E84 Modified): 0
3. Total VOC Content: < 0.00 mg/m3

G. Expansion and Control Joint Sealant: Silicone Sealant to be a one component, neutral cure, exterior grade silicone sealant and meet the following requirements:

1. Tensile Strength (ASTM C794): 280 psi (1.9 MPa)
2. Hardness (ASTM D751; Shore A): 25 (colored sealant) /15 (clear sealant)
3. Weather Resistance (QUV Weather-ometer): 10,000 hours (no change)

H. Spot Bonding Epoxy Adhesive: Stone Adhesive (Standard Grade) for installing adhered masonry veneer, brick and stone over vertical and overhead surfaces shall be high strength, high temperature resistant, non-sag and shall meet the following physical requirements:

1. Thermal Shock Resistance (ANSI A118.3): >1,000 psi (6.9 MPa)
2. Water Absorption (ANSI A118.3): 0.1 percent
3. Compressive Strength (ANSI A118.3): >8,300 psi (57.2 MPa)
4. Shear Bond Strength (ANSI A118.3 Modified): >730 psi (5 MPa)

## PART 3 - EXECUTION

### 3.01 - EXAMINATION

A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 - PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 - INSTALLATION OF ADHERED MASONRY THIN VENEER – MORTARED OR DRY STACK JOINTS

A. General: Install in accordance with current versions of American National Standards Institute, Inc. (ANSI) “A108 American National Standard Specifications for Installation of Ceramic Tile” and TCNA “Handbook for Ceramic Tile Installation.” Cut and fit adhered masonry veneer neatly around corners, fittings, and obstructions. Perimeter pieces to be minimum half unit of stone. Maintain masonry courses to uniform dimensions. Form vertical and horizontal joints of uniform thickness. Install divider strips at junction of flooring and dissimilar materials.

B. Direct Adhere Method to Install Masonry Veneer: Install latex Portland cement mortar in compliance with current revisions of ANSI A108.02 (3.11), A108.1B and ANSI A108.5. Use the appropriate trowel notch size to ensure proper bedding of the adhered masonry veneer, selected so that 100 percent coverage of the back surface of the Thin Adhered Veneer is achieved. Work the latex Portland cement mortar into good contact with the substrate and comb with notched side of trowel. Spread only as much latex Portland cement mortar as can be covered while the mortar surface is still wet and tacky. When installing large format (>8-inch x 8-inch (200 mm x 200 mm) units, spread latex Portland cement mortar onto the back of (i.e. 'back-butter') each piece/unit in addition to troweling latex Portland cement mortar over the substrate. Beat each piece/unit into the latex Portland cement mortar with a beating block or rubber mallet to insure 100 percent full bedding and flatness. Allow installation to set until firm. Clean excess latex Portland cement mortar from adhered masonry veneer face and joints between pieces.

1. Pattern Bond:

   a. Layout work in advance and distribute color range of stone uniformly over total work area.

   b. Lay stone with face exposed.

   c. Take care to avoid concentration of any one color to any one wall surface.

   d. Maintain uniform joints, as stone allows.

   e. Do not use stacked vertical joints.

C. Pointing/Grouting Joints (NOTE: Stacked Stone Installations to omit pointing of mortar joints)

D. Polymer Fortified Pointing Mortar - for joint widths ≥1/16-inch (1.5 mm) and ≤1-inch (25mm]). Allow Thin Adhered veneer to cure a minimum of 24 hours at 70° F (21°C). Verify joints are free of dirt, debris, wedges or spacers. Sponge or wipe dust/dirt off veneer face and remove any water standing in joints. Surface temperature must be between 40-90° F (4-32°C). Pour approximately 4 quarts (3.8 L) of clean, potable water into a clean mixing container. Add a 50 lb. (22.7 kg) bag of LATICRETE Pointing Mortar to the container while mixing. Mix by hand or with a slow speed mixer to a smooth, stiff consistency. Install latex fortified cement grout/pointing mortar in compliance with current revisions of ANSI A108.1A (7.0), ANSI A108.02 (4.5) and ANSI A108.10. Dampen dry surfaces with clean water.

E. Place Pointing Mortar into a high-quality masonry mortar pointing bag. Carefully bag the pointing mortar into the joints. Once the mortar has become stiff in the joint, ("thumb-print dry") typically 15 to 20 minutes after pointing at 70° F (21°C), using a striking or joint tool, strike the mortar joints to the desired finish/contour. Remove excess mortar using a masonry brush or sponge. Do not over wash the mortar joint.

F. Higher temperatures may require faster time to initial cleaning; wider joints or lower temperatures may require a longer time to initial cleaning. Allow joints to become firm. Inspect joint for pinholes/voids and repair them with freshly mixed grout/pointing mortar. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film. Do not use acid cleaners on latex Portland cement grout/pointing mortar less than 10 days old.

G. Expansion and Control Joints: Provide control or expansion joints as located in contract drawings and in full conformity, especially in width and depth, with architectural details.

1. Substrate joints must carry through, full width, to surface of adhered masonry veneer.

2. Install expansion joints in adhered masonry veneer work over construction/cold joints or control joints in substrates.

3. Install expansion joints where adhered masonry veneer abut restraining surfaces (such as perimeter walls, curbs, columns), changes in plane and corners.

4. Joint width and spacing depends on application and should be determined by the project design team.

5. Joint width: ≥ ⅛-inch (3mm) and ≤ 1-inch (25mm).

6. Joint width: depth ~2:1 but joint depth must be ≥ ⅛-inch (3mm) and ≤ ½-inch (12mm).

7. Layout (field defined by joints): 1:1 length: width is optimum but must be ≤ 2:1. Remove all contaminants and foreign material from joint spaces/surfaces, such as dirt, dust, oil, water, frost, setting/pointing materials, sealers and old sealant/backer. Use Primer for underwater and permanent wet area applications, or for porous stone (e.g. limestone, sandstone etc.) installations. Install appropriate backing material (e.g. closed cell backer rod) based on expansion joint design and as specified in SECTION 07900, JOINT SEALANTS. Apply masking tape to face of adhered masonry veneer, brick or stone veneer. Use caulking gun, or other applicator, to completely fill joints with sealant. Within 5 to 10 minutes of filling joint, 'tool' sealant surface to a smooth finish. Remove masking tape immediately after tooling joint. Wipe smears or excess sealant off the face of adhered masonry veneer or other absorptive surfaces immediately.

H. Adjusting: Correction of defective work for a period of two (2) years following substantial completion, return to job and correct all defective work. Defective work includes, without limitation, adhered masonry veneer units stones broken in normal abuse due to deficiencies in setting bed, loose grout/pointing mortar, and all other defects which may develop as a result of poor workmanship.

1. Control and Expansion Joints:

   a. Keep joints open and free of debris.

   b. Coordinate control joints as specified in SECTION 07900, JOINT SEALANTS for sealant performance.

2. Sealant Recesses:

   a. Provide open joints 3/4-inch deep and 1/4-inch wide, where masonry meets doors, windows, and other exterior openings.

   b. Coordinate sealant joints as specified in SECTION 07900, JOINT SEALANTS for sealant performance.

3. Cutting and Fitting:

   a. Cut and fit thin veneer stone for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials.

   b. Coordinate with other work to provide correct size, shape, and location.

4. During progress of the work, cover top of unfinished stone masonry work for protection from weather.

**3.04 - INSTALLATION BUILDING VENEER**

A. Install building veneer stone and mortar in accordance with manufacturer's instructions and ACI 530.1/ASCE 6/TMS 602.

B. Maintain masonry courses to uniform dimensions. Form vertical and horizontal joints of uniform thickness.

**3.05 - CLEANING**

A. Keep face of stone free of mortar as work progresses.

B. If residual mortar is on face of stone, allow to dry partially and brush mortar off surface and sponge off residue.

C. When work is completed and mortar has set for 2 to 3 days, clean surface from top to bottom using mild masonry detergent acceptable to natural stone manufacturer.

D. Do not use harsh cleaning materials or methods that could damage stone.

E. Do not use metal brushes or acids for cleaning.

**3.06 - PROTECTION**

A. Protect installed natural stone veneer to ensure that, except for normal weathering, stone will be without damage or deterioration at time of Substantial Completion.

B. Touch-up, repair, or replace damaged stone before Substantial Completion.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700 – CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 04200**

**UNIT MASONRY AND ACCESSORIES**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 04200, UNIT MASONRY AND ACCESSORIES is a part of DIVISION 04, MASONRY which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 04120, STONE VENEER.

B. The Work of SECTION 04200, UNIT MASONRY AND ACCESSORIES, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Unit Masonry and Accessories as specified herein and/or as shown on the Contract Drawings.

B. The work under this Section includes the following:

1. Concrete masonry units (CMU), solid and hollow core units.
2. Fire-rated concrete masonry units.
3. Reinforced concrete masonry lintels.
4. CMU bond beams.
5. Cavity wall insulation including spray foam insulation shall be provided by the filed sub-bid subcontractor in accordance with SECTION 07200, BUILDING INSULATION.
6. Grouting as indicated and as specified herein.
7. Installing miscellaneous metal items built into masonry.
8. Premolded masonry joint fillers.
9. Installation of loose steel lintels, steel plates, and masonry anchors.

10. Door and window frames built into masonry are furnished by the Contractor in Division 8 and installed under the work of this Section.
11. Masonry joint reinforcing, ties, anchors, miscellaneous reinforcing provided and installed under the work of this Section.
12. Deformed steel bars for wall reinforcing and CMU lintel reinforcing are furnished by the Contractor under Division 3, installed under the work of this Section.
13. Sample wall.
14. Installation of beams, sills and structural items to be embedded in masonry.
15. Installation of anchors, for precast concrete, to be embedded in masonry.
16. Membrane flashing (thru-wall), termination bar and sealant.
17. Installation of anchor bolts embedded in masonry.
18. Installation of metal flashing is included in this section and furnished in SECTION 07531, EPDM SINGLE-PLY MEMBRANE ROOFING.
19. Air/Vapor Barrier Membrane. The Air/Vapor Barrier Membrane shall be provided by the filed sub-bid subcontractor. The entire cavity (stone veneer and siding) shall receive the air/vapor barrier against the CMU.
20. Mortar Net.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's product data for:

a. Concrete masonry units of all types

b. Mortar and grout

c. Joint reinforcement

d. Anchors and ties

e. Membrane flashing, termination bar and sealant

f. Control joint key

g. Weephole inserts

h. Cavity wall insulation

i. Air/vapor barrier membrane and accessories.

2. Testing:

a. Provide efflorescence test results on actual masonry and mortar to be supplied for this project, including test results of potable water for mortar conforming to the specified requirements.

b. Provide from testing laboratory, the chemical analysis of water-soluble alkali content (%) of cement for mortar.

3. Samples for Approval:

4. Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections, control, expansion joints and wall openings.

5. Submit information and requirements for addressing special inspection required by SECTION 01065, STRUCTRURAL TESTS AND INSPECTIONS including all anticipated dates and time that will allow special inspection to be accomplished.

a. Engineer must be notified by Masonry Subcontractor within thirty (30) days of proposed inspection periods.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver masonry units in an air-dry condition.

E. Store masonry units above ground on level platforms that will permit circulation of air and prevent moisture absorption.

F. Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C90, when delivered to job site.

G. Handle masonry units, either individually or in groups, to keep units whole. Handle masonry units in a manner to maintain sharp edges and undamaged faces with minimum protection as follows:

| • Type of Unit | • Minimum Protection |
|---|---|
| • Concrete masonry units | • Handling |

H. Do not stack masonry units more than two (2) pallets high when stacking on frozen ground. Store masonry units on wooden planks.

I. Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

J. Cementitious and other package material shall be delivered in unopened containers, plainly marked and labeled with manufacturer's names and brands. Cementitious material shall be stored in dry, weather tight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Sample Masonry Panel(s):

1. Panels shall be L-shaped or otherwise configured to represent all the wall elements. Construct sample masonry panel(s) for concrete masonry exposed in finished work. Build panel(s) 4 ft. long x 2 ft. long x 6 ft. high by the required thickness as indicated on the drawings, with facing stone veneer on one side, and concrete masonry units on other side and incorporating joint reinforcement, vertical control joint, specialty shapes, insulation, air vapor/barrier membrane, accessories, weepholes and flashings, face units and backup units as indicated.

2. Construct sample panel(s) at project site location designated by the Engineer to allow acceptance by the Engineer prior to start of masonry work. Sample panel(s) shall not be built in, or as part of the structure, but shall be located where directed.

3. Construct sample panel(s) using specified materials and methods of construction, conforming to indicated shape, surface finish, color and texture range, mortar color, bond pattern, and joint finish.

4. Upon acceptance by the Engineer, sample panel(s) shall become the standard of workmanship and acceptance for represented masonry work. Do not start masonry work for which sample panel(s) are required until sample panel(s) have been accepted.

5. Protect and maintain sample panel(s) in original location and in original condition until the masonry work has been completed and approved.

6. After completion of the work, the sample panel(s), including all foundation concrete shall become the property of the Contractor and shall be removed from job site upon acceptance of represented masonry work, or when permitted by the Engineer.

C. Visual Appearance:

1. Provide stone veneer and concrete masonry units conforming to ASTM tolerances for visual appearance at time of delivery and maintain original appearance to conform to tolerances immediately prior to construction.

D. Remove masonry work damaged as a result of failure to comply with specifications, in the opinion of the Engineer, and reconstruct as directed by the Engineer at no additional cost to the Owner.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. A82: Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
2. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. C33: Standard Specification for Concrete Aggregates.
4. C55: Standard Specification for Concrete Brick.
5. C90: Standard Specification for Loadbearing Concrete Masonry Units.
6. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] cube specimens.)
7. C140: Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
8. C144: Standard Specification for Aggregate for Masonry Mortar.
9. C150: Standard Specification for Portland Cement.
10. C207: Standard Specification for Hydrated Lime for Masonry Purposes.
11. C270: Standard Specification for Mortar for Unit Masonry.
12. C331: Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
13. C404: Standard Specification for Aggregates for Masonry Grout.
14. C476: Standard Specification for Grout for Masonry.
15. C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
16. C979: Standard Specification for Pigments for Integrally Colored Concrete.
17. C1019: Standard Method of Sampling and Testing Grout.
18. D1056: Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
19. D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
20. D2000: Standard Classification System for Rubber Products in Automotive Applications.
21. D2240: Test Method for Rubber Property - Durometer Hardness.

B. American Concrete Institute ACI:

1. ACI 530/ASCE 5/TMS 402: Building Code Requirements for Masonry Structures & Commentary.
2. ACI 530.1/ASCE 6/ TMS 602: Specification for Masonry Structures & Commentary.

C. International Masonry Industry All Weather Council:

1. IMIAWC: Recommended Practices and Guide Specifications for Cold Weather Masonry.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SITE CONDITIONS**

A. Protection of Masonry:

1. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

2. Extend cover a minimum of 24-in. down both sides and hold cover securely in place.

3. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24-in. down face next to unconstructed wythe and hold in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention:

1. Prevent grout, mortar, and soil from staining the face of masonry and precast concrete to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

a. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.

b. Protect sills, ledges, and projections from mortar droppings.

c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

d. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements:

1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

a. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperatures is 40 deg. F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements:

1. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

a. When ambient temperature exceeds 100 deg. F, or 90 deg. F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

F. Prevent damage due to wind and wind-blown particles.

**1.10 - SPECIAL INSPECTION**

A. Provide in accordance with SECTION 01065, STRUCTURAL TESTS AND INSPECTIONS.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Provide masonry units with dimensions listed in ANSI A62.3 except where otherwise specified or indicated. Provide additional masonry units to complete masonry work as indicated.

B. For exposed alteration and restoration work, provide masonry units of same type, grade, size, and appearance as existing masonry work.

C. Furnish special coves, corners, bullnoses, and other special shapes as indicated.

D. Provide open cell neoprene or expanded polyethylene filler for top of nonload bearing masonry unit walls.

E. Obtain masonry units from one manufacturer.

F. Furnish stock and special shapes as shown in Facing Tile Institute Handbook to complete work as indicated.

**2.02 - MORTAR AND GROUT**

A. General:

1. Provide mortar conforming to ASTM C270, Type S, composed of portland cement, hydrated lime, and sand.
2. The damp, loose volume of sand is not to exceed three times the sum of the volumes of cement and lime.
3. Proportion of lime to portland cement, by volume: 1/4 to 1/2.
4. Portland cement: ASTM C150, Type I or Type II.
5. Lime: ASTM C207, Type S
6. Sand for Mortar: ASTM C144, from single acceptable source.
7. Sand for Grout: ASTM C404.
8. Water: Clean potable from single source and free from acids, alkalies, organic material, minerals and salts.
9. Do not use accelerators or other admixtures in mortar or grout without written approval of Engineer.
10. Retemper mortar only to replace water lost through evaporation and use mortar within 2 hours after mixing.

B. Colored Mortar:

1. Manufacturers:
   a. Glen-Gery Color Mortar Blend.
   b. Riverton Corp.
   c. Colorbond, Centurion R.D.
   d. Or acceptable equivalent product.
2. Provide colored mortar composed of factory mixed colored pigments, Type S, Portland cement and three parts, by volume, well-graded sand.
3. Pigments shall meet the requirements of ASTM C979. Do not use carbon black.
4. Color of mortar shall be selected by Architect.

C. Grout Mix: ASTM C476, 2,500 psi minimum compressive strength. Do not use air entraining admixtures. Provide fine or coarse grout to suit work being grouted.

**2.03 - CONCRETE MASONRY UNITS**

A. Unit Designations:

1. Hollow load-bearing units: ASTM C90
2. Solid load-bearing units: ASTM C90
3. Concrete building brick: ASTM C55

B. General:

1. Damaged units not permitted.
2. Provide concrete masonry unit Type I, moisture-controlled units.
3. Provide units free from iron and other substances that will stain plaster, paint, corrode metal or cause popouts. Aggregates not to contain more than 1.5 mg. of ferric oxide per 200 grams when tested in accordance with ASTM C331.
4. Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work indicated.

C. Hollow Load Bearing Units:

1. ASTM C90 light weight, Grade N, Type I.
2. Sand and aggregates: ASTM C33.
3. Moisture content when laid not to exceed 35 percent of total adsorption.
4. Wet-steam cured for a minimum of 12 hours followed by covered yard storage for not less than four weeks.
5. Nominal size: 8-in. by 16 in. by heights and bed thicknesses indicated or permitted.
6. Texture: Smooth for application of paint.
7. Provide external corner units: bullnosed.
8. Prism Strength: The average strength of 3 constructed masonry prisms shall be a minimum of 1,900 psi with no individual prism less than 1,700 psi when tested in accordance with ASTM E447.

D. Solid Concrete Masonry Units:

1. Provide solid concrete masonry units conforming to fire-rated wall requirements of Hollow Load Bearing Units.
    a. Net cross-sectional area of unit in every plane parallel to bearing surface at least 75 percent of gross cross-section area measured in sample plane.
2. Fire Rated Concrete Masonry Units: Provide concrete masonry units in fire rated assemblies and partitions which are listed by UL for the application indicated and provide construction which matches UL tested fire rated assemblies.
    a. Prism Strength: The average strength of 3 constructed masonry prisms shall be a minimum of 1,900 psi with no individual prism less than 1,700 psi when tested in accordance with ASTM E447.

**2.04 - LINTELS**

A. General:

1. Provide lintels to extend at least eight inches beyond each jamb of the masonry opening.
2. Provide lintels with all surfaces free of cracks, chips, and broken edges.
3. Provide lintels sized for wall thickness and masonry opening and with 3/8-in. allowance in height, width, and length for mortar joints.

B. Block Lintels:

1. Provide block lintels fabricated from standard lintel-type concrete masonry units of same material and texture as units in adjoining work, reinforced as indicated, and filled with grout having a minimum 28 day compressive strength of 2,500 psi as specified.

C. Steel Lintels:

1. Install galvanized steel lintels as specified under SECTION 05500, MISCELLANEOUS METAL.

**2.05 - JOINT REINFORCEMENT**

A. Manufacturers:

1. Reinforcing Corporation of America.
2. Dur-O-Wal, Inc.
3. Hohmann & Barnard, Inc.
4. Or acceptable equivalent product.

B. General:

1. Prefabricated, formed of ASTM A82 cold-drawn steel.
2. Hot-dip galvanized, ASTM A153, Class B-2.
3. Provide ladder type reinforcement with smooth cross wires flush welded together on 16-in. centers.
4. Provide prefabricated special pieces for corners and intersections of walls and partitions.
5. Provide joint reinforcing width according to width and type of wall indicated on drawings.

C. Exterior Cavity Walls:

1. Provide 3/16-in. side rods and 9-gage cross rods reinforcement.
2. Adjustable (two-piece) type with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties shall have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties shall extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties shall have hooks or clips to engage a continuous horizontal wire in the facing wythe.

**2.06 - VERTICAL REINFORCEMENT**

A. Contractor shall furnish vertical reinforcement and dowels as specified under SECTION 03200, CONCRETE REINFORCEMENT.

**2.07 - CAVITY WALL INSULATION – NOT USED**

**2.08 - MEMBRANE FLASHING AND TERMINATION BARS**

A. Provide 40 mil thick thru-wall flashing consisting of a 36 mil self-adhering rubberized asphalt membrane laminated to a 4 mil high density polyethylene film with silicone treated release sheet.

B. Products:

1. CCW-705-TWF Thru-Wall Flashing by Carlisle Coatings & Waterproofing Inc.
2. Perm-A-Barrier Wall Flashing by Grace Construction Products.
3. Blueskin SA Air/Vapor Barrier Membrane by Monsey Bakor.
4. Or acceptable equivalent product.

C. Termination Bar and Sealant:

1. Material: Type 304 stainless steel 26 gauge.
2. Size: 1/8-in. x 1-in. x 8 ft. long with ¼-in. holes spaced 6-in. o.c. Provide stainless steel screws suitable for masonry installation.
3. Type: Single-winged style to accept sealant.
4. Sealant shall be as recommended by membrane flashing manufacturer.

**2.09 - METAL DRIP EDGES**

A. Fabricate metal drip edges from 0.0156-in. thick stainless steel.

B. Extend drip edge at least 3-in. into wall and ½-in. out from wall, with a hemmed outer edge bend down 30 degrees.

**2.10 - CONTROL JOINT GASKETS**

A. Control joint gaskets shall be factory fabricated solid section of extruded rubber material conforming to ASTM D-2000 with a durometer hardness of 80 (+ or -5) when tested in conformance with ASTM D-2240.

B. The control joint gasket shall be provided with a solid shear section not less than 5/8-in. thick and 3/8-in. thick flanges.

**2.11 - COMPRESSIBLE JOINT FILLER**

A. Closed cell neoprene conforming to ASTM D1056, Class RE41.

B. Manufacturers:

1. D/A 2010 Rapid Soft Joint by Duro-O-Wal, Inc.
2. #NS-Closed Cell Neoprene Sponge by Hohmann & Barnard, Inc.
3. 3330 Horizontal Expansion Joint by Masonry Reinforcing Corp. of America.
4. 030 Soft Joint by National Wire Products Industries.
5. Or acceptable equivalent product.

**2.12 - VERTICAL EXPANSION JOINTS**

A. Provide 60 mil EPDM bellows with integral punched holes in 4-in. wide x .018-in. thick stainless-steel flanges.

**2.13 - SHOP TESTING**

A. Do not deliver, accept or install masonry units and mortar until the actual production run of masonry units has been tested and passes with "no efflorescence" results as specified.

B. Provide commercial testing laboratory approved by the Engineer to perform efflorescence testing.

1. Provide testing laboratory with a record of at least five (5) years of efflorescence testing.

C. Provide sample masonry units and mortar mix to testing laboratory.

D. Provide efflorescence testing of brick units by testing laboratory in accordance with ASTM C67.

1. Acceptable Test Result: ASTM C67 rating of "No Efflorescence."

E. Provide chemical analysis of water-soluble alkali content (%) of cement for mortar and adjust content in accordance with the recommendations of the Brick Institute of America to avoid efflorescence in the cured mortar joints.

**2.14 - MASONRY CLEANING AGENTS**

A. As recommended by masonry manufacturer. Muriatic acid not allowed.

## PART 3 - EXECUTION

### 3.01 - PREPARATION

A. Clean laitance, dust, dirt, debris, oil, grease, and other foreign substances which would affect bond of mortar, from surfaces to receive mortar.

B. Lay out walls to establish accurate spacing of bond pattern, for uniform joint widths, and to locate openings, movement-type joints, returns and offsets. Arrange units in manner which will result in less than two units being cut between each joint or wall opening.

C. Wet masonry having absorption rates in excess of 0.025 ounces per square inch per minute, when tested in accordance with ASTM C67, so that rate of absorption does not exceed that rate when masonry in installed.

### 3.02 - PROTECTION OF WORK

A. Protect the walls, including window sills, with non-staining waterproof coverings when work not in process.

B. Provide minimum 24-in. overhang of protective covering on each side of wall and anchor securely.

C. Protect facing materials from staining.

### 3.03 - INSTALLATION

A. Provide temporary bracing of all walls until walls have been completely erected.

B. Lay masonry plumb and square, true to dimensions, and with full, tightly bonded joints.

C. Horizontal joints of cavity and composite walls, which are to contain wall ties and joint reinforcement shall be level with each other.

D. Install products, indicated to be built into wall, as masonry work progresses. Fill spaces around built-in products with mortar, rake mortar joint, and allow space for sealant.

E. Fill backs of pressed-metal door frames solid with mortar.

F. Make joint width equal to difference between actual and nominal dimensions of unit being installed.

G. Tool exterior joints concave with hard glassy surface free from drying cracks. Tool interior joints flush in similar manner.

H. Provide level and solid mortar bearing in masonry walls directly under precast concrete slabs, beams, and sills, and under structural steel beams to sizes and thickness indicated.

I. Provide 1/2 in. minimum clearance between top of nonload bearing masonry walls and bottom of overhead construction.

J. Lay masonry units in a running bond with vertical joints breaking not less than 4 in. over units in course below, or in vertical stack bond as indicated.

K. Lay soldier course brick bond where indicated, three vertical bricks to one horizontal.

L. Lay vertical cored units with full beds on shells only. Fully butter vertical edges.

M. Cut masonry units with either dry or wet masonry saws.

N. Keep chases, wall cavities, air spaces, expansion joints and spaces to be grouted free from debris and mortar.

O. Lay concrete masonry and structural facing tile units dry.

P. Lay masonry units in full mortar bed.

Q. When resuming masonry work, clean exposed surface of set or partially set masonry and remove loose mortar prior to laying fresh masonry.

R. Install continuous wall reinforcement in accordance with manufacturer's printed installation instructions, and place in alternate horizontal masonry joints. Lap reinforcement not less than six inches and, at corners and intersections, connect to prefabricated reinforcement. Make splices in manner, and at those points, which will not reduce structural strength of wall. Make welded and mechanical connections to develop strength of reinforcement.

S. Install vertical reinforcement where indicated and in poured grout studs formed by vertically aligned cells of unit masonry. Secure reinforcement at top and bottom, and at intervals not more than 192 diameters of reinforcement. Use two-cell masonry units for vertical reinforcement.

T. Install control joint gaskets in concrete masonry unit walls where indicated and in accordance with manufacturer's printed installation instructions.

U. Set metalwork into masonry and build around metalwork. Metalwork furnished in accordance with requirements specified in the section herein.

V. Follow recommended practices and guide specifications for cold weather masonry work as set forth in IMIAWC-75.

W. Using a bristle brush, brush loose mortar from the faces of the walls whenever the scaffolding is moved or raised and at the end of each shift.

X. Install mortar net at the bottom of each air space. Mortar net thickness to match depth of air space.

Y. Construct faces of walls, and inside and outside corners, plumb, and courses level, within following tolerances:

1. Variation from plumb of lines and surfaces of columns, walls, and arises: 1/4 inch in 10 feet; 3/8 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

2. Variation from plumb of external corners, expansion joints, and other conspicuous vertical lines: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

3. Variation from level of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous horizontal lines: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 1/2 inch total.

4. Variation of linear building lines from established position in plan and related portion of columns, walls, and partitions: 1/4 inch in 20 feet; 1/2 inch in 40 feet, and 2 inch total.

5. Variations of cross sectional dimensions of columns and in the thicknesses of walls: Minus 1/4 inch, plus 1/2 inch.

6. Variations from plumb in masonry control joints: 0-in.

**3.04 - MORTAR**

A. General:

1. Machine mix mortar, except small batches by hand mixing, mixed for at least five minutes after materials are in mixer. Where hand mixing is permitted, mix mortar in tight mortar box until required plasticity is obtained. Mix mortar with maximum amount of water.

2. Use mortar within 2 hours after mixing.

B. Beds:

1. Place full mortar beds on masonry unit bearing surfaces bonded to bearing surface of unit below, and to surface of previously installed unit in same course as unit being installed; furrowing of mortar not permitted. Pack mortar under and around joint reinforcement before masonry unit is installed.

2. Make mortar bed of such thickness that cured mortar joint is equal to difference between actual and nominal dimensions of unit being installed.

3. Do not allow mortar fins to protrude into cores for masonry units which are to be vertically reinforced.

C. Colored: Proportion for each batch and mix in drum-type mechanical mixer shall be mixed between 3 and 5 minutes after materials have been deposited in mixer.

D. Provide cured mortar joints free from efflorescence.

**3.05 - GROUTING**

A. Provide clean out units in bottom course at every dowel where height of grout placement exceeds four feet. Remove overhanging mortar, mortar droppings, and obstructions from grout spaces. Seal clean out holes only after masonry work, reinforcement, and final cleaning of grout spaces have been approved by Resident Engineer, and before grouting. Sealing to match surrounding masonry.

B. Place grout within two hours after mixing.

C. For vertically reinforced concrete unit masonry, place grout in all cells containing reinforcement, and in lifts of not more than four feet. Consolidate grout at time of placing by either puddling or vibrating; reconsolidate grout by puddling before plasticity is lost. When grouting is stopped for one hour and longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost grouted unit. Use coarse grout in grout spaces which are four inches and larger in all horizontal directions; place fine grout in grout spaces which are smaller than four inches in any horizontal direction.

D. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, shall be filled solid with grout. For purposes other than vertically reinforced concrete unit masonry, place grout where indicated, and only after mortar joints and other Cementitious materials have cured. Place coarse grout in grout spaces which are two inches and larger in all horizontal directions; place fine grout in grout spaces which are smaller than two inches in any horizontal direction. Place grout at rate which allows consolidation of successive layers while preceding layer is plastic. Placement height not to exceed four feet. Consolidate grout and puddle when grouting stopped for two hours and longer; form horizontal construction joints by stopping grout placement 1/2 course height below top of uppermost grouted unit. Grouting accomplished from back-up face of masonry units.

E. Prevent grout from coming into contact with finish surfaces which are exposed to view, and with those surfaces which are to receive other finishes.

F. Place grout where indicated at all stair connection locations as indicated on drawings.

**3.06 - LAYING CONCRETE MASONRY UNITS**

A. Lay approved units with moisture absorption ratio of less than 35 percent.

B. Lay units in running bond with vertical joints breaking not less than 4 in. over units in next course below or as indicated. Lay units, cored vertically, with full beds on shells only. Vertical edges fully buttered.

C. Do not wet units before laying except in hot weather. Lightly moisten contact surfaces with water using soft brush just prior to laying units.

D. Install reinforced concrete masonry unit lintels in concrete masonry unit walls and partitions as indicated. Extend lintels at least 8 in. beyond each jamb of masonry opening. Install only completely cured lintels.

E. Jamb units shall be of the shape and sizes to conform with wall units.

**3.07 - BONDING AND JOINT REINFORCEMENT**

A. Bond concrete masonry unit against concrete walls with corrugated dovetail anchors placed in dovetail slots. Place anchors 16-in. on centers. Contractor shall furnish and install dovetail slots as specified under SECTION 03300, CAST-IN-PLACE CONCRETE.

B. Place joint reinforcement, for interior concrete masonry unit walls and partitions, continuously in horizontal joint on 16-in. centers. Interrupt at control joints. Place special pieces, for reinforcing corners, around columns and intersections, in every joint where reinforcement occurs.

C. Bond intersecting masonry walls and partitions with box wall ties spaced vertically at 16-in. on centers.

**3.08 - VERTICAL REINFORCEMENT**

A. Place steel reinforcement bars vertically in all masonry walls as indicated.

B. Locate vertical reinforcement and dowels in first cells of CMU at jambs of all masonry openings and then space horizontally as indicated.

C. Embed dowels 1-ft.-6-in. into reinforced concrete at top and bottom of CMU walls and partitions. Overlap reinforcing 2-ft.-0-in. using 6-ft.-0-in. maximum length bars.

D. Grout cells as specified.

**3.09 - CUTTING AND JOBBING**

A. Leave slots and opening for inserts, wires, conduits, and similar items of construction, open or cut.

B. Provide recesses or openings at junction boxes, or other locations as indicated.

C. Provide openings in exterior walls and interior partitions at duct, conduit, exhaust and other wall penetrations. Bridge above openings using concrete masonry units. Reinforced masonry lintels shall be provided at openings greater than 1-ft.-4-in. Install membrane wall flashing at exterior wall openings.

D. Masonry units to be dried to 35 percent moisture content from prior cutting or grinding before installation of mechanical and electrical services.

**3.10 - PARTITIONS**

A. Partitions shall be continuous from floor to underside of floor or roof deck as indicated. Openings in fire walls around joists or other structural members shall be filled in accordance with SECTION 07840, FIRESTOPPING. An isolation joint shall be placed in the intersection between partitions and structural members. Continuous sealants shall be provided at all isolation joints as specified in SECTION 07900, JOINT SEALANTS.

**3.12 - BOND BEAMS**

A. Bond beams shall be filled with grout and reinforced as indicated.

**3.13 - CONTROL JOINTS**

A. Control joints keys shall be provided as indicated and shall be constructed by using special control joint units and in accordance with the drawings. The vertical mortar joint at control joint locations shall be continuous. The control joint key shall be interrupted in courses containing continuous bond beam steel. Provide backer rod and sealant at all exterior control joints as specified in SECTION 07900, JOINT SEALANTS.

**3.14 - COMPRESSIBLE JOINT FILLERS**

A. Compressible joint fillers shall be provided as indicated and where directed by the Engineer.

**3.15 - SHELF ANGLES**

A. Shelf angles shall be adjusted as required to keep masonry level and at the proper elevation. Shelf angles shall be galvanized steel and provided in sections not longer than 10 feet and installed with a 1/4-in. gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4-ft., unless limited by building configuration.

**3.16 - CAVITY WALL INSULATION – NOT USED**

**3.17 - MEMBRANE FLASHING INSTALLATION AND COORDINATION**

A. Self-Adhered, Composite Flexible Membrane Flashing: Prepare masonry surfaces to receive flashings smooth and free of projections. Install flashing to dry surfaces at air and surface temperatures of 25 deg. F. and above in accordance with manufacturer's recommendations at locations indicated.

1. Precut pieces of flashing to easily handled lengths for each location.
2. Remove release paper and position flashing carefully before placing it against the surface.
3. When properly positioned, place against surface by pressing firmly into place by hand roller or a blunt object. Fully adhere flashing to substrate to prevent water from migrating under flashing.
4. Overlap adjacent pieces 2 inches and roll all reams with a steel hand roller or a blunt object.
5. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing ½-in. back from outside face of wall and adhere flashing to top of metal drip edge.
6. At heads, sills and all flashing terminations, turn up ends a minimum of 2 inches and make careful folds to form an end dam, with the seams sealed.
7. Do not allow the rubberized asphalt surface of the flashing membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
8. Do not expose flashing membrane to sunlight for more than thirty days prior to enclosure.
9. Install termination bar fastened at 6-in. o.c. along top edge of all flashings. Apply bead of sealant along top edge of termination bar and flashing.

B. Accessories:

1. Apply surface conditioner at rate recommended by the manufacturer, prior to flashing installation. Allow surface conditioner to dry completely before flashing application.
2. Apply a bead or trowel coat of mastic along flashing top edge, seams, cuts and penetrations.

**3.18 - VERTICAL EXPANSION JOINTS**

A. Set stainless steel flanges in continuous bed of sealant. Sealant to be compatible with air/vapor barrier.

B. Attach expansion joints per manufacturers recommendations.

**3.19 - FIELD QUALITY CONTROL**

A. Repair joints that are unsound, not full of mortar, or which have hairline cracks due to shrinkage or poor adhesion, as follows:

1. Cut or rake affected mortar to a depth of 3/4 in.
2. Brush out debris.
3. Thoroughly moisten remaining mortar and adjoining masonry and paint with neat cement.
4. Point joint full of mortar.
5. Tool joint to a hard, glassy surface.
6. After first day, wet down walls having repaired joints, at least five times daily, for a minimum of three days.

B. Remove and reconstruct work injured by climatic conditions, or because of insufficient protection as directed by the Engineer and at no additional cost to the Owner.

C. Pointing consists of raking out defective joints, and stack bond pattern joints; repairing defective joints; and working joint after mortar has initially set.

1. Joints except control joints, joints in stack bond pattern and joints to be sealed: Tool concave in a manner which will compact and press the mortar against the units. Strike flush joints covered with plaster, drywall, or waterproofing membrane.

2. Control joints, expansion joints and joints to be sealed shall not contain mortar.

3. Defective joints: Rake out the full depth of the joint, patch with mortar, and tool to match adjacent joints.

D. Apply cleaning agent to sample wall area of 20 sq. ft. in location acceptable to Engineer if cleaning by water does not produce satisfactory results to the Engineer.

1. Do not proceed with cleaning until sample area is acceptable to Engineer.

2. Follow manufacturer's printed instructions.

3. Scrub with approved cleaning agent.

4. Immediately rinse with clear water.

5. Work small sections at a time.

6. Work from top to bottom.

7. Protect sash, metal lintels, and other materials which may corrode when masonry is cleaned with acid solution.

8. Protect precast architectural concrete from masonry mortar stain and overflow.

E. When left overnight, cover tops of wythes of masonry walls with a by waterproof membrane extending at least 24 inches down both sides. Protect masonry left for greater length of time in accordance with requirements specified in SECTION 01500, TEMPORARY FACILITIES. When work is resumed, clean all top surfaces of loose mortar. Wet units thoroughly, except concrete masonry units when required as specified.

**3.20 - FIELD TESTING**

A. Provide in accordance with SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING and as specified.

B. Test concrete masonry units in accordance with ASTM C140.

C. A minimum of two specimens of mortar from separate batches shall be taken each day. A layer of mortar 1/2 to 5/8 in. thick shall be spread on the masonry units and allowed to stand one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 109.

D. Test grout compressive strength in accordance with ASTM C1019. A minimum of two specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2,500 psi at 28 days.

E. Efflorescence Test: Masonry which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of “effloresced” will be subjected to rejection.

**3.21 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 05120**

**STRUCTURAL STEEL**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 05120, STRUCTURAL STEEL is a part of DIVISION 5, METAL WORK which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 05500, MISCELLANEOUS METAL.

B. The Work of SECTION 05120, STRUCTURAL STEEL requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. The term "Structural Steel" is used as defined in accordance with the AISC Code of Standard Practice.

B. Provide structural steel as specified and as shown on contract drawings.

C. Detailing, fabrication and erection of structural steel shall comply with all applicable OSHA regulations.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submit in advance of fabrication complete information necessary for the fabrication of each component and part of the structural steel framing. Include the following:

1. Member size and length.
2. Bill of materials.
3. Material specifications.
4. Bolt hole size and bolt size.
5. Cuts, copes, and bevels.
6. Piece marks for field assembly.
7. Splices.

C. Submit erection drawings showing complete information necessary for the erection of each component part of the structural steel framing. Include the following:

1. Dimensions for alignment and elevations of each member.
2. Location of members and attachments by match-marking of piece numbers.
3. Type, location and details of each field connection.
4. Number of shear connectors on each member.
5. Anchor bolts and setting plans.

D. Do not develop shop drawings by using reproductions of contract drawings.

E. Submittals for Evidence of Conformity to Specifications: Certified mill test reports containing results of chemical and mechanical test as specified by ASTM A6 for the following material:

1. Structural steel shapes.
2. Structural steel bars.
3. Structural steel plates.

F. In addition to the certified mill test reports, the fabricator shall provide an affidavit stating that the structural steel furnished meets the requirements of the ASTM specification for the grade furnished. Qualification test reports bearing witness certification by an independent testing laboratory for each welder, welding operator and tacker to be employed in the work.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Load structural members in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

C. Protect structural steel members and packaged materials from corrosion and deterioration. Store material in a dry area.

D. Support materials stored outdoors above ground surfaces on wood runners and protected with acceptable effective and durable covers.

E. Do not place materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed by the Engineer.

**1.06 - DESIGN CRITERIA**

A. Structural Connections: AISC Specification for Structural Steel Buildings. Design connections not fully detailed on the Drawings to resist the loads shown on the Contract Drawings or specified.

B. Where beam end reactions are not shown, design the connection for one-half the total allowable uniform load in kips for beams laterally supported at the given span, as determined by the tables for allowable loads on beams in the AISC Manual of Steel Construction, in addition to any axial loads identified on the Drawings.

C. Unless otherwise noted on Contract Drawings, design connections for ASTM A325 bolts, bearing-type connection with threads included in shear plane.

**1.07 - QUALITY ASSURANCE**

A. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide structural steel in accordance with AISC Standard for Structural Steel Buildings and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.

C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the jurisdiction where the Project is located.

D. Steel fabricator shall have 5 years experience minimum in structural steel fabrications.

E. Steel erector shall have 5 years experience minimum in structural steel erection.

F. Welding Qualification and Certification:

1. Furnish written welding procedure for welds in conformance with the AWS D 1.1.

2. Each welder, welding operator and tack welder shall be certified by test to perform type of work required in conformance with AWS D 1.1.

3. If a welder or welding operator has not been engaged in a specific welding process for a period of six months or more, that individual shall be deemed unqualified and shall not perform work on the project until the individual has been qualified again by testing in conformance with AWS D 1.1.

4. Maintain duplicate qualification and certification records at the job site readily available for examination.

G. Tolerances:

1. Maintain tolerances conforming to AISC Code of Standard Practice.

2. Permissible variation tolerances conforming to ASTM A 6.

H. Field Measurements

1. The Contractor shall verify dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

2. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

**1.08 - REFERENCES**

A. American Institute of Steel Construction AISC:

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings

2. AISC Manual of Steel Construction, Thirteenth Edition

3. AISC Code of Standard Practice for Steel Buildings and Bridges

4. AISC Specification for Structural Joints using ASTM A 325 or A 490 Bolts

5. AISC Structural Steel Detailing Manual

B. American Welding Society AWS:

1. AWS D1.1: Structural Welding Code – Steel

C. ASTM International (ASTM):

1. A 6/A 6M: Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. A 36/A 36M: Specification for Carbon Structural Steel
3. A 123: Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. A 143: Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement
5. A 153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. A 194/A 194M: Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service
7. A 307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
8. A 325: Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
9. A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
10. A 385: Practice for Providing High Quality Zinc Coatings (Hot-Dip)
11. A 449: Specification for Quenched and Tempered Steel Bolts and Studs
12. A500/A500M: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
13. A 563: Specification for Carbon and Alloy Steel Nuts
14. A 572: Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
15. A 780: Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
16. A 992: Standard Specification for Steel for Structural Shapes for Use in Building Framing
17. F 436: Specification for Hardened Steel Washers
18. F 1554: Standard Specification For Anchor Bolts, Steel, 36, 55, and 105 ksi Yield

D. Occupational Safety and Health Administration (OSHA)

1. Safety and Health Standards for the Construction Industry, 29 CFR 1926 Subpart R Safety Standards for Steel Erection

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - Products**

**2.01 - STRUCTURAL STEEL**

A. W shapes in conformance with ASTM A 992 unless otherwise indicated or specified.

B. C, M, S and HP shapes in conformance with ASTM A 572, Grade 50, unless otherwise specified or shown on contract drawings.

C. Angles, plates and bars in conformance with ASTM A 36.

D. Round, square and rectangular structural tube members (HSS) in conformance with ASTM A 500, Grade B.

E. Steel pipe in conformance with ASTM A 53, Grade B.

F. Hot-Dip Galvanized Carbon Steel in conformance with ASTM A 123.

**2.02 - FASTENERS**

A. Carbon Steel Bolts, Nuts and Washers: ASTM A 307, Grade A.

B. High-strength fasteners in conformance with ASTM A325, Type 1.

C. Nuts and washers ASTM A 563 and F 436.

D. Hot-dip Galvanized Bolts, nuts and washers in conformance with ASTM A 153.

**2.03 - ANCHOR BOLTS**

A. Steel anchor bolts in conformance with ASTM F1554, grade 36.

**2.04 - WELDED STUDS:**

A. Weld studs in conformance with the requirements of ASTM A108, Grade 1015 or 1020.

**2.05 - WELDING**

A. Class E70XX electrodes.

B. Provide equipment for welding, electrodes, welding wire and fluxes capable of producing indicated welds when used by certified welders under AWS welding procedures. Provide welding materials that comply with requirements of AWS Structural Welding Code.

**2.06 - SHOP FABRICATION**

A. Fabricate each element and connection as indicated on the fabrication shop drawings accepted by the Engineer. Fabricate and shop assemble work to the greatest extent practical in conformance with following publications:

1. AISC Manual
2. AISC Specification for Structural Joints
3. AISC Detailing Manual
4. AWS Structural Welding Code

B. Perform shearing, manual flame cutting with mechanically guided torch and chipping such that it will not induce residual stress in metal being cut. Radii of re-entrant corners shall be as large as practicable but not less than 3/4 inch (19 mm). Perform flame cutting so that metal being cut is not carrying stress. Finish exposed edges.

C. Provide full cross section bearing on milled ends of columns, crane rails, monorails and bearing stiffeners.

**2.07 - CONNECTIONS**

A. Connect members with ASTM A 325 high strength bolts unless otherwise specified or shown on contract drawings. Provide clean-cut holes without torn or ragged edges and remove outside burrs.

B. Provide high-strength bolted construction assemblies in accordance with the AISC Specifications for Structural Joints.

1. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material.
2. Joint surfaces shall be free of burrs and foreign materials. Score hot-dipped galvanized contact surfaces with a wire brush or blasted prior to assembly. Grinding of surfaces is not permitted.
3. If the thickness of the material is not greater than the normal diameter of the bolt plus 1/8 inch, the holes may be punched. If the thickness of the material is greater than the normal diameter of the bolt plus 1/8 inch, drill it full size or subpunch 1/16 inch smaller than the bolt diameter and ream to full size.
4. Provide bolt hole diameters not more than 1/16 inch in excess of the nominal bolt diameter unless otherwise specified in contract drawings.

5. Provide required slotted or oversize bolt holes as specified in the AISC Specification for Structural Joints. Tighten each bolt to provide the minimum tension shown in the AISC Specification for Structural Joints for the size and grade of bolts used

6. Provide required slotted or oversize bolt holes as specified in the AISC Specification for Structural Joints.

C. Provide full cross section bearing on milled ends of columns, crane rails, monorails, and bearing stiffeners.

D. Welded Connections:

1. Weld connections indicated or specified.

2. Provide complete weather seal weldments made with 1/16 inch minimum continuous fillets to members having Type S and E Service and to welded connections that will be galvanized.

E. Make connections with ASTM A 307 carbon steel bolts only when specified or shown in contract drawings.

F. Provide ASTM F 1554 anchor bolts with washer and heavy hex nuts. Provide hot-dip galvanized anchor bolts, washers and heavy hex nuts with galvanized steel.

**2.08 - GALVANIZE**

A. Provide hot-dip galvanizing in conformance with ASTM A 123, Grade 100 to steel indicated or specified to be galvanize coated.

B. Provide hot-dip galvanizing, in conformance with ASTM A 153, to bolts, nuts and washers that will be used with galvanized steel.

C. Complete fabrication and prepare surfaces of steel by removing weld spatter, flux, residue, burrs and metal surface defects before galvanizing. Clean weldments with power wire brush prior to galvanizing.

D. Provide steel dipped into solution of zinc chloride plus ammonium chloride immediately prior to galvanizing. Do not use galvanizing process utilizing flux blanket overlaying molten zinc.

E. Chromate treat pieces that will be in contact with or encased in concrete or masonry after galvanizing.

1. Two coats of one of the following coating systems may be substituted for the chromate treatment:

a. Series 161 Tneme-Fascure by Tnemec Co. Inc.

b. CARBOGUARD 891 VOC by Carboline.

c. Valspar-Series 89 by Valspar Corp., Baltimore

d. Or accepted equivalent product.

2. Prepare the steel surface in conformance with the manufacturer's printed instructions immediately before applying the initial coat of the two coat system.

F. Tap bolt nuts after hot-dip galvanizing in conformance with ASTM A 563.

G. Inspect galvanized material for compliance with these specifications. Mark the material with a clearly visible stamp indicating the name of the galvanizer, the ASTM number and the weight of zinc coating in ounces per sq. ft.

**2.09 - GALVANIZE TOUCH-UP**

A. Galvanize Touch-Up: Where galvanizing is damaged, touch-up abraded areas, using brushed-on method, with zinc-rich coating. Touch-up repair with zinc-rich coating of not less than 3 mil and not more than 6 mil dry film thickness.

B. Touch-up damaged galvanized surfaces with one of the following zinc rich coatings:

1. Endupor, zinc-rich coating by Dampney Manufacturing Co., Everett, MA

2. ZiRP, zinc-rich coating by Duncan Galvanizing Corp., Everett, MA

3. ZRC Cold Galvanizing Compound or ZRC Galvilite by ZRC Worldwide, Division of Norfolk Corp., Marshfield, MA;

4. Or accepted equivalent product.

## PART 3 - EXECUTION

### 3.01 - ERECTION OF STRUCTURAL STEEL

A. Conform to the referenced AISC standards. Brace and secure work until permanent connections are completed. Provide accessories and fasteners to secure the work in place whether or not shown or specified.

B. Erect work plumb, square, and true to line and level and in precise positions. Provide temporary bracing and guys to counteract loads and stresses to which structure may be subjected, including those due to erection equipment and its operation.

C. Align the various members to the lines and elevations indicated within the specified erection tolerances. Make adjustments to members prior to making permanent connections. Permanently connect the work in a sequence that will minimize lock-in stress.

D. Splice members only where shown or specified. On exposed welded connections, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

E. Do not enlarge holes in members by burning or the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to place bolts. Do not use gas-cutting torches in the field for correcting fabrication errors in the structural framing.

### 3.02 - DAMAGED MEMBERS

A. Replace members that are bent, twisted, or damaged. Remove members that are impaired in appearance, strength, or serviceability and replace with new members at no additional cost to Owner.

### 3.03 - MISFITS AT BOLTED CONNECTIONS

A. Immediately notify the engineer where misfits in erection bolting are encountered. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

B. Do not enlarge incorrectly sized or misaligned holes in members by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and submit a proposed method of remedy for review by the Engineer.

### 3.04 - ANCHOR BOLTS

A. Install anchor bolts by using templates, setting drawings, and instructions provided by the fabricator. Verify positions of bolts prior to delivery of steel; report errors or deviation for adjustment. After anchor bolts have been embedded, protect threads by applying grease and by having the nuts screwed on until the metalwork is installed.

### 3.05 - COLUMN BASEPLATES AND BEARING PLATES

A. Set columns with base plates attached and bearing plates for beams and similar structural members to their proper alignment and elevation using shim packs. Tighten anchor bolts after members have been positioned and plumbed. Protruding wedges, shims, or other leveling devices shall not be removed but cut off flush with the base plate prior to packing with grout.

### 3.06 - HIGH STRENGTH BOLTS

A. Provide workmanship and techniques for bolted construction in conformance with requirements of AISC Specification for Structural Joints and as indicated or specified.

B. Install ASTM A 325 bolts with hardened washer under element being turned in tightening. Install plate washers in both outer plies when using oversize and slotted holes. Install galvanized washer under bolt head and nut when using galvanized bolts.

C. Do not reuse galvanized high-strength bolts, nuts and washers.

### 3.07 - WELDING

A. Workmanship and techniques for welded construction to conform to requirements of AWS Structural Welding Code and as indicated or specified.

B. No field welding permitted unless indicated on Engineer approved fabrication shop drawings.

C. No field welding permitted on galvanized steel.

**3.08 - CLEAN-UP**

A. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the operations, including disused equipment and implements of service, and leave the entire structure and site, insofar as the work of this section is concerned, in a neat, clean, and acceptable condition.

**3.09 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 05500**

**MISCELLANEOUS METAL**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 5, METALWORK shall include the complete Work specified in all of the following Sections:

1. SECTION 05500, MISCELLANEOUS METAL
2. SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS
3. SECTION 05120, STRUCTURAL STEEL

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 05500, MISCELLANEOUS METALS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 C-001 | 00 C-104 | 99 C-503 | 99 C-504 | 00 A-001 | 10 A-101 | 10 A-102 |
| 10 A-103 | 10 A-104 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-406 | 10 A-407 | 10 A-501 | 10 A-502 | 10 A-503 |
| 10 A-504 | 10 A-603 | 10 A-604 | 10 A-605 | 10 A-607 | 00 S-001 | 00 S-002 |
| 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 S-106 | 10 S-107 |
| 10 S-301 | 10 S-302 | 10 S-303 | 15 S-101 | 30 S-101 | 99 S-501 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | 99 C-605 | 10 D-106 | 30 E-101 |
| 00 C-104 | 00 C-105 | 00 D-102 | 00 D-001 | 00 D-002 | 10 D-100 | 10 D-101 |
| 10 D-102 | 10 D-103 | 10 D-104 | 10 D-105 | 10 D-106 | 10 D-301 | 10 D-302 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 D-303 | 10 D-304 | 10 D-305 | 10 D-306 | 10 D-307 | 10 D-308 | 15 D-101 |
| 15 D-102 | 15 D-103 | 15 D-104 | 15 D-301 | 30 D-101 | 99 D-501 | 99 D-503 |

2. The Work of SECTION 05500, MISCELLANEOUS METALS for Alternative A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 C-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-501 |
| 20 A-603 | 20 A-607 | 00 S-001 | 00 S-002 | 20 S-101 | 20 S-102 | 99 S-501 |
| 99 S-502 | 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 05500, MISCELLANEOUS METAL

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide metal fabrications not specifically included in other Sections and required for completion of work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in

construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of all miscellaneous metals work. Show anchorage and accessory items. Include details of all connections between all materials.

2. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered metal component will be installed.

3. Manufacturer's literature describing standard items.

4. Shop drawings showing materials, sizes, finishes, locations, attached hardware and fittings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, miter connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.

5. Setting diagrams, erection plans, templates and directions for installation of backing plates, anchors, and other similar items.

6. Manufacturer’s specifications, load tables, anchor details, installation details for grating.

7. Material, product data and specifications with standards designated.

8. One sample of finished railing proposed for use. Submit with shop drawing submittal.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Identify and match-mark, materials, items and fabrications, for installation and field assembly.

E. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

F. Carefully handle and store materials, protected from weather, rusting and other damage.

G. Store structural shapes, pipes, tubes and sheets off the ground on suitable supports, with webs of flanged shapes vertical.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Railings and Guardrails:

a. Railings and guardrails shall be designed for a live load of 100 plf vertical plus 50 plf horizontal applied concurrently or a concentrated load of 200 pounds applied in any direction at any point along the rail, whichever produces the most extreme condition.

b. Intermediate rails, balusters and panels or fillers shall be designed for a uniform load of 25 psf over the gross area of the guard of which they are a part. This loading need not be added to the loading of the main members prescribed above.

c. Handrails shall be designed for a live load of 50 plf applied in any direction or a concentrated load of 200 pounds applied in any direction at any point along the handrail, whichever produces the most extreme condition.

D. Aluminum grating and aluminum plate covers design shall be based upon the following criteria:

a. Design Live Loads:

i. Uniform Live Load: 300 psf

ii. Concentrated @ Center Span: 500 plf

b. Maximum bending stress = 12,000 psi

c. Maximum shear stress = 8,000 psi

d. Modulus of Elasticity = 10,000 ksi

e. Maximum deflection under 100 psf uniform live load = Span / 300

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Obtain field measurements prior to preparation of shop drawings and fabrication.

C. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Each welder, tacker and welding operator shall be certified by test within the past six months to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted and witnessed by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

**1.08 - REFERENCES**

A. Aluminum Association (AA):

1. AA M12C22A41.

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

c. A41: Clear Anodic Coating, Class I.

2. AAM12C22A42:

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

c. A42: Dark Bronze Anodic Coating, Class 1.

B. American Institute of Steel Construction (AISC):

1. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Steel.

D. Aluminum Association Standard Anodic Finish (AASAF).

E. American Society for Testing and Materials (ASTM) Publications:

1. A36: Specification for Structural Steel.
2. A53: Specification for Pipe, Steel Black and Hot-dipped, Zinc-Coated Welded and Seamless.
3. A123: Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
4. A153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. A167: Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. A269: Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
7. A276: Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
8. A312: Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
9. A325: Specification for High Strength bolts for Structural Steel Joints.
10. A366: Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
11. A569: Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
12. A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
13. B26: Specification for Aluminum-Alloy Sand Castings.
14. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. B211: Specification for Aluminum-Alloy Bars, Rods, and Wire.
16. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
17. B241: Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
18. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
19. B249: Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes.
20. B308: Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
21. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - MATERIALS

A. Steel:

1. Conform to latest issue for the following:

a. Steel Shapes and Plates: ASTM A36

b. Steel Pipe: ASTM A53.

c. Nuts, Bolts, Rivets, Washers, and Anchorage Devices: ASTM A325 and AISC Specification.

d. Steel Sheets: Cold-rolled or hot-rolled carbon steel, ASTM A366, or ASTM A569.

B. Stainless Steel

1. Type 316 unless otherwise indicated or specified.

2. General: Type (or Grade) 304L for welding, otherwise Type (or Grade) 304.

3. Shapes and Bars: ASTM A276

4. Plate, Sheet, and Strip: ASTM A167

5. Tubing: ASTM A269

6. Pipe: ASTM A312, Schedule 40S

C. Aluminum:

1. Plates, rolled or extruded shapes, sheets or castings conforming (unless otherwise permitted or indicated) to the following Aluminum Association alloy and temper designations:

a. Rolled structural sheets and plates: ASTM B209-6061-T6

b. Rolled Structural Shapes: ASTM B308-6061

c. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6

d. Extruded structural tube or pipe: ASTM B429 Alloy 6061 T-6

e. Gratings (bearing bars): ASTM B211-6061-T6

(crimp bars): ASTM B211-6061-T5

f. Castings: ASTM B26-214

g. Sheets: ASTM B209-Alclad 3003-H14 and 3003

h. Bolts and nuts: Type 316 stainless steel

i. Pipe railings: ASTM B241-6061-T6

j. Handrail posts: ASTM B241-6061-T6

k. Die and hand forgings: ASTM B247 Alloy 6061-T6

l. Welding filter rods: ASTM B241-6061-T6

D. Bolts, washers and nuts: Type 316 stainless steel

E. Welding:

1. Provide filler materials appropriate and compatible for the alloys and tempers in accordance with the AWS Structural Welding Code.

2. Provide Class 5356 electrodes.

**2.02 - FABRICATION**

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified with straight lines, square corners or smooth bends; free from twists, kinks, warps, dents, and other imperfections. Straighten work bent by shearing or punching.

2. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.

3. Provide sufficient quantity and size of anchors for the proper fastening of work.

4. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.

5. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.

6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

8. Welding:

   a. Grind exposed edges of welds to a 1/8-inch minimum radius. Grind burrs, jagged edges and surface defects smooth.

   b. Prepare welds and adjacent areas such that there is (1) no undercutting or reverse ridges on weld bead, (2) no weld spatter on or adjacent to weld or any other area to be painted, and (3) no sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

9. Bolting:

   a. Provide Type 316 stainless steel stud bolts and nuts with heavy aluminum washer for fastening of aluminum material.

   b. Draw up bolts or nuts tight, and deform threads where possible. Use bolts of lengths required so that bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

   c. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting equipment to supports to a tolerance of + 1/16-inch of exact dimensions indicated.

   d. Provide plastic protection caps.

B. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

C. Fabricated Products:

1. Pipe Sleeves in Concrete Construction: Weld standard weight, black steel pipe, with anchors to exterior to accommodate passage of conduits, pipes ducts and similar items.

**2.03 - ALUMINUM PLATE COVERS AND FRAMES**

A. Provide aluminum tread plate covers of type, size indicated and as specified.

1. Provide with nonskid surface, reinforced with aluminum bars and angles welded to underside of cover. Fit covers neatly and accurately in frames.

2. Maximum size of plate covers shall not exceed 3 feet square unless otherwise indicated.

3. Frames:

   a. Provide aluminum angle frames with leveling bars.

   b. Provide mitered corners and welded joints. Grind smooth where exposed.

   c. Provide welded strap anchors at 24-inch maximum [610 mm] spacing, minimum two per side, for securing in concrete floor or 1/2-inch [13 mm] diameter, Type 316 stainless steel expansion bolts for securing to concrete, as applicable.

4. Provide aluminum cover plates and frames with a natural mill finish.

B. Removable Type Plate Covers:

1. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

C. Hinged Type Plate Covers:

1. Covers hinged to frame with Type 316 stainless steel, heavy duty plain bearing hinges and stainless steel pins.

2. Attach hinges to covers and frames with Type 316 stainless steel machine screws.

3. Provide covers with slam lock and spoon handle and fixed wrench type handle, or as indicated.

4. Provide a minimum of two airtight plate cover lift handles for each plate cover section.

D. Gasketed and Bolted Type Covers:

1. Provide plate covers with continuous, compressible neoprene seals between cover and frame at perimeter.

2. Provide covers secured to frames with countersunk, flathead, Type 316 stainless steel machine screws spaced 6-inches [150 mm] on centers.

3. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

E. Bolted Type Covers:

1. Provide covers secured to frames with countersunk, flathead, Type 316 stainless steel machine screws spaced 6-inches [150 mm] on centers.

2. Fit cover neatly and accurately in frames. Provide a minimum of four airtight plate cover lift handles for each plate cover section.

**2.04 - LOOSE LINTELS AND CMU PARTITION SUPPORTS**

A. Furnish loose lintels and CMU partition supports as indicated on drawings. Fabricate from structural steel shapes and plates. Hot-dip galvanize after fabrication.

**2.05 - ENGINE EXHAUST SLEEVE**

A. Fabricated of aluminum pipe or tubing with a minimum wall thickness of 1/8-inch. Inside diameter of sleeve 2 inches greater than outside diameter of exhaust pipe. Provide aluminum wall cover plate, aluminum plate with slip joint, and retaining ring. Weld plate to sleeve to form cover plate. Cut outer end to 45 degree.

**2.06 - GRAB BARS**

A. Provide grab bars at floor hatch openings adjacent to walls. Fabricated of 3/4-inch diameter solid aluminum rods and bent to shape indicated, with ends to be embedded in wall and bent downward for anchorage. Bars 2-feet wide with projected distance of 7 inches from wall to center of the bars.

**2.07 - ALUMINUM PIPE RAILS**

A. Provisions: All-welded assembly fabricated from 1-1/2-in. IPS, schedule 80 aluminum pipe, alloy 6061-T6 for posts, top rails and intermediate rails. Provide mitered connections at the intersections of posts and railings. Provide radius connections as indicated. Alloy of welding filler rods shall be compatible with alloy of posts and railings. Grind exposed welds smooth. Reinforce pipe rail posts with 14-inch long solid aluminum rod inserts at bottom of stanchions.

1. Complete railing, including anchorage and framing, and post spacing at a maximum of 4 feet on centers to withstand specified loading. Provide 1/4-inch thick aluminum kick plates as indicated.

2. Provide cast aluminum brackets for wall-mounted handrails.

3. Weld posts, to be mounted on top of stair stringers, to aluminum angle brackets. Fasten brackets to stringers with 1/2-inch diameter stainless steel bolts.

4. Side mount guard rail posts, to concrete. Weld to extruded aluminum brackets. Secure brackets to concrete with four 1/2-inch diameter stainless steel expansion bolts.

5. Set posts into concrete curbs, and into preformed holes. Secure in place with nonshrinking non-metallic grout. Provide holes at least 1 inch greater in diameter than outside diameter of posts and minimum of 6 inches deep.

6. Fabricate removable pipe railings in same manner as fixed railings.

7. Provide panels as large as practicable with joints between panels made neat and inconspicuous with exposed welds ground smooth.

**2.08 - ALUMINUM LADDERS**

A. Fabricate from 1-1/2-inch IPS, Schedule 80 aluminum pipe side rails and 1-inch solid round aluminum rod rungs, mortised and welded to uprights. Ladders for roof access, provide with uprights flared at top and turned back to form guard rails.

1. Provide rungs knurled or dimpled to minimize slipping.

B. Provide aluminum safety cages around ladders where the vertical distance between floors or landings is 20 feet or more. Fabricate cages from structural aluminum components as detailed.

C. Conform to OSHA Regulation 1910.27 for safety cages.

D. Ladder safety post extensions shall be provided on all fixed ladders 20 feet or less in height located below hatches and roof scuttles and as indicated. The aluminum telescoping tubular safety post extension shall lock in its vertical position and extend a minimum of 36 inches above the opening and shall be secured to the ladder rungs with stainless steel fasteners and brackets. The ladder post extension shall be Ladder UP Safety Post, Model LU-4 by Bilco Co.; Series L1E Safety Extension by Halliday Products; Pull-up Bar by Access Manufacturing or equal.

**2.09 - ALUMINUM FINISHES**

A. After fabrication, provide interior and exterior aluminum pipe railing assemblies, kick plates, posts, and ladders with Aluminum Association Standard clear anodized finish, Designation C22A41.

**2.10 - ALUMINUM PROTECTION**

A. Protect aluminum against electrolysis from all sources as specified in SECTION 01063, MISCELLANEOUS REQUIREMENTS. Under no circumstances shall aluminum contact a dissimilar metal.

1. Members Encased in Concrete: Zinc chromate primer.

2. Members in Contact with Concrete Masonry or Mortar: Coal tar epoxy.

B. Manufacturers:

1. 46H-413 Hi-Build Tnemec Tar by Tnemec Co., Inc.

2. Bitumastic 300M by Carboline Co.

3. Targuard by Sherwin Williams.

4. Or acceptable equivalent product.

**2.11 - RUNGS AND GRAB BARS**

A. Fabricate rungs from 1-inch diameter, Type 316 stainless steel rod and shaped to meet the requirements of OSHA 1910.27, Fig. D-1. Provide a clear width of 16 inches, drop front design approximately 3 inches deep and turned upward at least 2 inches at the embedded ends, and embed to a depth of 6 inches into the wall. Space rungs a maximum 12 inches apart vertically, and projecting 7 inches from face of wall to centerline of rungs. Provide stainless steel grab bars built into wall above the hinged floor plate covers.

1. Provide rung knurled or dimpled to minimize slipping.

**2.12 - FALL PREVENTION SYSTEM FOR LADDERS – NOT USED**

**2.13 - STEEL BOLLARDS**

A. Pipe for the bollards shall be 6-inch O.D. in all locations standard strength galvanized steel conforming to ASTM A120 or A53, except for bollards located around electrical transformers which shall be 4 inch O.D.s standard strength galvanized steel conforming to ASTM A120 or A53. Lengths shall be such as to allow bollards to extend 4-feet above and below grade.

A. Concrete for bollard encasement and for filling the inside of the pipe shall conform to DIVISION 3, CONCRETE.

B. Bollards shall be covered with a dome top low-density polyethylene thermoplastic tube having ultra-violet resistance and anti-static properties with a nominal thickness of 0.250 inches. Color shall be OSHA yellow and surface of sleeve shall be smooth with round top. No ribbed or multiple piece systems accepted.

**2.14 - HATCHES**

A. Hatches shall be of the styles, types and sizes shown on the Contract Drawings. All hatches and covers shall be rated Heavy Duty intended for use in vehicular travel areas and capable of withstanding HL-93, HS-20 with 30 percent impact, or M306 loading. Manufacturer shall guarantee proper operation and defects in material or workmanship for a period of five (5) years. All hatches shall be of aluminum or cast-iron construction as manufactured by the following manufacturers or an approved equal:

EJ
1125 Pearl Street, Brockton, MA 02301
Phone: 508-586-3130
https://www.ejco.com/am/en/?region=americas

Pennsylvania Insert Corporation
490 First Avenue, Royersford, PA 19468
Phone: 610-948-9688
www.pennsylvaniainsert.com

USF Fabrication
3200 West 84 Street, Hialeah, FL 33018
Phone: 860-398-0496
http://www.usffab.com/usffab-products/catalog/product_details/44

B. Exterior Hatches shall have a 1-1/2-inch drainage coupling located in the front right corner of the Hatch channel frame. Hardware shall be stainless steel factory mill finish and bituminous coating applied to the exterior of the frame. Hatches that are not shown connected to a drainage system, shall be provided with extensions to the drainage coupling to allow drainage to the areas below.

C. Hatches shall be installed in accordance with the recommendations of the manufacturer and as approved by the Engineer.

D. Hatches shall be provided with integral protective safety grating panels which operate independently from the hatch cover. Panel shall be constructed with aluminum “I” bar construction, all T-316 stainless steel hardware, tamper proof stainless steel hinge bolts, lockable with owner-supplied padlock, hinged with positive latch to maintain upright position, load rated consistent with access cover, view area for observation and limited maintenance, safety orange powder-coated finish, nut rail and stainless steel spring nuts with 300 psf loaded doors.

E. Type HL-93 hatches shall be single leaf or double leaf, watertight, self-draining type. Door leaf shall be of 3/8-inch thick aluminum diamond pattern plates reinforced with aluminum stiffeners as required and capable of withstanding an AASHTO HL-93 wheel load. Channel frame shall be 1/2-inch thick aluminum with anchor flange around the perimeter. Each door leaf shall be equipped with a minimum of two (2) hinges, with stainless steel pins, compression spring operators enclosed in telescopic tubes to afford easy operation, and an automatic hold-open arm with release handle. Snap locks with removable handle and safety chains shall be provided. A 1-1/2-inch drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be stainless steel with factory mill finish and bituminous coating applied to exterior of frame.

**2.15 - MISCELLANEOUS ITEMS**

A. Provide items of miscellaneous metalwork not particularly specified, of the shape, size, material and detail indicated and suitable for the purpose intended.

**2.16 – BAR RACK:**

A. Provide Manual Bar Rack, Drainage Plate and Bar Clamp in accordance with the detail shown on Drawing 99 D-501 - Details I with regards to shape, size, material and detail indicated and suitable for the purpose intended.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Accurately set and properly secure in place as indicated and specified. Where bolted connections are used, draw closely together and draw nuts tightly. Use bolts of lengths so that they do not project more than 1/4-inch [6 mm] beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

B. Locate anchors and anchor bolts and build into connecting work. Insert expansion bolts into drilled holes.

C. After erection, clean aluminum with mild soap and water, followed by clear water rinse, after erection.

D. Miscellaneous metal items specified shall be installed as indicated, specified and in accordance with accepted shop drawings.

**3.02 - ALUMINUM PROTECTIVE COATING**

A. Protect aluminum from contact with dissimilar metals, concrete, masonry, motar or grout.

B. Coat surfaces of aluminum with heavy coat of bitumastic paint.

C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot wate and dry thoroughly.

**3.03 - ALUMINUM PIPE RAILINGS**

A. Set posts plumb and align railings horizontal or parallel to rake of stairs to within 1/4 inch in 10 feet [6 mm in 3 meters] unless otherwise indicated.

B. Side mount posts to concrete with aluminum brackets as indicated.

C. Set top mounted posts in concrete curbs into preformed holes.

1. Provide holes at least 1 inch greater in diameter than outside diameter of posts and a minimum of 6 inches [150 mm] deep.
2. Moisten interior of holes and surrounding surfaces.
3. Set railing in position and brace until grout sets.
4. Secure in place with non-metallic, non-shrink grout. Provide 1/8-inch [3 mm] build up of grout around base of posts, sloped away from posts.

D. Provide butt splice joints with internal sleeves bonded with adhesive.

E. Provide expansion joints at intervals of not more than 32 feet [10 meters].

1. Locate joints within 6 inches [150 mm] of posts.
2. Provide slip joint with internal sleeve extending 2 inches [50 mm] beyond joint on each side.
3. Fasten internal sleeve securely to one side only.
4. Provide gap of 0.002 inch per foot per degree Fahrenheit [.10 mm per meter per degree Celsius].

**3.04 - ALUMINUM HANDRAILS**

A. Install aluminum handrail brackets spaced at a maximum of 4 feet [1.2 meters] on center.

**3.05 - LADDERS**

A. Anchor uprights to wall with angles or bent plates, weld to uprights and bolt expansion to wall. Ground smooth all welds.

B. Secure interior ladders to floor slabs with floor flanges.

C. Install safety cages or fall prevention system as indicated and in accordance with accepted shop drawings.

**3.06 - ALUMINUM GRATINGS AND FRAMES**

A. Accurately set and properly secure frames and gratings in place. Where bolted connections are used, draw closely together and draw nuts tightly.

B. Provide standard panel widths.

C. Perform cutting and fitting as required for installation.

D. Place grating panels such that cross bars align.

E. Cutouts for pipes or circular obstructions shall be 2-inch [50 mm] larger in diameter than the diameter of the obstruction.

F. Provide saddle clips, z-clips or other approved fasteners to secure grating at every 4-square feet. Provide a minimum of four fasteners per grating section.

G. Attachments shall permit removal of the grating panels.

**3.07 - ALUMINUM PLATE COVERS**

A. Accurately set and properly secure frames and covers in place. Where bolted connections are used, draw closely together and raw nuts tightly.

B. Set frames with welded anchors in forms prior to concrete placement.

C. Provide standard panel widths.

D. Perform cutting and fitting as required for installation.

E. Cutouts for pipes or circular obstructions shall be 2 inches [50 mm] larger in diameter than the diameter of the obstruction.

**3.08 - LIFTING HOOKS**

A. Fasten lifting hook to 1/2-inch by 4-inch by 11-inch steel anchor plate and assembly placed in formwork before concrete is placed.

B. Place lifting hooks in punched holes in bottom flange of steel beams and secure in place by nuts.

**3.09 - ENGINE EXHAUST SLEEVE**

A. Secure sleeve to masonry wall with two anchor lugs welded to sleeve. Fasten aluminum plate with slip joint around sleeve to masonry on inside. Fit retaining ring between sleeve and engine exhaust pipe to retain insulated packing.

**3.10 - GRAB BARS**

A. Space grab bars at 12-in. on center or as indicted. Apply protective coat of bituminous material to embedded parts of bars.

**3.11 - STRUCTURAL DOOR FRAMES**

A. Provide structural steel angles, plates and strap anchors as indicated.

**3.12 - ANGLE PROTECTION**

A. Provide structural steel angles and strap anchors as indicated and specified.

**3.13 - FALL PREVENTION SYSTEM**

A. Install in accordance with manufacturer's printed instructions and as specified.

**3.14 - ALUMINUM PLANK**

A. Acurately set and properly secure frames and planks in place. Where bolted connections are used. Draw closely together and draw nuts tightly.

B. Provide standard panel widths.

C. Perform cutting and fitting as required for installation.

D. Cutouts for pipes or circular obstructions shall be 2 inch larger in diameter than the diameter of obstruction.

E. Attachments shall permit removal of plank.

**3.16 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 05511**

**PRE-ENGINEERED ALUMINUM STAIRS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS is a part of DIVISION 5, METAL WORK which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 05500, MISCELLANEOUS METAL.

B. The Work of SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install pre-engineered aluminum stairs including surface preparation and shop priming.

B. The extent of pre-engineered aluminum stairs shall be as shown.

C. The Work also includes:

1. Providing openings in and attachments to pre-engineered aluminum stairs to accommodate the Work under this and other Sections and providing for the pre-engineered aluminum stairs all items such as anchor bolts, studs and all items required for which provision is not specifically included under other Sections.
2. Stair contractor shall provide design, detailing, fabrication and installation of ALL stair framing and connections, including column base connections, per specifications and provide calculations stamped by a structural engineer licensed in the state of MA to the Structural Engineer of Record for review. Column base connections shall be designed with post-installed anchors to foundations (exterior) or existing floor slabs (interior). All exterior stair framing, diagonal braces and column base anchorage shall be grade 316 stainless steel."

D. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the pre-engineered aluminum stairs Work.

E. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Samples: Submit the following:

1. Representative samples of materials including nosings, tread material, and other items as requested by the Engineer. Review will be for type only. Compliance with all other requirements is exclusive responsibility of Contractor.

B. Shop Drawings and Calculations: Submit the following:

1. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of the pre-engineered aluminum stair Work. Show anchorage and accessory items. Include details of all connections between all materials.

2. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed.

**C.** Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Manufacturer’s Qualifications:

1. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single pre-engineered aluminum stair manufacturer.

2. The pre-engineered aluminum stair manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pre-engineered aluminum stair manufacturer.

C. Codes: Comply with the applicable requirements of the Massachusetts State Building Codes.

D. Source Quality Control: Contractor shall be responsible for entire design, fabrication and installation of pre-engineered aluminum stair Work.

E. The Shop Drawings and calculations shall be prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed and is a recognized expert in the type of Work shown and specified.

**1.08 - REFERENCES**

A. All pre-engineered aluminum stairs shall be in accordance with:

1. Aluminum Association (AA), Specification for Aluminum Structures.

2. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
4. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
5. ASTM B 308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
6. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
7. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
8. ASTM F 594, Specification for Stainless Steel Nuts.
9. AWS D1.2/D1.2M, Structural Welding Code-Aluminum.
10. NAAMM, Metal Stairs Manual and Metal Finishes Manual.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - JOB CONDITIONS**

A. Conform to applicable OSHA and the Massachusetts Building Codes.

**PART 2 – PRODUCTS**

**2.01 - DESIGN CRITERIA**

A. Pre-engineered aluminum stairs shall comply with the requirements of the NAAMM, "Metal Stairs Manual".

B. Sizes of miscellaneous items such as carrier angles and platform stiffeners, and design stresses shall be as recommended in Section 4 of the "Metal Stairs Manual", unless otherwise shown.

C. All required stair loadings and other stair related requirements shall comply with the governing building code in which the pre-engineered aluminum stairs will be installed.

**2.02 - FABRICATION**

A. General:

1. Use welding for joining pieces together, unless otherwise shown or specified. Welding to comply with the applicable provisions of AWS D1.2/D1.2M. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and make connections between parts light proof tight. Provide continuous welds, ground smooth where exposed.
2. Construct stair units to conform to sizes and arrangements as shown. Provide pre-engineered aluminum framing, hangers, columns, struts, clips, brackets, bearing plates and other components for the support of pre-engineered aluminum stairs and platforms. Erect pre-engineered aluminum stair Work to line, plumb, square, and true with runs registering level with floor and platform levels.
3. Provide brackets and bearing surfaces as detailed and as required to anchor and contain the pre-engineered aluminum stairs on the supporting structure.
4. Where masonry walls support the pre-engineered aluminum stair Work, provide temporary supporting struts, designed for the erection of stair components before installation of masonry.
5. Finish: Provide Architectural mill finish as specified in the NAAMM Manual.
6. Protection of Aluminum from Dissimilar Materials: Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel as specified in SECTION 09900, PAINTING.

B. Stair Framing:

1. Fabricate stringers of structural aluminum channels, or plates, or a combination thereof, as shown. Provide closures for exposed ends of stringers.

2. Construct platforms of structural aluminum channel headers and miscellaneous framing members, as shown. Bolt or weld headers to stringers. Bolt or weld framing members to strings and headers. Refer to SECTION 05051, ANCHOR SYSTEMS and frame to the columns identified on the drawings, Supplement the columns with diagonal braces and as necessary to satisfy the design.

C. Aluminum Grating Treads and Platforms:

1. For aluminum grating, refer to SECTION 05532, ALUMINUM GRATING. Fabricate grating treads with abrasive nosing on one edge and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts. Provide grating treads at the following stairs:

a. Open grated stair treads in exterior applications.

b. Open grated stair treads on unenclosed stairs within buildings.

2. Fabricate grating platforms, with serrated nosing matching that on grating treads, at all landings. Provide toe plates at open sided edges of floor grating fastened to platform framing members.

3. Provide platforms 3/8 inch minimum thick with solid abrasive surface matching that on treads. Secure platforms to platform framing members with bolts.

D. Stair Aluminum Railing:

1. Aluminum railings shall conform to the requirements of SECTION 05522, ALUMINUM HANDRAILS AND RAILINGS.

**PART 3 – EXECUTION**

**3.01 - INSPECTION**

A. Contractor shall examine the conditions under which the Work is to be installed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Provide concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction.

**3.03 - INSTALLATION**

A. Fastening to In Place Construction:

1. Provide anchorage devices and fasteners where necessary for securing pre-engineered aluminum stairs to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors as required. The anchorage devices and fasteners shall be Type 316 stainless steel. Refer to SECTION 05051, ANCHOR SYSTEMS.

B. Cutting, Fitting and Placement:

1. Perform cutting, drilling and fitting required for the installation of the pre-engineered aluminum stairs. Set the pre-engineered aluminum stairs accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.

2. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units that have been hot dip galvanized after fabrication and are intended for bolted or screwed field connections.

**3.04 - CONTRACT CLOSEOUT**

C. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 05519**

**POST-INSTALLED CONCRETE ANCHORS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide open drilled in concrete anchors and concrete as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following after award.

1. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
2. Quality Assurance Submittals:
    a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
    b. Certificates: ICC ES Evaluation Reports.
3. Manufacturer’s installation instructions.
4. Installer Qualifications & Procedures: Submit installer qualifications as stated herein. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

B. ICC ESR document for each type and size of anchor to be installed in the work.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Store anchors in accordance with manufacturer’s recommendations.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

1. Installer Qualifications:

   a. Drilled-in anchors shall be installed by an installer with at least five years of experience performing similar installations.

2. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

   a. hole drilling procedure

   b. hole preparation & cleaning technique

   c. adhesive injection technique & dispenser training / maintenance

   d. rebar dowel preparation and installation

   e. proof loading/torqueing

3. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:

   a. ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. ASTM A307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
2. ASTM A449: Specification for Quenched and Tempered Steel Bolts and
3. ASTM A563: Specification for Carbon and Alloy Steel Nuts
4. ASTM F436: Standard Specification for Hardened Steel Washers
5. ASTM A36: Specification for Carbon Structural Steel
6. ASTM A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
7. ASTM A510: Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
8. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
9. ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
10. ASTM F594: Standard Specification for Stainless Steel Nuts
11. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
12. ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
13. Reinforcing Dowels: ASTM A615

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - FASTENERS AND ANCHORS

A. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.

B. Carbon and Alloy Steel Nuts: ASTM A563.

C. Carbon Steel Washers: ASTM F436.

D. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.

E. Wedge Anchors: ASTM A510; or ASTM A108.

F. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.

G. Stainless Steel Nuts: ASTM F594.

H. Zinc Plating: ASTM B633.

I. Hot-Dip Galvanizing: ASTM A153.

J. Reinforcing Dowels: ASTM A615

### 2.02 - DRILLED-IN ANCHORS

A. Wedge Anchors: Not Allowed.

B. Screw Anchors: Screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8μm min.).

2. Products:

   a. Hilti Kwik-HUS-EZ.

   b. Powers Fasteners; Wedge-Bolt

   c. Simpson; TITEN HD.

   d. Or equal

C. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s installation instructions. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) [or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038].

2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3. Reinforcing dowels shall be A615 Grade 60.

4. Products:
    a. Hilti; HIT-Z anchor rods with HIT-HY 200R.
    b. Powers Fasteners; PE1000+
    c. Simpson; Strong TIE SET-XP
    d. Or equal
5. Reinforcing dowels shall be A615 Grade 60.

D. Drop-in Anchors: The use of drop-in anchors is prohibited.

**PART 3 - EXECUTION**

**3.01 - DRILLED-IN ANCHORS**

A. Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.

1. Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.
2. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
3. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

B. Perform anchor installation in accordance with manufacturer instructions.

C. Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

D. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

E. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

**3.02 - REPAIR OF DEFECTIVE WORK**

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

**3.03 - FIELD QUALITY CONTROL**

A. Testing: 10% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.

1. Tension testing should be performed in accordance with ASTM E488.
2. Torque shall be applied with a calibrated torque wrench.
3. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed D/10, where D is the nominal anchor diameter.

B. Minimum anchor embedment, proof loads and torques shall be as recommended by the manufacturer.

**3.04 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 06170**

**METAL-PLATE-CONNECTED WOOD TRUSSES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide metal-plate-connected wood trusses, bridging, bracing, anchorage, and preservative treatment of wood as indicated and specified.

B. The term “metal-plate-connected wood trusses" as defined in this Section, includes planar structural units consisting of metal-plate-connected members fabricated from dimensioned lumber, cut and assembled before delivery to the Project site.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS:

1. Completely detailed shop drawings for all trusses. Indicate all dimensions, architectural details, connections, openings and lifting devices. Mark each member for identification. Show mark on erection plan and place legibly on unit at time of manufacture. Do not fabricate members before shop drawings are approved by the Engineer.
2. Manufacturer's specifications, anchor details and installation details.
3. Shop drawings showing materials, sizes, finishes, locations of appurtenances and attached hardware and fittings.
4. Setting diagrams, erection plans, templates including field erection details showing cuts, copes, connections, holes and threaded fasteners.
5. Drawings shall bear the seal and signature of a Professional Structural Engineer holding current registration in the state where the trusses are to be installed.
6. Drawings shall include as minimum information for each truss:
    a. Codes and specifications to which structural design conforms.
    b. Span, depth, slope, camber, weight and spacing of trusses.
    c. Deflections under live and total loads.
    d. Required bearing widths and locations.
    e. Top Chord Dead Load

f. Top Chord Live Load

g. Bottom Chord Dead Load

h. Bottom Chord Live Load

i. Concentrated loads and their points of application

j. Wind and seismic criteria

k. Vertical and horizontal support reactions under the various design loading combinations.

l. Member material specifications, sizes and gauges.

m. Truss web bracing, and splices as required.

n. Bridging member sizes, connections and locations.

o. Truss connection Requirements:

(1) Truss anchorage

(2) Truss to truss girders

(3) Truss ply to ply

(4) Field Splices

B. Drawings of modifications or changes in features or details that are necessitated by design requirements. Make all such modifications without additional compensation.

C. Manufactures design drawings shall bear the seal and signature of a structural engineer licensed in the state where the trusses are to be installed. Drawings shall be approved by the Engineer prior to fabrication.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in conformance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Transport, handle and store materials to protect from weather, rusting, corrosion or other damage.

E. Store structural members off the ground on supports, with webs vertical. Cover and protect from snow, rain and ground splatter.

F. Use nylon slings or padded cables for handling trusses. Do not drop or drag trusses.

G. Provide galvanized bolts, nuts and washers. Ship and store together in wood or metal containers.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Design trusses in accordance with these specifications and where any applicable design feature is not specified herein, design shall be in accordance with applicable provisions of the latest edition of National Design Specifications for Wood Construction (NDS) American Forest and Paper Association (AFPA), Design Specifications for Metal Plate Connected Wood Trusses (ANSI/TPI 1), and the Governing Building Code.

C. Fabrication shall be performed by a firm that participates in a recognized quality-assurance program that involves inspection by the Southern Pine Inspection Bureau (SPIB); Timber Products Inspection, Inc.; Truss Plate Institute (TPI); or other independent inspecting and testing agency acceptable to the Engineers and authorities having jurisdiction and is experienced in fabricating metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance.

D. Installation shall be performed by a firm that has completed wood truss installation similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

E. Provide product certificates signed by an officer of the truss fabricating firm certifying that the metal-plate-connected wood trusses supplied for the project comply with specified requirements and shop drawing.

F. Provide Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance

G. Provide material certificates for dimensioned lumber specified to comply with minimum allowable unit stresses. Indicate species and grade for each use and design values approved by the American Lumber standards Committee (ALSC) Board of review.

H. Provide wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For each type of preservative-treated wood product, include certification by treating plant starting type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to truss fabricator

3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

**1.08 - REFERENCES**

A. American Society of Civil Engineers (ASCE):

1. ASCE 7: Minimum Design Loads for Buildings and Other Structures

B. American National Standards Institute:

1. ANSI/TP1.1: National design standard for Metal-Plate-Connected Wood Truss Construction.

2. TPI HIB: Commentary and Recommendations for Handling Installing & Bracing Metal Plate Connected Wood Trusses.

3. TPI DSB: Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.

C. ASTM International (ASTM):

1. A 123: Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A 153/A 153M: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. A 143: Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting.
4. A 384: Practice for Safeguarding Against Warpace and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
5. A 385: Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
6. A 307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
7. A 563/A 563: Specification for Carbon and Alloy Steel Nuts.
8. A 653/ A 653M: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
9. A 666: Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, strip, Plate, and Flat Bar.
10. A 780: Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
11. F 568: Specification for Carbon and Alloy Steel externally Threaded Metric Fasteners.

D. American Society of Mechanical Engineers:

1. 10. B18.2.1: Square and Hex Bolts and Screws Inch.
2. 11. B18.2.3.8m: Metric Hex Lag Screws.

E. U.S. Department of Commerce, National Institute of Standards and Technology:

1. DOC PS 20: American Softwood Lumber Standard.

F. Council of American Building Officials:

1. CABO NER-272: Pneumatic or Mechanically Driven Staples, Nails, P-Nails and Allied Fasteners for Use in All Types of Building Construction.

G. Federal Specifications:

1. FS FF-N-105B: Nails, Brads, Staples and Spikes: Wire, cut and Wrought.

H. International Code Conference (ICC):

1. International Building Code

I. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - DESIGN REQUIREMENTS**

A. Design trusses in accordance with the latest edition of ASCE 7, the specified building code and these specifications.

B. Design roof trusses for the dead load of the member and the superimposed dead load of all ceiling and roof components.

C. Design roof trusses for the uniform and concentrated live loads, wind loads and seismic loads indicated on the drawings and specified. The roof trusses shall carry an Underwriter's Laboratories wind uplift Class-90 rating.

D. Design all individual framing members of the building roof and truss system for the snow, live, wind and seismic loads indicated.

E. Vertical deflection building trusses shall not exceed 1/240th of the span under design loads. Vertical deflection building trusses supporting plaster ceilings shall not exceed 1/360th of the span under design loads.

F. The roof coverings shall be designed for the specified live load and the wind load, and shall carry an Underwriters' Laboratories wind uplift Class 90 rating. Deflection of the roof panels shall not exceed 1/180th of its span when supporting these loads.

G. The truss manufacturer shall obtain information for all additional loads required for the design from the contractor and incorporate these loads into the design.

H. The structural analysis shall include the effect of geometric irregularities such as hatches, dormer openings and perimeter support members.

I. Truss system, with framing components and accessories shall provide a complete framing system, ready for deck installation.

J. Truss design shall provide minimum clear truss panel openings of 16 inches x 14 inches [410 mm x 360 mm] to accommodate ductwork.

K. Design Loads:

1. Design roof trusses for the dead load of the truss and the superimposed dead load of all components attached to or supported from the truss, including all roofing and ceiling materials, piping ductwork and lighting. As a minimum, the truss design shall consider a uniform dead load of 15 pounds per square foot applied to the top chord and 10 pounds per square foot applied to the bottom chord.
2. Design roof trusses for the uniform and concentrated live loads, wind loads and seismic loads indicated on the drawings and specified.
3. Design roof trusses for actual piping and equipment loads to be supported by the member. As a minimum the roof frames shall be designed for a uniform piping load of 15 pounds per square foot [700 N per square meter] of tributary area or a concentrated load of 2000 pounds [9 kN] located at any point along the length of the member, whichever produces the most severe condition.
4. Live Load: The trusses shall be designed for a minimum live load of 35 psf [1.67 $kN/m^2$ ].
5. Wind Load: Wind loads shall be determined in accordance with ASCE 7.
6. Snow Load: Snow loads shall be determined in accordance with ASCE 7.
7. Seismic Loads: Seismic loads shall be computed in accordance with ASCE 7.
8. Loading Combinations: Load combinations shall be as prescribed in ASCE 7.
9. Design trusses for loads resulting from lifting, transporting and installing.
10. Trusses, connections and anchorages shall be designed for a lateral (seismic/wind) load applied at the end anchorage equivalent to 200 pounds per linear foot of supporting wall.

**2.02 - DIMENSION LUMBER**

A. Provide trusses fabricated of Southern Yellow Pine members.

B. Factory mark each piece of lumber with type, grade, mill, and grading agency.

C. Lumber shall be dressed lumber, surfaced four sides, manufactured to actual sizes required by PS 20 and comply with the following:

1. Moisture content: Seasoned, with 15 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness.

2. Species and grade that complies with the following for species group as defined in NFOPA 01 for extreme fiber stress in bending $F_b$ for single and repetitive members, and for modulus of elasticity E.

    a. Chord members: $F_b$ of 1,500 psi for single member use and 1,750 psi for repetitive member used, and E for 1,600,000 psi.

    b. Web Members: $F_b$ of 1,500 psi for single member use and 1,750 psi for repetitive member use, and E of 1,600,000 psi.

3. Fire retardant treated lumber, if applicable, shall meet specifications of truss design and ANSI/TPI 1 and shall be redried after treatment in accordance with APA Standard C20. Allowable values must be adjusted in accordance with NDS. Truss manufacturer shall supply certificate of compliance for treated material.

**2.03 - CONNECTOR PLATES**

A. Provide metal connector plates from one source and by a single manufacturer.

B. Fabricate connector plates from metal complying with requirements indicated:

1. Hot-Dip Galvanized Steel Sheet: Structural quality sheet, zinc coated by hot-dip process complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; Grade 33 and not less than 0.0359 inch (0.91 mm) thick.

2. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316, chromium nickel steel sheet; 33,000 psi (230 Mpa) minimum yield strength and not less than 0.035 inch (0.89 mm) thick.

3. Fasteners: Provide fasteners of the size and type indicated that comply with requirements specified below for material and manufacture:

    a. Nails Wire, Brads, and Staples: FS FF-N-105

    b. Power Driven Fasteners: CABO NER-272

    c. Wood screws: ASME B18.2.1

    d. Lag Bolts and Screws: ASME B18.2.1 (ASME B18.2.3.8M)

    e. Bolts: steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and flat washers.

**2.04 - FRAMING ANCHORS**

A. Framing anchors shall be furnished by a single supplier.

B. Provide products with allowable design loads published by manufacturer that meet or exceed those indicated or required. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Provide hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type indicated.

D. Stainless steel shall be ASTM A 666, type 304 or 316, chromium nickel steel sheet; 33,000 psi (230 Mpa) minimum yield strength.

**2.05 - ACCESSORIES**

A. Anchors:

1. Hurricane Anchors for wood to wood: Steel sheet zinc-coated by hot-dip process prior to fabrication to comply with ASTM A653 for Coating designation.

2. Anchor bolts for fastening wood sleepers shall comply with ASTM A307 and shall be galvanized to ASTM A153. Anchor bolts shall be placed in coordination with location of the trusses.

**2.06 - GALVANIZE**

A. Provide hot-dip galvanizing in conformance with ASTM A 123, Grade 100 to all steel indicated or specified to be galvanized.

B. Provide hot-dip galvanizing, in conformance with ASTM A 153, to all bolts, nuts and washers that will be used with galvanized steel.

1. Prepare the steel surface in conformance with the manufacturer's printed instructions immediately before applying the initial coat of the two coat system.

2. Tap bolt nuts after hot-dip galvanizing in conformance with ASTM A 563.

3. Inspect galvanized material for compliance with these specifications. Mark the material with a clearly visible stamp indicating the name of the galvanizer, the ASTM number and the weight of zinc coating in ounces per sq. ft.

**2.07 - GALVANIZE TOUCH-UP**

A. Galvanize Touch-Up: Where galvanizing is damaged, touch-up abraded areas, using brushed-on method, with zinc-rich coating. Touch-up repair with zinc-rich coating of not less than 3 mil [0.075 mm] and not more than 6 mil [0.15 mm] dry film thickness.

B. Touch-up all damaged galvanized surfaces with one of the following zinc rich coatings:

1. Endupor, zinc-rich coating by Dampney Manufacturing Co., Everett, MA

2. ZIRP, zinc-rich coating by Duncan Galvanizing Corp., Everett, MA

3. ZRC Cold Galvanizing Compound or ZRC Galvilite by ZRC Worldwide, Division of Norfolk Corp., Marshfield, MA;

4. Or equal.

**2.08 - FIRE-RETARDANT-TREATED MATERIALS**

A. Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

C. For interior locations, use chemical formulation that produces treated lumber with the required design properties under conditions present after installation.

D. Bending strength, stiffness, and fastener-holding capacities shall not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.

E. No form of degradation shall occur due to acid hydrolysis or other causes related to treatment.

F. Contact with treated wood shall not promote corrosion of the fasteners.

G. Inspect each piece of treated lumber after drying and discard damaged or defective pieces.

**2.09 - FABRICATION**

A. Fabricate each element and connection as indicated on the fabrication shop drawings approved by the Engineer.

B. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

C. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.

| Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances listed. Position members to produce design camber indicated. | |
|---|---|
| Length or Height | Tolerance |
| Length < 30 feet [9150 mm] | ½-inch [13 mm] |
| Length > 30 feet [9150 mm] | ¾-inch [19 mm] |
| Height < 60 inches [1525 mm] | 1/4-inch [6 mm] |
| Height > 60 inches [1525 mm] | 1/2-inch [13 mm] |

D. Connect truss members by metal connector plates located and securely embedded simultaneously into both sides of wood members by air or hydraulic press

**PART 3 - EXECUTION**

**3.01 - ERECTION**

A. Do not install trusses until supporting construction is in place, braced and secured.

B. Verify that rough-in utilities and/or chases that will interface with the trusses or truss bracing are in correct locations and do not interfere with truss placement

C. Do not install trusses before unacceptable conditions have been corrected. Commencement of construction activities of this section indicates installer's acceptance of conditions.

D. Assemble trusses delivered to the Project site in more than one piece before installation using the correct fasteners.

E. Hoist trusses in place by lifting equipment suited to size and types of trusses required, exercising care not to damage truss members or joints.

F. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

G. Hold trusses securely in place with temporary bracing and stays to resist all vertical and lateral loads, until members are permanently fastened and floors and roofs completed.

H. Space, adjust, and align trusses in location before permanently fastening as indicated on the drawings

I. Anchor trusses securely at all bearing points using metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer’s fastening schedules and written instructions.

J. Securely connect each truss ply required for forming built-up girder trusses.

K. Anchor trusses to girder trusses as indicated on the approved shop drawings.

L. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

M. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated

N. Install wood trusses within installation tolerances of ANSI/TPI 1.

O. Do not cut or remove truss members.

P. Report errors in shop fabrication or deformation resulting from handling or transportation immediately to Engineer. Remove from job site incorrectly fabricated or deformed material at no additional cost to the Owner.

Q. Do not alter trusses in the field.

R. Align and adjust members forming parts of a complete assembly before permanent fastening.

**3.02 - GALVANIZE TOUCH-UP**

A. Galvanize Touch-Up: Where galvanizing is damaged, touch-up abraded areas, using brushed-on method, with zinc-rich coating. Touch-up repair with zinc-rich coating of not less than 3 mil [0.075 mm] and not more than 6 mil [0.15 mm] dry film thickness.

B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 06200**

**CARPENTRY**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide the necessary materials to do rough and finished carpentry as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS. Submit the following:

1. Material Specifications including grade and species.
2. Details of construction for each item specified.
3. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer’s written instructions for handling, storing, installing, and finishing treated material.
4. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver to jobsite and store off the ground in a manner to ensure proper drainage, ventilation, and protection from the weather.

E. Protect lumber and plywood from extreme changes in temperature and humidity.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials

**1.08 - REFERENCES**

A. American Society of Mechanical Engineers (ASME):

1. B18.2.1: Square and Hex Bolts and Screws (Inch Series).
2. B 18.2.3.8M: Metric Hex Lag Screws.
3. B 18.6.1: Wood Screws (Inch Series).

B. American Society for Testing and Materials (ASTM):

1. A 307: Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
2. A 563/A563M: Specification for Carbon and Alloy Steel Nuts [Metric].
3. C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
4. D 5516: Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
5. D 5664: Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
6. E 488: Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
7. F 568M: Specification for Carbon and Alloy Steel Externally threaded metric Fasteners.
8. F 593: Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
9. F 594: Specification for Stainless Steel Nuts.
10. F 738M: Specification for Stainless Steel Metric Bolts, Screws, and Studs.
11. F 836M: Specification for Style 1 Stainless Steel Metric Nuts.
12. F 1667: Specification for Driven Fasteners: Nails, Spikes, and Staples.

C. American Wood Preserver's Association (AWPA) Standard:

1. C20: Structural Lumber – Fire-Retardant Treatment by Pressure Process.
2. P5: Wood Pressure Treated with Water-Borne Preservatives.

D. Council of American Building Officials (CABO):

1. CABO NER 272: Pneumatic or Mechanically Driven Staples, Nails, P-Nails and Allied Fasteners for Use in All Types of Building Construction.

E. Federal Specifications:

1. TT-W-550: Wood Preservative, Chromated Copper Arsenate Mixture.

2. TT-W-571I(2): Wood Preservation, Treating Practices.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - WOOD PRESERVATIVES**

A. For wood encased in or in contact with concrete or masonry, and wood items incorporated in the roofing, use preservatives conforming to following:

1. AWPA standard P5

2. Federal Specification TT-W-550

**2.02 - FIRE-RETARDANT-TREATED MATERIALS**

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber.

2. Use treatment that does not promote corrosion of metal fasteners.

3. Use Interior Type A High Temperature (HT), unless otherwise indicated.

**2.03 - PLYWOOD**

A. Plywood sheathing shall be of a thickness as indicated on the drawings conforming to Douglas Fir Plywood Association requirements for exterior, Grade C-6, Group 1, unsanded and shall bear the stamp of the American Plywood Associated.

B. Fire-retardant-treated plywood sheathing shall comply with the requirements in section 2.02.

**2.04 - FASTENERS**

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

**2.05 - AIR BARRIER**

A. Basis of Design: High-performance, spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® and related assembly components.

B. Performance Characteristics:

1. Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type 1 per ASTM E1677.

2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.

3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.

4. Basis Weight: 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.

5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.

6. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.

7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.

8. Surface Burning Characteristcs: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

C. Seam Tape: 3 inch wide, DuPont™ Tyvek® Tape for commercial applications.

**2.06 - Z-GIRT SYSTEM**

A. Basis of Design: ThermaFast Z-Track

B. Materials Properties

i. Design loads: Wind pressure and self-weight of cladding as indicated on the project's Architectural/Structural Drawings and as required by the International Building Code.

ii. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi (450MPa) minimum tensile strength, with ASTM A653/A653M G90 (Z275) hot dipped galvanized coating.

iii. Thickness: 54 mil minimum (16 gauge, 0.0566-inch design thickness)

iv. Thermal Tape: Thickness 1/16-inch, Density 15 lbs/ft3 (ASTM D-1667)

v. Thermal Conductivity k-factor: 0.3 (ASTM C-518)

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Securely fasten and neatly fit carpentry with screws, nails, bolts, or spikes of ample size and suitable type.

1. Secure wood work to masonry and other hard surfaces with expansion bolts and plugs or shield in a manner to provide rigid and permanent support.

2. Countersink screws and bolts. Putty holes and sand smooth.

B. Install fire retardant treated plywood and blocking as indicated.

C. Plywood:

1. Plywood sheathing shall be installed with the face grain perpendicular to the supports, with end joints staggered and located at supports. A minimum of 1/16-in. space shall be allowed at end joints and 1/8-in. space at edge joints. Nails for securing the roof panel shall be 6d ring-shank or spiral thread nails spaced 6-in. on centers along panel edges and 12-in. on centers at intermediate supports.

D. Wood Preservatives:

1. Apply preservatives in accordance with Federal Specification TT-W-571I(2), Treating Practices, Table III, Obtain and submit notarized certificate of treatment from treatment company.

2. Prior to treatment, ensure that lumber is sawed to exact length and bored as required insofar as practicable.

3. Apply two heavy coats of preservative to any surfaces cut or bored after treatment, prior to installation.

### 3.02 – Z-GIRT SYSTEM

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

B. Attach cladding support system to steel stud backup with a minimum of two #10-16 self-drilling screws to each stud. Additional screws may be required for high design wind pressures per manufacturer’s recommendations.

C. Attach cladding panels or tiles to cladding support system per cladding panels manufacturer’s recommendations.

D. Door Openings: Install framing below sills of openings to match framing required above door heads.

E. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly and support closures and to make partitions continuous from floor to underside of solid structure.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 06225**

**EXTERIOR FINISH CARPENTRY**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide the necessary materials to do rough and finished carpentry as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS. Submit the following:

1. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

2. Samples for Verification:

   a. For shingle siding, six shingles.

   b. For cellular PVC trim, with ½ of exposed surface finished; 50 sq. in.

3. For PVC molding, 50 sq. in.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver to jobsite and store off the ground in a manner to ensure proper drainage, ventilation, and protection from the weather.

E. Protect lumber and plywood from extreme changes in temperature and humidity.

F. Stack lumber, materials per manufacturer's recommendations. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

**1.08 – FIELD CONDITIONS**

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

a. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration

**1.09 – WARRANTY**

A. Manufacturer's Warranty for Cellular PVC Trim: Manufacturer agrees to repair or replace trim that fails due to defects in manufacturing within specified warranty period. Failures include, but are not limited to, deterioration, delamination, and excessive swelling from moisture.

B. Warranty Period: Ten years from date of Substantial Completion

**PART 2 - PRODUCTS**

**2.01 – EXTERIOR TRIM**

A. Cellular PVC Trim: Extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized, rigid material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Vycom Azek., Corp or a comparable product by one of the following:

a. CertainTeed Corporation; CertainTeed Restoration Millwork.

b. Wolfpac Technologies Inc., Versatex

2. Products:

a. Exterior trimboards and sheets as indicated, of sizes as indicated.

b. Milled PVC custom profiles as indicated.

3. Finish: Matt White

4. Density: Not less than .55 g/cm3.
5. Heat Deflection Temperature: Not less than 150 deg F., according to ASTM D648.
6. Coefficient of Thermal Expansion: Not more than 4.5 x 10-5 inches/inch x deg F.
7. Water Absorption: Not more than .2 percent, according to ASTM D570.
8. Flame-Spread Index: 25 or less, according to ASTM E84

B. Trim

1. Size of Vertical Trims: 1-1/2-inch thick, 3-1/2-inch wide, smooth sanded edge.
2. Size of Fascia Boards: 3/4-inch thick, 9-1/2-inch wide Fascia boards, and 3/4-inch thick, 2-1/2-inch wide Fascia boards.
3. Size of Frieze Boards: 3/4-inch thick, 5-1/2-inch wide Frieze boards.
4. Texture: Smooth.
5. Color: As selected by Architect from manufacturer's full range of industry colors.

C. Fiber Cement Soffit

1. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
2. Nominal Thickness: Not less than 5/16-inch.
3. Pattern: 12-inch wide sheets.
4. Texture: Smooth.
5. Ventilation: Provide perforated continuous soffit vents- see accessories.
6. Color: As selected by Architect from manufacturer's full range of industry colors.

D. Beam and Post Wraps

1. Size: 3/4-inch thick, largest panel available to avoid joints.
2. Texture: Smooth.
3. Color: As selected by Architect from manufacturer's full range of industry colors.

**2.02 - FIRE-RETARDANT-TREATED MATERIALS**

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Interior Type A High Temperature (HT), unless otherwise indicated.

**2.03 - EXTERIOR TRIM MISCELLANEOUS MATERIALS**

A. Fasteners for Exterior Finish Trim: Provide stainless steel screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate, recommended by manufacturers.

B. Provided pre-painted fastener heads to match trim finish.

C. Provide adhesives per trim manufacturer's recommendations.

D. Provide sealants per trim manufacturer's recommendations and specification Section 07900 – Joint Sealants.

E. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

F. Flashing: Comply with requirements in Section 07600 – Wall Flashing and Sheet Metal Work for flashing materials installed in exterior finish carpentry.

G. Round Soffit Vents: Stamped aluminum louvered vents, size as indicated, made to be inserted into round holes cut into soffit.

1. Finish: White paint typical or Mill Finish where indicated

H. Fabrication:

1. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.

**2.04 - EXTERIOR PVC WINDOW SHUTTERS**

A. Size of shutter shall match height of window and trim.

B. Material: Composite PVC.

C. Factory primed and finshed paint.

1. Color to be determined by Architect.

**2.05 - AIR BARRIER**

A. Basis of Design: High-performance, spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® and related assembly components.

B. Performance Characteristics:

1. Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type 1 per ASTM E1677.

2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.

3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.

4. Basis Weight: 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.

5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.

6. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.

7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.

8. Surface Burning Characteristcs: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

C. Seam Tape: 3 inch wide, DuPont™ Tyvek® Tape for commercial applications.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

**3.03 - INSTALLATION, GENERAL**

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

**3.04 - STANDING AND RUNNING TRIM INSTALLATION**

A. Install flat-grain lumber with bark side exposed to weather.

B. Install cellular PVC trim to comply with manufacturer's written instructions.

C. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available.

1. Use scarf joints for end-to-end joints.

2. Stagger end joints in adjacent and related members.

D. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

**3.05 - ADJUSTING**

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

**3.06 - CLEANING**

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

**3.07 - PROTECTION**

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 06400**

**ARCHITECTURAL WOODWORK**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Architectural Woodwork (including, but not limited to, Laminate-clad cabinets (plastic-covered casework) and shelving, Solid surfacing countertops) as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS:

1. Product Data: Submit for each type of product and process specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
2. Shop Drawings: Show locations of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
    a. Show details full size.
    b. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
    c. Show locations and sizes of cutouts and holes for wire management grommets, plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
3. Samples:
    a. Plastic laminate panel products, 6 inches by 8 inches.
    b. Solid surface countertops.
    c. Exposed cabinet hardware, one unit for each type and finish.
4. Product Certificates: By woodwork fabricator certifying that products and construction comply with specified requirements.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Protect woodwork during transit, delivery, storage and handling to prevent damage, soilage, and deterioration.

E. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Fabricator Qualifications: Company specializing in performing the work of this Section with minimum 5 years experience of successful in service performance, as well as sufficient production capacity to produce required units.

C. Installer Qualifications: Arrange for interior architectural woodwork installation by a firm that can demonstrate successful experience, minimum 5 years, in installing architectural woodwork items similar in type and quality to those required for this Project.

D. Quality Standard: Except as otherwise indicated, comply with the following standard:

1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.

2. The Contract Documents contain selections chosen from options in the Quality Standard as well as additional requirements beyond those of the Quality Standard. Comply with such selections and requirements in addition to the Quality Standard.

**1.08 - PROJECT CONDITIONS**

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Obtain and comply with woodwork fabricator's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation.

C. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final Shop Drawings.

**1.09 - COORDINATION**

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Wood Products: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
3. Particleboard: ANSI A208.1, Grade M-2 made with phenol-formaldehyde resins.
4. Softwood Plywood: PS 1.
5. Hardwood Plywood and Face Veneers: HPVA HP-1, 7 ply core, no voids.

B. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard. Grade GP-28 for vertical surfaces and GP-50 for countertops and horizontal surfaces.

1. Colors, Patterns, and Finishes: To be selected by the Engineer.
    a. Manufacturer: Formica
2. Edgebanding for Plastic Laminate: Plastic laminate.

C. Semi-Exposed Plastic Laminate Millwork Materials: Comply with the following:

1. Plastic Laminate Cabinet Liner: White high-pressure decorative laminate cabinet liner complying with NEMA LD 3, CL 20.
    a. Laminate Attachment: Bond laminate materials to core material with catalyzed PVA glue with a minimum average pressure of 90 PSI and average 180 degree temperature.
2. Thermofused Melamine Laminate: Permanently thermofused melamine laminate, fused to core using average pressure of 320 PSI and average 320º F. temperature. Shall meet ALA 1996 specification standards, as tested against the high-pressure laminate NEMA LD 3-1995, VGS.028 specification standards.

D. Thermoset Decorative Laminate: Comply with ALA 1988 and NEMA LD 3 for GP 20; melamine.

E. Adhesive for Bonding Plastic Laminate: Contact cement.

F. Solid Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.

1. Product: Corian; DuPont Polymers; Price Group C.
2. Lavatories and Sinks: Seamed undermount “S” integral to top.
    a. Sink: Model 871S.
    b. Lavatory: Model 810S.

**2.02 - CABINET HARDWARE**

A. General: Provide specific cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by reference to BHMA numbers or referenced to this standard.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA code number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

D. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements of BHMA A156.9.

E. Cabinet Hinges: Blum Model 10 or equal, 3 dimensional adjustable, 110 degree open angle, slide on technique, all metal hinge with automatic steel closing mechanism.

F. Full Extension Drawer Slides: Grass 6200, MEPLA 3211, telescoping full extension ball bearing slide, 100 pound capacity, baked on epoxy finish, color as selected by the Engineer.

1. Drawer Slide Filing Rail: Grass filing cabinet system 6110 Pendaflex railing, or MEPLA Prosystem, baked on epoxy finish, color as selected by the Engineer.

2. Pencil Drawer Slide: Knapt & Vogt No. 8200, Grant 344, minimum 50 pounds.

G. Door and Drawer Pulls: Solid brass with satin chromium finish, 26D or stainless steel with 32D finish.

**2.03 - ACCESSORY MATERIALS**

A. Counter Bracket Supports: Fabricated of 6063 T-6, T-shaped extruded aluminum; MIG welded along 45 degree miters and along back; pre-punched for 1/4-inch fasteners; provide rubber grommet in 7/8-inch hole; powder coated finish; Rakks, Rangine Corp., Millis, MA.

B. Plastic Grommets: Round wire management grommets No. 35-3" by Outwater Plastics, Woodridge, NJ, (800) 631-8375. Color shall be selected from manufacturer's full range of colors and finishes.

C. Shelf Support: Provide double-slotted aluminum shelf standards and double boltless aluminum shelf brackets, with satin anachrome finish.

1. Provide shelf supports with coat rod.

**2.04 - INSTALLATION MATERIALS**

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.

C. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

E. Glue: Aliphatic- or phenolic-resin wood glue recommended by manufacturer for general carpentry use.

F. Sealants: Sealants shall comply with SECTION 07900, JOINT SEALANTS.

1. Color: As selected by Engineer from manufacturer’s full range of colors.

**2.05 - FABRICATION, GENERAL**

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate Woodwork to Dimensions, Profiles, and Details Indicated. Ease Edges to Radius Indicated for the Following:

1. Corners of edges of solid-wood (lumber) members 3/4 inch (19 mm) thick or less: 1/16 inch (1.5 mm).

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.

D. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

**2.06 - PLASTIC LAMINATE CABINETS**

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets. Provide Custom grade.

B. Plastic Laminate Cabinets: Flush overlay construction without face frame cabinet construction. Custom grade and meeting the following specified requirements.

1. Base Cabinets: Bottoms and ends of cabinets, exposed backs, and tops of cabinets; 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, melamine or plastic laminate cabinet liner faced on semi-exposed surfaces.

a. Backs of Cabinets: 3/8-inch (13-mm) plywood. Back mounted to side bottom and top, inset 3/4 inch to conceal mounting rails. Base cabinet shall have rail positioned at the top.

b. Mounting Rails: 3/4 inch thick, fastened to cabinet back on interior of cabinet or as indicated in details.

c. Cabinet Sub-Base: Separate and continuous (no cabinet body sides to floor), water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder type construction of front, back, and intermediates to form a secure and level platform to which cabinets attach.

d. Depth: Provide cabinets of the type indicated meeting the following.

(1) Deep Cabinet: Minimum outside depth of 23 inches from wall to face of cabinet box, less the door (approximately 24 inches from wall to face of door).

(2) Shallow Cabinet: Minimum outside depth of 13 inches from wall to face of cabinet box, less the door (approximately 14 inches from wall to face of door).

2. Inside Corners: Construct cabinets and fillers at inside corners to allow for proper clearance and operation of drawers and doors.

3. Solid Doors: 3/4-inch (19-mm-) thick particleboard or medium-density fiberboard, plastic-laminate faced on exposed surface, melamine or plastic laminate cabinet liner faced on semi-exposed surfaces.

**2.07 - SOLID SURFACING COUNTERTOPS**

A. Quality Standard: Comply with AWI Section 400, Custom Grade requirements for countertops.

B. Solid Surfacing Material Thickness: 3/4 inch (19 mm), unless indicated otherwise.

C. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

D. Drill holes in countertops for plumbing fittings, deck-mounted soap dispensers, and similar devices in shop.

## PART 3 - EXECUTION

### 3.01 - PREPARATION

A. Condition millwork to average prevailing humidity conditions in installation areas before installing.

B. Before installing architectural millwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

### 3.02 - INSTALLATION

A. Quality Standard: Install millwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of millwork involved.

B. Install millwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches for plumb and level (including tops and sills).

C. Scribe and cut millwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor millwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with millwork and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96 inch sag, bow, or other variation from a straight line.

F. Countertops: Anchor securely by screwing through corner blocks of base units or other support systems as indicated into underside of countertop. Caulk space between backsplash and wall with specified sealant.

1. Install countertops with no more than 1/8 inch in 96 inches sag, bow, or other variation from a straight line.

2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c.

3. Provide cutouts for grommets, plumbing fixtures and fittings and detailed openings. Verify locations of cutouts from on site dimensions. Seal surfaces of cutout edges.

4. Install countertop brackets.

G. Complete the finishing work specified in this Section to the extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in the shop.

### 3.03 - ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces.

### 3.04 - PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

### 3.05 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 06610**

**FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS**

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## PART 1 – GENERAL

### 1.01 - DESCRIPTION

A. This section includes:

1. FRP Grating and Treads.
2. FRP Molded Grating.
3. FRP Structural Shapes.
4. FRP Stairs.
5. FRP Railing.
6. FRP Ladders and Cages.
7. FRP Plank Covers.

B. Furnish all labor, materials, equipment and incidentals necessary to install the fiberglass polymer products specified.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Detail shop drawings indicating:

a. Dimensions.

b. Sectional assembly.

c. Location and identification mark.

d. Connections, connections to structure and fastening methods.

e. Size and location of supporting frames required.

f. Materials of construction.

g. Installation instructions.

2. Catalog data and design tables showing limits for span length and deflection under various and concentrated loads.

3. Stamped by Professional Structural Engineer registered in State where the project is located.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Store materials during and after shipment to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to materials, including damage due to over exposure to sun.

C. Remove material that is damaged from the site, at no cost to the Owner.

D. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

E. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Sustainable Design

1. Product Data for Credits MR 4.1 and Credit MR 4.2: For products having recycled content, provide documentation indicating percentages (by weight) of post-consumer and pre-consumer recycled content. For each recycled product used, include a statement indicating costs.

2. Product Certificates for Credit MR 5.1: For products extracted, harvested and manufactured within 500 miles of the project site, provide documentation indicating percentages (by weight) of regional materials that meet the criteria. For each regional product used, include a statement indicating costs.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Provide documentation showing that the Contractor doing this work has a minimum of 5 years experience in the manufacture and installation of FRP systems similar to that indicated for this project, with sufficient capacity to produce required units without causing delay of work.

C. Install materials in accordance with the manufacturer’s instructions.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. D70: Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method).

2. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

3. D635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

4. D638: Standard Test Method for Tensile Properties of Plastics.

5. D695: Standard Test Method for Compressive Properties of Rigid Plastics.

6. D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between-30 Degree C and 30 Degree C with a Vitreous Silica Dilatometer.

7. D732: Standard Test Method for Shear Strength of Plastics by Punch Tool.

8. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

9. D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
10. D2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
11. D3918: Standard Terminology Relating to Reinforced Plastic Pultruded Products.
12. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
13. G152: Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
14. G153: Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Seasafe, Inc.

B. Strongwell

C. IMCO Reinforced Plastics, Inc.

D. International Grating, Inc.

E. Fibergrate Composite Structures, Inc.

F. Creative Pultrusions, Inc.Or acceptable equivalent product.general:

G. Provide new materials free from defects and imperfections that might affect performance of finished product.

H. After fabrication, seal cut ends, holes and abrasions of FRP shapes with a compatible resin coating to prevent intrusion of corrosion and moisture.

I. Fabricate so that exposed surfaces are smooth and true to form.

J. Manufacture FRP products using vinyl ester resin with flame retardant and UV inhibitor additives. Provide synthetic surface veil covering exterior surface. Provide FRP shapes with flame spread of 25 or less in accordance with ASTM E84.

K. Provide FRP products exposed to weather with ultraviolet inhibitor and one mil thick UV coating to shield from ultra-violet light.

L. Provide Type 316L stainless steel metal accessories unless noted otherwise.

**2.02 - FRP GRATING AND STAIR TREADS**

A. Design Requirements:

1. Grating:
    a. Design grating and support system to sustain dead loads and superimposed live loads.
    b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.
2. Stair Treads:
    a. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load on an area of 4 square inches (2,600 square millimeters) located in the center of the tread, whichever produces greater stress.

3. Deflection:

   a. 1/4-inch (6 mm) maximum under uniform live load of 100 psf (4.8 kPa) for grating and stair treads.

   b. L/240 maximum for support members.

B. Fabricate grating and Stair Treads from pultruded bearing bars and cross rods. Assemble grating using a locking cross-rod design that makes a permanent connection between the cross-rod and bearing bar, and is completely bond into a one-piece panel.

C. Color shall be gray. Stair treads shall have a safety yellow nosing.

D. Provide grating with a slip resistant epoxy grit surface.

E. Use Type 316L stainless steel grating hold down clamps spaced as required by manufacturer, but not greater than 4 feet (1,200 mm) on center. Provide two at each support with a minimum of four per panel.

F. Position grating sections flat and square with ends bearing minimum 1-1/4 inches (30 mm) on supporting structure.

G. Provide embedded angle support frames with continuous integral anchor for grating set in concrete openings unless noted otherwise.

H. Maximum Grating Clearances:

1. 1/4-inches (6 mm) from vertical steel sections.

2. 1/2-inches (12 mm) from concrete and masonry walls.

3. 1/4-inches (6 mm) between sections and at ends.

**2.03 - MOLDED GRATING**

A. Design Requirements:

1. Grating:

   a. Design grating and support system to sustain dead loads and superimposed live loads.

   b. 100 psf (4.8 kPa uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.

2. Deflection:

   a. 1/4-inches (6 mm) maximum under uniform live load of 100 psf (4.8 kPa for grating and stair treads.

   b. L/240 maximum for support members.

B. Continuous glass filament reinforcement, approximately 30 percent glass to resin ratio.

C. Resin rich exterior surfaces free of air bubbles and dry glass.

D. Color shall be safety yellow gray.

E. Provide a slip resistant quartz grit applied surface.

F. Provide Type 316L stainless steel hold down clamps spaced as required by manufacturer, but not greater than 4 feet (1,200 mm) on center. Provide two at each support with a minimum of four per panel.

G. Position grating sections flat and square with ends bearing minimum 1-1/4 inches (30 mm) on supporting structure.

H. Set grating set in concrete openings with embedded angle support frames having continuous integral anchor unless noted otherwise.

I. Maximum Grating Clearances:

1. 1/4-inches (6 mm) from vertical steel sections.
2. 1/2-inches (12 mm) from concrete and masonry walls.
3. 1/4-inches (6 mm) between sections and at ends.

**2.04 - STRUCTURAL SHAPES**

A. Design requirements:

1. Design Loads:
   a. Design structural framing to sustain dead loads and superimposed live loads.
   b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, whichever produces maximum stress.
2. Deflection:
   a. L/240 maximum.

B. Manufacture structural shapes by the pultrusion process.

C. Provide structural shapes with a UV inhibitor.

D. Provide structural shapes containing a glass fiber reinforced vinyl ester resin matrix, approximately 50 percent glass by weight with a synthetic surface veil outer layer covering the exterior surfaces. Provide glass strand rovings shall be for longitudinal strength. Provide continuous strand glass mats or stitched reinforcements shall for transverse strength.

E. Provide Type 316L stainless steel bolts and washers.

F. Abrade joint surfaces to be bonded to remove surface gloss and be free of burrs or other foreign materials that would prevent proper adhesion.

**2.05 - STAIRS**

A. Fabricate from FRP structural shapes form material as specified.

B. If rise and runs are not noted on Drawings, use OSHA standards for rise and run.

C. Provide Stair Treads from material as specified.

D. Provide handrail from material as specified.

E. Use Type 316 stainless steel bolts throughout.

**2.06 - RAILING**

A. Design requirement:

1. Design railing system to meet the configuration and loading requirements of OSHA, IBC or local buildings codes. Apply requirements of the most stringent code.

B. Fully bond all post to rail connections with an epoxy adhesive and with an internal connection for added strength and durability. Provide smooth transitions between post and rail connections.

C. Provide kickplates where required by OSHA. Kick plate shall be 4 inches by 1/2-inch (100 mm by 12 mm) thick pultruded shape attached to posts with stainless connectors.

D. Color shall be safety yellow.

E. Fabricate handrail to standard two-rail design unless noted otherwise.

1. Post Locations:

a. No greater than 12 inches (25 mm) from horizontal or vertical change in handrail direction.

b. Post centers shall be no greater than 60 inches (1,500 mm) apart on any straight run of rail.

c. Post centers shall be no greater than 48 inches (1,200 mm) apart on inclined rail section.

F. Provide side mounted, base mounted, embedded, or removable anchorage mounted handrail as noted on Drawings.

G. Accurately locate handrail sections and erect plumb and level.

**2.07 - LADDERS AND CAGES**

A. Design requirement:

1. Design ladder and cage system to meet the configuration and loading requirements of OSHA, IBC or local buildings codes. Apply requirements of the most stringent code .

B. Provide ladder side rails 2 inches by 2 inches by 0.156 inches (50 mm by 50 mm by 4 mm) minimum thickness square tubes manufactured by the pultrusion process.

C. Provide ladder rungs pultruded 1 inch (25 mm) diameter minimum solid round bar with slip resistance epoxy grit surface.

D. Install ladder fiberglass stand-off brackets at a maximum of 6 feet (1,800 mm) on center.

E. Fabricate ladder cages per OSHA, from FRP Hoops and Straps. Hoops are to be 3 inches by 1/4-inch (75 mm by 6 mm) preformed FRP. Hoop spacing shall be a maximum of 4 feet (1200 mm) on center. Straps shall be 2 inches by 3/16-inch (50 mm by 5 mm) FRP spaced at 9 inches (230 mm) on center maximum. Bond hoops and straps with epoxy adhesives and riveted with Type 316 stainless steel rivets. Attach hoops to side rails in manner that provides hand clearance throughout length of ladder.

F. Ladder and Cage shall be safety yellow.

**2.08 - PLANK COVER**

A. Design Requirements:

1. Design Loads:

a. Design structural framing to sustain dead loads and superimposed live loads.

b. 100 psf (4.8 kPa) uniform live load or 300 pound (1.3 kN) concentrated live load, on an area of 4 square inches (2,600 square millimeters) located in the center of the plank, whichever produces greater stress.

2. Deflection:

a. 1/4-inches (6 mm) maximum.

B. Manufacture planks by the pultrusion process. Provide planks 2 inches (50 mm) deep and 24 inches (600 mm) wide with interlocking joints on outside legs of plank. The glass fiber reinforcement for the planks shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. A synthetic surface veil shall be the outermost layer covering the exterior surfaces.

C. Provide planks with UV inhibitor and a skid resistant surface.

D. Cap ends of individual plank pieces with channel caps.

E. Provide 3/8-inches (10 mm) diameter bent stainless steel rod recessed lifting handles. Provide one two handles at each end of individual pieces.

F. Set planks in concrete openings with embedded angle support frames having continuous integral anchor unless noted otherwise. Bear planks on length as required by plank manufacturer.

G. Color shall be gray.

## PART 3 - EXECUTION

### 3.01 - EXAMINATION

A. Remove and replace damaged items at no cost to Owner.

B. Examine supports for size, layout and alignment. Maintain surfaces free of debris.

### 3.02 - INSTALLATION

A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.

B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.

C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

### 3.03 - CLOSEOUT ACTIVITIES

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07160**

**BITUMINOUS DAMPPROOFING**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

1. SECTION 07610, BITUMINOUS DAMPPROOFING
2. SECTION 07840, FIRESTOPPING
3. SECTION 07900, JOINT SEALANTS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-101 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 |
| 10 A-303 | 10 A-304 | 10 A-305 | 10 A-406 | 10 A-407 | 10 A-505 | 10 A-602 |
| 10 A-603 | 10 A-604 | 10 A-605 | 10 A-606 | 10 A-607 | 00 S-001 | 00 S-002 |
| 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 10 S-105 | 10 A- 106 | 10 A-107 |
| 10 S-301 | 10 S-302 | 10 S-303 | 15 S-102 | 15 S-301 | 30 S-101 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | 00 P-001 | 10 P-101 | 10 P-102 |
| 10 P-103 | 10 P-104 | 10 P-`05 | 10 P-106 | 10 P-107 | 10 P-108 | 10 P-109 |
| 99 P-501 | 00 F-001 | 10 F-101 | 10 F-102 | 99 F-501 | 99 F-502 | 00 E-001 |
| 00 E-601 | 10 E-001 | 10 E-002 | 10 E-101 | 10 E-102 | 10 E-103 | 10 E-104 |
| 10 E-201 | 10 E-202 | 10 E-203 | 10 E-204 | 10 E-205 | 10 E-301 | 10 E-302 |
| 30 E-001 | 30 E-101 | 99 E-501 | 00 FA-001 | 10 FA-101 | 10 FA-102 | 10 FA-201 |
| 10 FA-202 | | | | | | |

2. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for Alternative A-1 for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-501 |
| 20 A-601 | 20 A-602 | 20 A-603 | 00 S-001 | 00 S-002 | 20 S-101 | 99 S-502 |
| 99 S-503 | 99 S-504 | 99 S-505 | 99 S-506 | 20 P-101 | 99 P-501 | 00 E-001 |
| 00 E-601 | 20 E-101 | 20 E-102 | 99 E-501 | 00 FA-001 | 20 FA-101 | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 07610, BITUMINOUS DAMPPROOFING,
SECTION 07840, FIRESTOPPING and SECTION07900, JOINT SEALANTS

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. Provide and apply materials for below grade dampproofing as indicated and specified.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course. Product data from dampproofing manufacturer stating the specified VOC content and compliance.

2. Recycled Content Submittal

a. For products having recycled content, documentation indicating specified percentages by weight of postconsumer and pre-consumer recycled content.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with Section 01400 and as specified herein.

B. Installer Qualifications: Engage an experienced Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. D 1227: Specification for Emulsified Asphalt used as a Protective Coating for Roofing.

2. D 1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

**1.10 - PROJECT CONDITIONS**

A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

**1.11 - SEQUENCING AND SCHEDULING**

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Hydrocide 700B Semi-mastic by ChemRex, Inc.; Sonneborn Building Products Div.

B. Liquid Asphalt 472 Emulsion by Koppers Industries, Inc.

C. 220AF Fibered Dampproofing by Karnak Chemical Corporation.

D. Or acceptable equivalent product

**2.02 - BITUMINOUS DAMPPROOFING**

A. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's printed instructions.

1. Semi-mastic Grade: Emulsified asphalt semi-mastic, prepared with mineral-colloid emulsifying agents and containing fibers other than asbestos, complying with ASTM D 1227, Type II, Class I.

2. VOC Content: 0.25 lb/gal. (30 g/L) or less

**2.03 – PROTECTION COURSE**

A. Protection Course: Unfaced, fan-folded, extruded-polystyrene board insulation, nominal thickness ¼ inch with compressive strength of not less than 8 psi per ASTM D1621.

1. Recycled Content: Provide extruded polystyrene board insulation with recycled content so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than thirty (30) percent

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of manufacturer.

B. Install cant strips and similar accessories as shown and as recommended by manufacturer.

C. Fill voids, seal joints, and apply bond breakers as recommended by manufacturer.

D. Install separate flashings and corner protection stripping, as recommended by manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations.

E. Prime substrate as recommended by manufacturer.

F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

**3.03 – INSTALLATION, GENERAL**

A. Comply with manufacturer's printed instructions except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.

B. Application: Apply dampproofing to the following surfaces.

1. Exterior, below-grade surfaces of exterior concrete walls in contact with earth or other backfill.

2. Back side of concrete or masonry retaining walls and stone facing to prevent percolating of water through the wall or facing.

3. Where indicated on the Drawings.

C. Apply vertical dampproofing down walls from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

D. Semimastic Grade: Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 5 gal./100 sq. ft., to produce a uniform, dry-film thickness of not less than 30 mils.

**3.04 – PROTECTION AND CLEANING**

A. General: Where indicated, install protection course of type indicated over completed and cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

**3.05 - INSTALLATION OF PROTECTION COURSE**

A. General: Where indicated, install protection course of type indicated over completed and cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07200**

**BUILDING INSULATION**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide building insulation as indicated and specified including the following:

1. Foundation insulation (supporting backfill).
2. Building insulation in batt form.
3. Foam-in-Place Insulation.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. “Thermal Resistivity” shall mean where the thermal resistivity of insulation products are designated by "r values," they represent the reciprocal of thermal conductivity (k values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Each type of insulation product and accessory specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

E. Protect Plastic Insulation as Follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Fire Performance Characteristics: Provide insulation materials that meet the following:

1. Surface Burning Characteristic: ASTM E84.

2. Fire Resistance Ratings: ASTM E119.

3. Combustion Characteristics: ASTM E136.

C. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
2. ASTM C665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
3. ASTM D4397: Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
4. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E119: Standard Methods for Fire Tests of Building Construction and Materials.
6. ASTM E136: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

**2.02 - PERIMETER FOUNDATION RIGID INSULATION**

A. Description:

1. Extruded Polystyrene Board Insulation: ASTM C578, Type IV, 25 psi.

B. Manufacturers:

1. Greenguard: PACTIV Building Products.
2. Styrofoam: The Dow Chemical Company.
3. Foamular 25: Owens Corning.
4. Or acceptable equivalent product.

**2.03 - BELOW SLAB RIGID INSULATION**

A. Description:

1. Extruded Polystyrene Board Insulation: ASTM C578, Type VII, 60 psi.

B. Manufacturers:

1. Greenguard: PACTIV Building Products.
2. Styrofoam: The Dow Chemical Company.
3. Foamular 60: Owens Corning.
4. Or acceptable equivalent product.

**2.04 - BUILDING INSULATION IN BATT FORM**

A. Description:

1. Unfaced Mineral Fiber Blanket/Batt Insulation, ASTM C665. Thickness, full depth of cavity. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.

B. Manufacturers:

1. Certainteed.
2. Owens Corning.
3. Johns Manville.
4. Or acceptable equivalent product.

**2.05 - FOAM-IN-PLACE INSULATION**

A. Description:

1. On-site foam-in-place insulation shall be Froth-Pac 1.75-25 FS Class 1 foam.

B. Manufacturers:

1. Insta-Foam Products, Inc.
2. Demilec (USA) LLC
3. Pyro-Chem Company
4. Or equal.

**2.06 - ACCESSORIES**

A. Polyethylene Vapor Retarder: ASTM D 4397, 6.0 mils thick, with a maximum permeance rating of 0.13 perms.

B. Tape for Vapor Retarder: Pressure sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.

**3.03 - INSTALLATION, GENERAL**

A. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness. Where cavity requires insulation that is thicker than standard size, install next larger size and compress into cavity.

**3.04 - INSTALLATION OF PERIMETER RIGID INSULATION**

A. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.

1. Place against inside face of foundation walls from bottom of slab to top of footing unless otherwise indicated.

**3.05 - INSTALLATION OF BELOW SLAB INSULATION**

A. Place under slabs, extending inward from foundation wall to a minimum of 48-in. unless otherwise indicated.

1. Lay insulation in place with edges pressed together and butting foundation wall or adjacent vertical insulation.

**3.06 - INSTALLATION OF GENERAL BUILDING INSULATION**

A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Fill voids in thermal envelope not covered by the work of other sections.

B. Stuff glass fiber insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

**3.07 - INSTALLATION OF VAPOR RETARDERS**

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16 inches o.c.

C. Seal overlapping joints in vapor retarders with adhesives or tape per vapor retarder manufacturer's printed directions. Seal butt joints and fastener penetrations with tape of type recommended by vapor retarder manufacturer. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with tape of type recommended by vapor retarder manufacturer to create an airtight seal between penetrating objects and vapor retarder.

F. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with tape or another layer of vapor retarder.

**3.08 - INSTALLATION OF FOAM-IN-PLACE INSULATION**

A. Install foam-in-place insulation sealant to a minimum depth of 1-in., or as required to achieve required or indicated R value, sealing roof deck and construction cracks and gaps where outside air and cold can infiltrate, providing an airtight building envelope.

**3.09 - PROTECTION**

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07270**

**AIR/VAPOR BARRIER MEMBRANE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide air/vapor barrier membrane and accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Submit manufacturer’s product data for each material. Include standard details, certified test results, installation instructions, and recommendations for sealing penetrations and perimeter.
2. Samples: Submit two labeled samples of each product, not less than 6 by 12 inches in size.
3. Shop Drawings for Air/Vapor Barrier Membrane Mockup: Submit shop drawings for mockup indicating size of mockup, details of construction, and expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. Address shop drawing review comments prior to construction of mockup. Revise to show changes necessary to mockup.
4. Shop Drawings: Submit shop drawings indicating details of construction, including expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. Shop drawings shall include details of the following connections, as applicable to the project:
    a. Foundation and walls.
    b. Walls and windows or doors.
    c. Different wall systems.
    d. Wall and roof.
    e. Wall and roof over unconditioned space.
    f. Walls, floor and roof across construction, control and expansion joints.
    g. Walls, floors and roof to utility, pipe and duct penetrations.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications:

1. Each worker who is installing air/vapor barriers must be either a Certified Applicator as defined in Paragraph 1.05.C below or an installer who is registered with ABAA.

C. Air/vapor barrier installers must be trained and certified by NECA (National Energy Conservation Association) and PSDI (Professional Skills Development Institute) for energy conservation.

D. Single-Source Responsibility: Obtain air/vapor barrier materials from a single manufacturer.

E. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

F. Mockups of Air Vapor Barrier Membrane Installation: Prior to installation on the building, construct a mockup of a typical exterior wall assembly to indicate relationship of materials with air barrier and quality of workmanship. Mockup shall use actual air barrier membrane and wall materials as indicated in SECTION 04200, UNIT MASONRY AND ACCESSORIES. Remove mockup assemblies from site at completion of project. Mockup is subject to acceptance by Engineer, rebuild mockups which are rejected at no additional cost to the Owner.

G. Project Meetings:

1. Pre-Construction Meeting: After completion of mockup shop drawings, but prior to construction of mock-up, convene a meeting with representatives of materials to be incorporated in the mockup and installers of mockup. Agenda shall include sequence and details of construction to ensure continuity of air barrier.

2. Pre-Installation Meeting: Convene a pre-installation meeting a minimum of one week prior to commencing work of this section. Attendees shall include representatives of air barrier manufacturer, exterior wall installers and all other associated trades involved in air/vapor barrier installation including project superintendent. Agenda shall include the following:

a. Review of submittals.

b. Review of mock-ups.

c. Coordination with sequence of installation with adjacent materials.

d. Schedule for subsequent work covering air/vapor barrier.

e. Procedures for quality assurance.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM D 412: Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
2. ASTM E 96: Test Methods for Water Vapor Transmission of Materials.
3. ASTM E 283: Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
4. ASTM E 330: Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
5. ASTM E 699: Criteria for Evaluation of Agencies Involved in Testing Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E-6.

B. ABAA: Air Barrier Association of America.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - LIQUID AIR/VAPOR BARRIER MEMBRANE**

A. Liquid Air Barrier Membrane: Water-based asphalt emulsion modified with a blend of synthetic rubbers and special additives, compatible with sheet membranes.

B. Transition Materials: To provide an air/vapor barrier between the membrane and adjacent materials, provide transition materials consisting of extruded low-modulus silicone sheet and silicone sealant intended to adhere to polyethylene side of membrane and adjacent material. Provide the following materials as recommended by the manufacturer of the air barrier membrane:

1. Cleaning Agent: Toluene.
2. Silicone Sheet: Provide preformed corners.
3. Silicone Sealant.

C. Performance Criteria:

1. Air permeability no greater than 0.004 CFM/$Ft^2$ under pressure differential of 0.3 in. of water.
2. Moisture Control: Maximum permeability no greater than 0.1 perms.

D. Manufacturers: Subject to compliance with requirements, provide one of the following products:

1. Rubber Polymer Corp.
2. Monsey Bakor.
3. Grace Construction Products.
4. Carlisle Coatings & Waterproofing Inc.
5. Or acceptable equivalent product.

## PART 3 – EXECUTION

### 3.01 - PREPARATION

A. Clean substrate surfaces to receive air/vapor barrier membrane in accordance with manufacturer's instructions. Apply primer if recommended by manufacturer.

B. Installation:

1. Strictly comply with air barrier membrane manufacturer's printed instructions, reviewed submittals and the following:

    a. Apply materials within manufacturer's requirements for temperature and weather conditions.

    b. Do not apply to wet or frozen substrates.

    c. Do not allow contamination with dust or dirt.

    d. Seal completely at edges, perimeter and penetrations.

2. Protect installed work from damage due to harmful weather exposures, physical abuse, and other causes.

3. Provide temporary protection over air barrier membrane if materials covering air barrier membrane will not be installed within manufacturer's recommended time limit for exposure.

4. Repair damage to air/vapor barrier membrane caused by construction activities or subsequent work prior to covering.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 07461**

**SIDING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Fiber Cement Lap Siding, Soffit Trim, Fascia, Moulding and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Manufacturer's data sheets on each product to be used, including:
    a. Preparation instructions and recommendations.
    b. Storage and handling requirements and recommendations.
    c. Installation methods.
2. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.
3. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
4. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches, representing actual product, color, and patterns.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications: Minimum of 2 years experience with installation of similar products.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.

2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

3. Refinish mock-up area as required to produce acceptable work.

**1.08 - WARRANTY**

A. Product Warranty: Limited, non-pro-rated product warranty.

1. Lap siding for 30 years.

2. Soffit for 30 years.

B. Product Warranty: Limited, product warranty.

1. Trim boards for 15 years.

C. Finish Warranty: Limited product warranty against manufacturing finish defects.

1. When used for its intended purpose, properly installed and maintained according to manufacturer’s published installation instructions, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip. Finish warranty includes the coverage for labor and material.

D. Workmanship Warranty: Application limited warranty for 2 years.

**1.09 - REFERENCES**

A. American Society for Testing and Materials:

1. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets
2. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.
3. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

**1.10 - PROJECT CONDITIONS**

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

**PART 2 – PRODUCTS**

**2.01 - MANUFACTURERS**

A. Acceptable Manufacturer:

1. James Hardie Building Products, Inc.,
2. CertainTeed Corp.
3. GAF

B. Requests for approval of equal substitutions will be considered in accordance with provisions of SECTION 01600, CONTROL OF MATERIALS.

**2.02 - SIDING**

A. Lap siding requirement for Materials:

1. Fiber-cement Siding - complies with ASTM C 1186 Type A Grade II.
2. Fiber-cement Siding - complies with ASTM E 136 as a noncombustible material.
3. Fiber-cement Siding - complies with ASTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
4. CAL-FIRE, Fire Engineering Division Building Materials Listing - Wildland Urban Interface (WUI) Listed Product.
5. National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI, IBC, IRC).

B. Lap Siding:

1. Type: Texture 7-1/4 inches with 6 inches exposure.
2. Texture: Wood grain.
3. Color: As selected by Architect from manufacturer’s full range of industry colors.

C. Corner Boards (Interior and Exterior)

1. Size of Vertical Trims: 5/4-inch thick, 11-1/4-inch wide, smooth sanded edge.
2. Texture: Smooth.
3. Color: As selected by Architect from manufacturer’s full range of industry colors.

**2.03 - FASTENERS**

A. Wood Framing Fasteners:

1. Wood Framing: 4d common corrosion resistant nails.
2. Wood Framing: 6d common corrosion resistant nails.
3. Wood Framing: 8d box ring common corrosion resistant nails.
4. Wood Framing: 0.089 inch (2.2 mm) shank by 0.221 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.
5. Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.
6. Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2-1/2 inches (64 mm) corrosion resistant siding nails.
7. Wood Framing: 0.091 inch (2.3 mm) shank by 0.221 inch (5.6 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.
8. Wood Framing: 0.091 inch (2.3 mm) shank by 0.225 inch (5.7 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.
9. Wood Framing: 0.121 inch (3 mm) shank by 0.371 inch (9.4 mm) head by 1-1/4 inches (32 mm) corrosion resistant roofing nails.
10. Wood Framing: No. 11 gauge 1-1/4 inches (32 mm) corrosion resistant roofing nails.
11. Wood Framing: No. 11 gauge 1-1/2 inches (38 mm) corrosion resistant roofing nails.
12. Wood Framing: No. 11 gauge 1-3/4 inches (44 mm) corrosion resistant roofing nails.

B. Masonry Walls (CMU):

1. Masonry Walls: Aerico Stud Nail, ET&F ASM No.-144-125, 0.14 inch (3.6 mm) shank by 0.30 inch (7.6 mm) head by 2 inches (51 mm) long corrosion resistant nails.

**2.04 - ACCESSORIES**

A. General: Provide starter stripes, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

B. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.

C. Flashing: Provide stainless steel flashing complying with Division 07 where indicated.

D. Continuous Soffit Vents: Aluminum, hat-channel shape:

1. Net-Free Area: provide minium 8 sq. in./linear ft or as required to meet applicable ventilation requirements.
2. Finish: Manufacturers standard primer and baked on acrylic or polyester in color: to match adjacent soffit.

E. Insect Screening for Soffit Vents: Glass-fiber fabric mesh.

**2.05 - FINISHES**

A. Factory Finish for siding:

1. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
2. Process:
   a. Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing

process.

b. Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photospectrometer and verified by third party.

3. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed.

4. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Do not begin installation until substrates have been properly prepared.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Nominal 2 inch by 4 inch wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

1. Install water-resistive barriers and claddings to dry surfaces.

2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.

3. Protect siding from other trades.

**3.02 - PREPARATION**

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install a water-resistive barrier as required in accordance with local building code requirements.

D. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

E. Install weather barrier in accordance with local building code requirements.

F. Use Seam Tape and joint and laps.

G. Install flashing and Flex Flashing

**3.03 - INSTALLATION – LAP SIDING**

A. Install materials in strict accordance with manufacturer's installation instructions.

B. Starting: Install a minimum 1/4 inch thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches wide laps at the top. The bottom edge of the first plank overlaps the starter strip.

C. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

D. Align vertical joints of the planks over framing members.

E. Maintain clearance between siding and adjacent finished grade.

F. Locate splices at least one stud cavity away from window and door openings.

G. Wind Resistance: Where a specified level of wind resistance is required lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.

H. Locate splices at least 12 inches away from window and door openings.

**3.04 - INSTALLATION – TRIM BOARDS**

A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.

B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

C. Place fasteners no closer than 3/4 inch and no further than 2 inches from side edge of trim board and no closer than 1 inch from end. Fasten maximum 16 inches on center.

D. Maintain clearance between trim and adjacent finished grade.

E. Trim inside corner with a single board trim both side of corner.

F. Outside Corner Board Attach Trim on both sides of corner with 16 gage corrosion resistant finish nail 1/2 inch (13 mm) from edge spaced 16 inches (406 mm) apart, weather cut each end spaced minimum 12 inches (305 mm) apart.

G. Allow 1/8 inch gap between trim and siding.

H. Seal gap with high quality, paint-able caulk.

I. Shim frieze board as required to align with corner trim.

J. Fasten through overlapping boards. Do not nail between lap joints.

K. Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten Trim boards to Trim boards.

L. Shim frieze board as required to align with corner trim.

M. Install Trim Fascia boards to rafter tails or to sub fascia.

**3.05 - FINISHING**

A. Finish unprimed siding with a minimum one coat high quality, alkali resistant primer and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

B. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

**3.06 - PROTECTION**

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 07600**

**WALL FLASHING AND SHEET METALWORK**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of 3. SECTION 07600, WALL FLASHING AND SHEET METALWORK is a part of DIVISION 7, THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07610, METAL ROOFING.

B. The Work of 3. SECTION 07600, WALL FLASHING AND SHEET METALWORK requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Wall Flashing, Sheet Metalwork, and Appurtenant Work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturers' literature describing products.
2. Shop drawings showing fabricated items, complete details of joints, supports, and fasteners.
3. Setting drawings, or templates and setting instructions, for exact installation.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any

unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

C. National Roofing Contractors Association (NRCA).

D. Sheet Metal and Air Conditioning Contractors Association (SMACNA).

E. Federal Specifications (Fed. Spec.):

1. QQ-A-250/2D: Aluminum Alloy 3003, Plate and Sheet.

2. QQ-C-576B (1): Copper Flat Products with Slit, Slit and Edge-rolled, Sheared, Sawed, or Machined Edges, (Plate, Bar, Sheet, and Strip).

3. SS-C-153C: Cement, Bituminous, Plastic.

F. American Society for Testing and Materials (ASTM) Publications:

1. A167: Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

2. B101: Specification for Lead-coated Copper Sheets.

G. American Wood-Preservers' Association (AWPA).

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - JOB CONDITIONS**

A. Protect exposed finishes against construction damage; remove protection prior to final acceptance.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Thickness: Except where otherwise indicated, comply with minimum gauge requirements as specified in SMACNA's "Architectural and Sheet Metal Manual."

B. Flashing Compound: Polyisobutylene type, non-skinning, nondrying sealant, bulk conforming to Fed. Spec. SS-C-153, Type 1, or tape as required by installation conditions, 1-in. minimum width by 1/16-in. minimum thickness.

C. Fasteners (Nails, Screws, Rivets, and Bolts and Nuts): Same material as item being fastened.

D. Nailers: Pressure treated wood as specified in SECTION 06200, CARPENTRY.

**2.02 - FLASHING**

A. Metal:

1. Stainless Steel: Stainless steel sheets, Type 304, finish 2D, Condition A (annealed) conforming to the applicable requirements of ASTM A167, and not less than 26 gage or 0.018 in. thick.

**2.03 - ALUMINUM GUTTERS, DOWNSPOUTS AND ACCESSORIES**

A. Materials:

1. Aluminum alloy 3003-H14, flat prefinished sheets. Corrugated downspouts will not be acceptable.
2. Thickness: .050 in.
3. Gutter Size: 6-in. wide x 4-3/4-in. with Ogee profile.
4. Downspout Size: 4-in. x 4-in.
5. Joints: Factory welded joints every 10 ft. o.c.
6. Accessories: 2-in. wide aluminum strap channels. Finish similar to downspouts.
7. Finish: Kynar 500 (Fluoropolymer) finish.
8. Color: To be selected by Engineer from manufacturer’s full range of colors.

**2.04 - FABRICATION**

A. General:

1. Fabricate in accordance with SMACNA's "Architectural and Sheet Metal Manual", and applicable requirements of NRCA's "A Manual of Roofing Practice", unless indicated otherwise.
2. Form and fabricate sheet metal in shop, when possible. Identify bulk materials from which items are field fabricated by manufacturer's trademark printed or embossed at frequent intervals.
3. Provide profiles with interactions that are sharp, even and true, with plane surfaces free from buckles and waves; and seams that follow direction of water flow.
4. Reinforce correctly for strength and appearance.
5. Cut, fit, and drill sheet metal as required to accommodate related, adjacent or adjoining work.
6. Fold, bend or return exposed edges of sheet metal. Raw edges not permitted.

B. Sheet Metal Joints:

1. Provide lock joints; where impractical, lap, rivet, solder, or weld joints, or join as recommended by manufacturer.
2. Join joints and miters as recommended by manufacturer.
3. Weld in accordance with applicable AWS specification, when positive joining is required.
4. Turn lock joints, on exposed surfaces, in direction of flow.

C. Expansion and Contraction of Sheet Metal Runs: Provide loose locking slip joint at maximum eight feet from external or internal corners, maximum 24 feet length of straight runs unless manufacturer recommends more frequent interval, and one at center of runs less than 20 feet but more than eight feet.

D. Flashing into Masonry:

1. Cap or counter flashing at intersections of roofs and vertical.
2. Counter, Equipment Support, and Roof: 3/4-in. locked and soldered seams, assembled into units not longer than 16 feet. Join units with three-inch wide loose locked seams filled with soft grade butyl base compound, before units are assembled. Mitre corners and join by riveted or locked and soldered joints.
3. Through Wall: Stainless steel sheet, to bond in mortar bed, prevent from moving laterally, and free from breaks and perforations. Bonding features having series of continuous ribs, extending transversely, formed to prevent pocketing of water, and located not more than three inches apart. Where through-wall flashing connects with other flashing, fabricate a specially formed edge to engage other flashing.

## PART 3 - EXECUTION

### 3.01 - PREPARATION

A. Coordinate work with installation of adjoining work.

### 3.02 - GENERAL

A. Conform with procedures and methods of installation and applicable details indicated and described in SMACNA's "Architectural and Sheet Metal Manual" and NRCA's "A Manual of Roofing Practice."

B. Where installation requires fabrication at the job site, conform to applicable requirements of Article 2.05.

C. Install standard catalog products in accordance with manufacturer's instructions, unless otherwise indicated.

D. Install work watertight; insure that items are installed in true and accurate alignment with other items and related work, that joints are accurately fitted, that corners are reinforced and that exposed surfaces are free of dents.

E. Apply flashing compound at slip joints or wherever metal-to-metal contact occurs and movement may be anticipated to occur.

F. Fastenings:

1. Fasten sheet metal runs to underlying material by nailing through slotted holes in flange at three inches on center, unless otherwise indicated or required by manufacturer.
2. Provide waterproof washers wherever fasteners penetrate flashing.
3. Bolts, nuts, screws and other type fasteners in contact with aluminum shall be stainless steel.

### 3.03 - WALL FLASHING INSTALLATION

A. Spandrel Beam Type:

1. Install membrane flashing.
2. Prime surfaces, to receive flashing, with asphalt primer, then brush coat with asphalt roof coating.
3. Apply flashing with not less than 3-in. lap cemented with plastic cement.
4. Fill anchor bolt holes with plastic cement.
5. Extend flashing into wall and cut 1/4 in. from inside face of exterior wall.

### 3.04 - METAL CAP FLASHING INSTALLATION

A. Intersections of Roofs and Vertical Walls:

1. Lap cap flashing over base flashing by at least 4 in. and turn back bottom edges by 1/2 in.
2. Extend into masonry and turn up on inside as indicated.

### 3.05 - GUTTER AND DOWNSPOUT INSTALLATION

A. Attach gutters as indicated. Attach downspouts to walls with aluminum strap channels and stainless-steel fasteners.

B. Space strap channels every 2 ft. o.c. maximum.

C. Provide elbows, shoes, wire strainers, fastenings, and accessories with downspouts.

D. Conform to approved shop drawings.

### 3.06 - ALUMINUM PROTECTION AND CLEANING

A. Contact Separation with Dissimilar Metals:

1. Separate by painting metal surface with suitable bituminous paint or by layer of roofing felt.
2. Coat aluminum surfaces with bituminous paint, if contact with concrete, brick masonry or mortar after erection.

3. Clean aluminum gutters, downspouts and other exposed aluminum work with mild soap and water, after erection.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07610**

**METAL ROOFING**

**(Filed Sub-bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION shall include the complete Work specified in all of the following Sections:

1. SECTION 07610, METAL ROOFING
2. SECTION 07710, ROOF SPECIALTIES
3. SECTION 07600, WALL FLASHING AND SHEET METALWORK

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

E. Reference Drawings

1. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-103 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 |
| 10 A-303 | 10 A-305 | 10 A-505 | 10 A-603 | 00 S-001 | 00 S-002 | 10 S-105 |
| 10 S-303 | 99 S-505 | 99 S-506 | | | | |

2. The Work of DIVISION 7, THERMAL AND MOISTURE PROTECTION for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-102 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 |
| 20 A-501 | 00 S-001 | 00 S-002 | 20 S-102 | 99 S-505 | 99 S-506 | |

F. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 07610, METAL ROOFING
SECTION 07710, ROOF SPECIALTIES
SECTION 07600, WALL FLASHING AND SHEET METALWORK

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

G. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SUMMARY**

A. Scope of Work: Contract Drawings indicate extent and general configuration of roof. Provide materials for and install complete roof system including, but not limited to:

1. Metal Roof.
2. Underlayment Board.
3. Exterior Sheathing.
4. Fasteners and attachment devices.
5. Flashings and other accessories.
6. Attic ventilation accessories.

B. Material Included But Not Installed Under This Section:

1. Extra Stock: Matching sheet metal for fabrication and installation under Section. Furnish extra stock in timely sequence.

**1.02 - REFERENCES**

A. Aluminum Association: “Publication 35: Specifications for aluminum sheet metal work in building construction.”

B. American Society for Testing and Materials, current edition to apply:

C. B209 – Aluminum and Aluminum-Alloy Sheet and Plate.

D. Underwriters Laboratory: Building Materials Directory.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.03 – PERFORMANCE REQUIREMENTS**

A. Structural Design: Comply with design criteria.

B. Watertightness: No uncontrolled water leakage shall occur through roof system.

C. Wind Uplift: Shall be installed to meet applicable building codes.

D. Fire Safety: Shall be installed to meet applicable building codes.

E. Material Compatibility: Prevent contact between dissimilar metals and between metals and potentially corrosive or staining substances.

F. Special Environmental Conditions: Roof shall be compatible with following environmental conditions when applicable:

1. Marine environment.

2. High industrial pollution levels.

G. Expansion and Contraction: Shall be installed to accommodate thermal expansion and contraction.

**1.04 - SUBMITTALS**

A. Product Data: Submit manufacturer's specifications, standard detail drawings and installation instructions.

B. Shop Drawings:

1. Submit shop drawings indicating thickness and dimensions of parts, fastenings and anchoring methods.

2. Indicate roof terminations, clearly showing flashings and change of direction.

3. Clearly indicate locations of field-applied sealant.

4. Show locations of nailing clips and fasteners.

5. Provide a plan showing layout of entire roof.

C. Samples:

1. Submit two sample panels showing metal thickness, profile and required finish.

2. Submit standard color samples on metal for Architect's selection.

D. Applicators: Submit list of completed Projects and name of Architects.

**1.05 – QUALITY ASSURANCE**

A. Manufacturer's Qualifications:

1. Twenty years minimum experience in factory fabrication of metal roofing systems.
2. Products listed in this specification section are as manufactured by Classic Products, Inc.
3. No other bidder will be accepted without prior written approval of architect based upon other manufacturer's products meeting all specified requirements.
4. Substitution requests must be submitted at least ten working days prior to bid date and approved substitutions will be set forth in an addendum.
5. No substitutions will be permitted after bid date.
6. No fax requests will be accepted.

B. Installer's Qualifications: Installer shall provide necessary manpower and equipment to assure progress of work in accordance with Project schedule. Installer shall employ a foreman on Project site who shall have a minimum of five years experience installing similar products on comparable projects.

C. Regulatory Requirements: Comply with requirements of applicable building codes and other agencies having jurisdiction for wind uplift ratings.

D. Pre-Installation Conference:

1. Conduct meeting.
2. Convene and conduct pre-installation conference. Notify others whose work requires coordination with roof installation.
3. Review and coordinate scheduling, sequencing of trades that influence roof installation, tool and utility requirements, and other Project requirements.

E. Workmanship and methods for sheet metal work shall conform to the applicable requirements of the National Roofing Contractors Association, New England Approved Roofers Association Manual and the Sheet Metal and Air Conditioning Contractors National Association.

**1.06 – DELIVERY, STORAGE AND HANDLING**

A. Comply with manufacturer's delivery, storage and handling instructions.

B. Schedule deliveries to assure continuous progress of work.

C. Protect products against damage.

D. Store under waterproof covering, with proper ventilation to prevent condensation.

E. Inspect materials upon arrival at site and note damaged materials. Do not install damaged materials.

F. Verify access limitations to site and roof. Verify that materials proposed to be stored or staged on roof do not exceed structural limitations of building.

**1.07 – SEQUENCE AND SCHEDULING**

A. Schedule work of this Section to avoid impeding work of other sections.

**1.08 – WARRANTY**

A. Furnish manufacturer's standard limited transferable warranty stating architectural fluorocarbon finish will be:

1. Free of fading or color change in excess of 5 NBS units as measured per ASTM D2244 for a period of 20 years.
2. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D659 for a period of 20 years.
3. Will not peel, crack or delaminate for a period of 50 years.

B. Furnish written warranty signed by applicator for five-year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURER**

A. Acceptable Manufacturers

1. Classic Metal Roof Systems

2. Approved Equal

B. Basis of Design Product: Oxford Shingle aluminum roofing panels as manufactured by Classic Metal Roof Systems, Inc., Piqua, OH, Tel. 1-800-543-8938.

C. Substitutions

1. Substitutions must fully comply with specified requirements.

2. Refer to Quality Assurance Section 1.05 for substitution request procedures.

**2.02 - MATERIALS**

A. Panels

1. Metal roofing shall be roll formed tension-leveled panels. Panel material shall be with a minimum thickness of 0.024, 3105-H14 aluminum with a smooth texture and coated with a two coat Kynar 500 or Hylar 5000 finish applied over a polyester prime coat.

2. Provide factory-formed interlocking panels with a 12-inch x 60-inch exposure.

3. Panels shall be warranted for 20 years against peeling, cracking, blistering, chipping, and rust-through. Color will be selected from the manufacturer's premium color range.

**2.03 - ACCESSORIES**

A. General: Accessories shall be as recommended by roof system manufacturer to meet performance criteria.

B. Base and counter flashings, copings, fascias, and trim shall be of the same material and thickness and have the same finish as the roof panels. All hold down clips and fasteners shall be concealed and made of galvanized steel or stainless steel. All components shall be manufactured by the roofing system manufacturer

C. Soffit panels shall be roll-formed with a minimum thickness of 0.024 aluminum and coated with a two coat Kynar 500 or Hylar 5000 finish as used for the roof panels. Matching "J" channel trim shall be provided. Panels shall be Full Vent PAC-750 soffit as manufactured by PAC-CLAD. Color to be selected from the manufacturer's standards

D. Gutters shall be 4-inch x 6-inch, 0.024 aluminum with concealed hangers. Color to match adjacent trim or siding color. Provide end caps, corners and all accessories.

E. Downspouts shall be 3-inch x 4-inch, 316 Stainless Steel with boots and concealed fasteners. Color to be stainless steel with brushed finish.

F. Snow Cleat System shall be Cleat System or equal approved for use with the metal shingle roof panels by the metal roof system manufacturer. Rail system shall be clamped to the metal shingles and held in place with set screws. Rails shall match roof panel color.

G. Roof jacks shall be made of EPDM rubber compound resistant to ozone and UV light. Life expectancy within a temperature range of -65 to 250 degrees F shall be 20 years.

H. Install eaves membrane around entire chimney(s) extending at least 6 inches (152mm) up the wall and 12 inches (305mm) on to the roof surface. Lap the membrane over the roof deck underlayment

I. Underlayment

1. Self-Adhered Underlayment installed on roof eaves, rakes, ridges, and valley of entire roof. See roof plans

for exact locations and dimensions. Self-adhering waterproof membrane to be made of rubberized asphalt with a cross laminated polyethylene film or Polymer Modified Bituminous Sheet Materials used as Steep Roofing Underlayment with a minimum thickness of 60 mils as manufactured by W.R. Grace Construction Products, or equal

a. Basis of Design: Grace Ultra – Roofing Underlayment.

2. One layer 30 lb. asphalt felt; ASTM D226; or one layer Roof Aqua Guard or other synthetic underlayment in field area of roof as shown on roof plan.

J. Exterior Sheathing Board: See spec SECTION 06200, CARPENTRY.

K. Flashing

1. Flashings shall provide for positive drainage, prevent ponding of water, and allow moisture to drain off roof without affecting underlying construction. Flashing to prevent capillary action.

2. Flashings utilizing pop rivets must be self-sealing or sealed with sealant and always be above line of water flow.

L. Penetration Seals

1. Round Penetrations: Flash with aluminum and neoprene pipe boots.

2. Rectangular Openings: Flash with flashings compatible with roof system.

M. Snow Retention Devices: If necessary, provide and install snow retention devices approved by roof manufacturer for use with roof system.

N. Fasteners

1. Panels shall be fastened to the deck with nail clips provided by the roof system manufacturer. Use 5 clips per panel and one fastener per clip.

2. Provide fasteners of sizes and types required by Project conditions to meet performance specifications and roof manufacturer's recommendations. Fasteners shall be corrosion resistant and compatible with roofing and other materials.

3. Pop Rivets: Provide non-corroding, not-staining type. They shall be sealed and located above flow of water. Rivets shall have a minimum shank diameter of 0.125 inches and shall be of sufficient length to form a proper head.

O. Sealants

1. Sealants shall be color-matched butyl rubber sealant provided by roof system manufacturer, non-corrosive and compatible to adjacent material.

2. Seal with cartridge-type sealant.

a. Sealants shall remain fluid.

b. Sealants shall adhere to panel surfaces. Clean panels that may be lightly coated with lubricants or airborne contaminants. Sealants must be compatible with contiguous materials.

c. Sealants should be applied only to dry surfaces.

**2.04 - FINISHES**

A. Painted

1. Pretreatment: Metal shall undergo continuous cleaning, rinsing, and chemical conversion process immediately prior to painting.

2. Exterior Coat:

a. Primer coat shall be 0.2 mil minimum average thick, fully cured, and corrosion resistant and flexible base for topcoat.

b. Topcoat shall yield a 0.7 mil minimum thick coating. Topcoat shall be fully cured and of consistent color throughout Project.

c. Adhesion:

(1) Bend Test: 1/8" mandrel, no tape pull-off per ASTM D522.

(2) Reverse Impact: 3 x metal thickness per ASTM D2794.

d. Corrosion Resistance:

(1) Salt Spray: 1000 hours per ASTM B117.

e. Accelerated Weathering: 2,000 hours per ASTM G23 or ASTM G26.

f. Weatherability: 5-year South Florida or equivalent exterior exposure:

(1) Color Retention: 5 AEE units maximum degradation per ASTM D2244.

(2) Chalk resistance: 8 minimum rating per ASTM D4214.

3. Gloss Retention: 75% minimum retention per ASTM D523.

4. Back Coat: Corrosion resistant primer plus wash coat, 0.2 mil minimum total dry thickness.

B. Color: As selected by architect from manufacturer's standard colors. (Custom colors available, consult manufacturer.)

**2.05 – FABRICATION TOLERANCES**

A. Panel Construction: Uniformly dimensioned. Fasteners and nailing clips shall be concealed.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrate to ensure it is solid and smooth.

B. Do not commence installation until field conditions have been verified.

C. Ensure cuttings from field fabrication are removed prior to installation.

**3.02 - PREPARATION**

A. Field measure prior to fabrication of custom fabricated items.

B. Lay out work to provide random appearance and to avoid short courses. Where field cutting is required, make cuts in a workmanlike manner.

C. Protection:

1. Adjacent surfaces: When possible, install flashings prior to siding and stucco installation.

2. Dissimilar metals: Isolate any dissimilar metals to prevent corrosion.

**3.03 - INSTALLATION**

A. General: Comply with approved shop drawings, manufacturer's installation instructions, and applicable construction and safety regulations.

B. Underlayment: Install underlayment according to procedures recommended by roof system manufacturer.

C. Panels shall be interlocked with each other and securely attached to the roof deck.

D. Flashings:

1. Follow approved details.
2. Flashings shall be lapped four inches and fastened 12 inches on center.
3. Lap valley minimum of six inches.
4. Allow for expansion and contraction of lineal accessories.

E. Protective Materials: Provide temporary protective materials if needed to protect previously installed roof surfaces.

F. Sealants:

1. Apply only to dry surfaces in accordance with sealant and roof manufacturer's instructions.
2. Apply only in bend thickness of minimum 3/8".
3. Apply in workmanlike manner.
4. Install sealants only when ambient temperature and conditions are in accordance with sealant manufacturer's recommendations.

G. Accessories: Securely install in accordance with manufacturer’s instructions.

**3.04 – ADJUSTING, CLEANING, AND PROTECTION**

A. Protect roof from damage by work of other sections on, above, or adjacent to roof.

B. Installed panels and accessories shall be secured before leaving roof area at end of day.

C. Keep installed roof clean and protected from damage.

D. Clean gutters of roof installation debris at completion.

E. Repair minor damage to finishes. Use matching coatings recommended by roof manufacturer. Remove and replace items which can not be satisfactorily repaired.

F. Protect roofing from metal filings or shavings. Metal filings or shavings shall be cleaned from panels or flashing surfaces by end of each day.

**3.05 - CONTRACT CLOSEOUT**

G. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07710**

**ROOF SPECIALTIES**

**Filed Sub-bid Required**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07610, METAL ROOFING.

B. The Work of SECTION 07710, ROOF SPECIALTIES, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Roof-Edge Flashings and Roof-Edge Drainage Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Maintenance Data: For roofing specialties to include in maintenance manuals.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

D. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - PERFORMANCE REQUIREMENTS**

E. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

F. FM Approvals' Listing: Manufacture and install copings roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

G. SPRI Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

**PART 2 - PRODUCTS**

**2.01 - MISCELLANEOUS MATERIALS**

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

**2.02 - ROOF-EDGE DRAINAGE SYSTEMS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Andreas Renner KG.

2. Architectural Products Company.

3. ATAS International, Inc.

4. Berger Building Products, Inc.

5. Castle Metal Products.

6. Cheney Flashing Company.

7. CopperCraft by FABRAL; a Euramax company.

8. Hickman Company, W. P.
9. Klauer Manufacturing Company.
10. Merchant & Evans, Inc.
11. Metal-Era, Inc.
12. Metal-Fab Manufacturing, LLC.
13. MM Systems Corporation.
14. National Sheet Metal Systems, Inc.
15. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.

B. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Formed Aluminum: 0.050 inch (1.27 mm)
2. Fabricate from the following exposed metal:

a. Formed Aluminum: 0.050 inch (1.27 mm) thick.

C. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.

1. Fabricate from the following exposed metal:

a. Formed Aluminum: 0.063 inch (1.6 mm)

D. Aluminum Finish: Premium Kynar finish, (3) coat system: color to be selected by Architect.

**2.03 - SNOW CLEATS**

A. Manufacturer: Subject to compliance with requirements in spec section 07610 – Metal Roofing. Provide products by one of the following manufacturers:

1. Alpine SnowGuards
2. Berger Building Product
3. Rocky Mountain Snow Guards

B. Materials: Aluminum – Strap, hood and gusset are .032 aluminum.

C. Finish: Mill finish – standard.

**2.04 - GENERAL FINISH REQUIREMENTS**

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.05 - FALL ARREST ANCHOR**

A. Capable of withstanding 5000 lbs. in any direction without permanent deflection.

B. Anchor eye size: Not less than ¾ inch diameter material with 2-1/4 inch eye opening.

C. Anchor eye metals:

1. Stainless steel, type 304, solution annealed, 35 ksi minimum.

D. Anchor tube height: not less than 4 in. above the finished roof.

E. Installed per manufacturer's standard details.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 - INSTALLATION, GENERAL**

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.

2. Provide uniform, neat seams with minimum exposure of solder and sealant.

3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

4. Torch cutting of roof specialties is not permitted.

5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise shown on Drawings.

2. When ambient temperature at time of installation is between 40 and 70 degrees F (4 and 21 degrees C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 degrees F (4 degrees C).

**3.03 - ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION**

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1-inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspout to direct water away from building.

2. Connect downspouts to underground drainage system indicated.

C. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper discharge.

**3.04 - CLEANING AND PROTECTION**

A. First paragraph below is not applicable to stainless steel or to painted or coated steel and aluminum.

B. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

C. Clean and neutralize flux materials. Clean off excess solder and sealants.

D. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

E. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 07840**

**FIRESTOPPING**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 07840, FIRESTOPPING is a part of DIVISION 07 THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07160 – BITUMINOUS DAMPROOFING.

B. The Work of SECTION 07840, FIRESTOPPING, requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. Provide firestopping as indicated and specified including the following:

1. Penetrations through fire resistance rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire resistance rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire resistance rated construction, including gypsum drywall partitions, masonry walls and adjacent construction.

B. General Contractor shall be responsible for providing firestopping for the project.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Submit manufacturer's literature for each type of Firestop material to be installed. Indicate product characteristics, typical uses, performance and limitation criteria, and test data.

2. Shop Drawings: Show typical installation details for the methods of installation. Indicate which firestop materials will be used where and thickness for different hourly ratings. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

a. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement derived from a similar UL system design or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgement shall follow the requirements set forth by the International Firestop Council.

3. Certificates: Submit certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.

4. Installation Instructions: Submit manufacturer's installation procedures for each type of product.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number and shelf life.

E. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:

1. Firestopping tests are performed by UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per ASTM E 814.

3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119.

C. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design, and extent to that indicated for Project and that has performed successfully.

D. Single Source Responsibility: Obtain through penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.

E. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

F. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through penetration firestop systems are installed per specified requirements.

G. Preinstallation Conference: Conduct conference at Project site.

H. Field Testing of firestop systems will be performed for each type of firestop systems.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. E84: Test Methods for Surface Burning Characteristics of Building Materials.

2. E119: Test Methods for Fire Tests of Building Construction and Materials.

3. E814: Test Method for Fire Tests of Through-Penetration Five Stops.

B. Underwriters Laboratories Inc.

1. UL Fire Resistance Directory.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.

B. F-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire resistance rating of the constructions penetrated.

C. T-Rated Through Penetration Firestop Systems: Provide through penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-ratings shall be per code but not less than 1 hour. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature rise rating.
4. Where firestop systems protect penetrating items larger than a 4 inch diameter nominal pipe or 16 square inches in overall cross sectional area.

D. Fire Resistive Joint Sealants: Provide joint sealants with fire resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.

E. For Firestopping Exposed to View, Traffic, Moisture, and Physical Damage, Provide Products That Do Not Deteriorate When Exposed to These Conditions:

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetration with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F. For firestopping exposed to view, provide products with flame spread values of less than 25 and smoke developed values of less than 450, as determined per ASTM E 84.

**1.10 - PROJECT CONDITIONS**

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

**1.11 - SEQUENCING AND SCHEDULING**

A. Coordinate the work of this Section as required with the work of other trades.

B. Coordinate construction of openings and penetrating items to ensure that firestopping systems are installed according to specified requirements.

C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

D. Do not cover up those firestopping installations that will become concealed behind other construction until Owner’s inspection agency and authorities having jurisdiction, if required, have examined each installation.

1. Notify the Owner’s inspecting agency at least seven days in advance of through-penetration firestop system installations. Confirm dates and times on days preceding each series of installations.

## PART 2 - PRODUCTS

### 2.01 - GENERAL

A. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire-resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

1. Provide paintable firestop products at locations exposed to the public. Mechanical and electrical rooms are not considered public spaces.

2. Provide VOC compliant materials.

B. Compatibility: Provide through-penetrations firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including, but not limited to, the following:

a. Slag-/rock-wool-fiber insulation.

b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.

c. Fire-rated form board.

d. Fillers for sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

### 2.02 - MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Specified Technologies Inc. (STI), Somerville, NJ.

2. Hilti, Inc., Tulsa, OK.

3. 3M Fire Protection Products, St. Paul, MN.

4. Bio Fireshield, Carlisle, MA.

5. W.R Grace, Flamesafe.

6. Or acceptable equivalent product.

### 2.03 - MATERIALS

A. Firestop Mortar:

1. Specified Technologies Inc. SpecSeal Mortar.

2. Bio Fireshield Novasit K-10.

3. Hilti FS 635 Trowelable Firestop Compound.

B. Firestop Sealants and Caulks:

1. STI SpecSeal Sealant.
2. Dow Corning Firestop Sealant No. 2000.
3. 3M CP25WB + Caulk.
4. Bio Fireshield Biotherm and Biostop.
5. Hilti FS-ONE High Performance Intumesent Firestop Sealant.

C. Firestop Putty:

1. STI Spec-Seal Firestop Putty Bars and Pads.
2. 3M MPS-2 Moldable Putty Stix and Putty Pads.
3. Hilti CP 617 and CP 618 Putty Pads and Putty Sticks.

D. Firestop Collars:

1. STI SpecSeal Firestop Collars.
2. 3M PPD Collars.
3. B10 Fireshield Bio Firestop Sleeve.
4. Hilti CP 643 and CP 642 Firestop Collars.

E. Wrap Strips:

1. SpecSeal Wrap Strip.
2. 3M FS-195 Wrap Strip.
3. Hilti CP 645 Firestop Wrap Strips.

F. Cast-In-Place Firestop Device:

1. Hilti CP 680 Cast-In-Place Firestop Device.

G. Fire Safing Insulation:

1. Fibrex Insulations, Inc.
2. Owens Corning HT, Inc.
3. Thermafiber LLC.
4. Or approved equal.

H. Accessories: Forming/damming materials - mineral fiberboard or other type recommended by manufacturer.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

4. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

B. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

**3.03 - INSTALLING THROUGH PENETRATION FIRESTOPS**

A. General: Comply with the "System Performance Requirements" article in Part 1 and the through penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross sectional shapes and depths required to achieve fire ratings of designated through penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install Fill Materials for Through Penetration Firestop Systems by Proven Techniques to Produce the Following Results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Install fire safing insulation at all interior full-height fire rated walls at roof intersections.

**3.04 - FIELD QUALITY CONTROL**

A. Allow for 3 random samples of each type of firestopping system to be inspected. Reinstall disturbed samples to comply with requirements.

B. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

C. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

**3.05 - CLEANING**

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 07900**

**JOINT SEALANTS**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 07900, JOINT SEALANTS is a part of DIVISION 07, THERMAL AND MOISTURE PROTECTION which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 07160, BITUMINOUS DAMPPROOFING.

B. The work of SECTION 07900, JOINT SEALANTS, requires the subcontractor to perform all work specified under this section

### 1.01 - SCOPE

A. Provide joint sealants as indicated and specified including the following:

1. Exterior Joints in Vertical Surfaces and Non-traffic Horizontal Surfaces as Indicated Below:
    a. Joints between architectural precast concrete units.
    b. Control and expansion joints in unit masonry.
    c. Perimeter joints between materials listed above and frames of doors, louvers, and windows.
    d. Other joints as indicated.
    e. Joints at precast concrete coping.
2. Interior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces as Indicated Below:
    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Tile control and expansion joints.
    d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
    e. Perimeter joints between interior wall surfaces and frames of interior doors, louvers, and windows.
    f. Perimeter joints of toilet fixtures.
    g. Other joints as indicated.
3. Interior Joints in Horizontal Traffic Surfaces as Indicated Below:
    a. Joints as indicated.
4. Construction joint materials for concrete work shall be in accordance with SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: For each joint sealant product specified.

2. Samples: For selection purposes submit three (3) of manufacturer's standard color chart including bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in service performance.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM C 834: Standard Specification for Latex Sealing Compounds.
2. ASTM C 919: Standard Practice for Use of Sealants in Acoustical Applications.
3. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
4. ASTM C 1193: Standard Guide for Use of Joint Sealants.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM PERFORMANCE REQUIREMENTS**

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

**1.10 - PROJECT CONDITIONS**

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees F (4.4 degrees C).
3. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

**1.11 - SEQUENCING AND SCHEDULING**

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

1. Provide paintable sealants at locations that are exposed to view.

**2.02 - MANUFACTURERS**

A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two components.

1. Sonolastic NP-2; Sonneborne
2. Dymeric; Tremco
3. Sikaflex-2c, NS; Sika
4. Dynatrol 2; Pecora
5. Vulkem 922; Vulkem
6. Chem-Calk 500; Bostik
7. Or acceptable equivalent product.

B. Type 2 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

1. Tremco Acrylic Latex; Tremco
2. AC-20; Pecora
3. Chem-Calk 600; Bostik
4. Or acceptable equivalent product.

C. Type 3 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.

1. Sanitary 1700; GE Silicones
2. 898 Silicone; Pecora
3. 786 MR Silicone; Dow Corning
4. Or acceptable equivalent product.

D. Type 4 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.

1. Tremco Acoustical Sealant; Tremco
2. AC-20 FTR Acoustical Sealant; Pecora Corp.
3. Sheetrock Acoustical Sealant; United States Gypsum Co.
4. Or acceptable equivalent product.

**2.03 - JOINT SEALANT BACKING**

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self adhesive tape where applicable.

**2.04 - MISCELLANEOUS MATERIALS**

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

**3.02 - PREPARATION**

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

**3.03 - INSTALLATION OF JOINT SEALANTS**

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

**3.04 - CLEANING**

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

**3.05 - PROTECTION**

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

**3.06 - SCHEDULE**

A. Exterior Joints for Which No Other Sealant Type is Indicated: Type 1; colors as selected.

B. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type 2.

C. Interior Joints for Which No Other Sealant is Indicated: Type 2; colors as selected.

D. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type 3.

E. Exposed and Concealed Joints where Acoustical Sealant is indicated and required: Type 4, colors as selected.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08100**

**METAL DOORS AND FRAMES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Metal Doors, Frames and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings of doors and frames indicating dimensions, gages of metals, fastening and anchorage method for frames, types of finishes, and alloy of aluminum for acceptance. Include certification that preparation for hardware is in accordance with templates furnished by hardware manufacturer.
2. Submit manufacturer's specifications for all types of doors and frames.
3. For informational purposes only, submit manufacturer’s installation instructions for all types of doors, frames, vision panels and sidelights.
4. Submit three (3) color charts for aluminum finish.
5. Submit certified performance results for sound-retarding doors and frames tested in accordance with ASTM E 90.
6. Submit certificates, as required for doors and frames, of testing agency fire-rating.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Before delivery, identify type and size of each door with markings that will not damage finish.

E. Preassemble frames and door mullions in shop and deliver to project site with spreader bar at sill, or tie in pairs to form box.

F. Store all doors and frames in a weathertight enclosure and do not expose to the elements.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide exterior doors and frames which comply with current applicable IECC (International Energy Conservation Code) requirements for the project location.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Testing Agency Qualifications: Testing agency fire-rating certification with approval of authority having jurisdiction and re-examination service.

C. Requirements of Regulatory Agencies: Provide openings having indicated fire-resistive rating of 3/4-hour or longer with doors and frames bearing testing agency-issued label for required fire rating.

**1.08 - REFERENCES**

A. Aluminum Association (AA).

B. American Architectural Manufacturers Association (AAMA) Specification.

1. AAMA 2605-02: Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

2. AAMA 611-98: Voluntary Guide Specification for Anodized Architectural Aluminum.

C. National Association of Architectural Metal Manufacturers (NAAMM).

D. Underwriters' Laboratories, Inc. (UL).

E. American Society for Testing and Materials (ASTM) Publications:

1. A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. National Association of Architectural Metal Manufacturers (NAAMM).

G. Hollow Metal Manufacturers Association (HMMA):

1. 810: Hollow Metal Doors.
2. 820: Hollow Metal Frames.
3. 830: Hardware Preparation and Locations for Hollow Metal Doors and Frames.
4. 840: Installation and Storage of Hollow Metal Doors and Frames.
5. 862: Guide Specifications for Commercial Security Hollow Metal Doors and Frames.
6. 861: Guide Specifications for Commercial Hollow Metal Doors and Frames.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - PREPARATION**

A. Verify details; obtain copy of accepted hardware schedule templates and other information.

B. Verify size, design and fire-resistive rating of each opening.

C. Coordinate details of construction with other work supporting or adjoining frames and doors.

**2.02 - FLUSH ALUMINUM DOORS**

A. Manufacturers:

1. Type G, manufactured by Vistawall Architectural Products Co.
2. SL-16 manufactured by Special-Lite, Inc.
3. D9 Series manufactured by U.S. Metals Manufacturing Corp.
4. Or acceptable equivalent product.

B. General:

1. Fabricate aluminum components (stiles and rails) from metal of acceptable alloys best suited to requirements of use, generally: 6063-T5.
2. Thickness: Minimum 0.125 in. unless otherwise indicated or specified.
3. Mortise and reinforce doors for hinges with aluminum alloy 2024-T4 plates or extruded shapes at least 1/4-in. thick.
4. Provide reinforcement within door for other finishing hardware similar to that furnished for hinges.
5. Glazed Doors:
    a. Edge openings with extruded aluminum.
    b. Furnish manufacturer’s standard snap-in aluminum glazing stops.
    c. Furnish gray virgin vinyl glazing inserts, durometer hardness 70-74 (Shore A).
6. Provide cut-out in doors for monorail as indicated. Provide neoprene skirt around cut-out with metal trim and fastenings.

C. Doors shall be one of the following types:

1. Welded tubular core type:

a. Substructure: Weld 1-1/2-in. square extruded aluminum tubing to form substructure.

b. Face sheets: Bond 0.062 in. thick smooth face sheets to substructure.

c. Stiles: Applied extruded aluminum.

d. Apply cushion strips between face sheets and substructure.

e. Fill voids between grid sections, with compressed, high density, noncombustible and water proof volcanic mineral insulation.

**2.03 - ALUMINUM FRAMES**

A. Manufacturers:

1. Vistawall Architectural Products, Co.

2. Special-Lite, Inc.

3. U.S. Metals Manufacturing Corp.

4. Or acceptable equivalent product.

B. Provide head and jamb frame members with doorstops and integral weatherstripping.

C. Provisions:

1. Provide aluminum frames for aluminum doors by same manufacturer as doors.

2. Construct frames of types and sizes indicated.

3. Material: Extruded aluminum rectangular tubular sections of alloy 6063-T5 with sharp corners and wall thickness of not less than 0.125 in.

4. Mortise and reinforce frames for strike plates and hinges: 1-3/4-in. stainless steel hinge reinforcements not less than 1/4-in. thick, and full height of door long. Insert bar within frame and fasten above and below each hinge mortise.

**2.04 - FABRICATION OF ALUMINUM DOORS AND FRAMES**

A. Free from dents or tools marks, warpage, buckle, and open joint. Lines straight or true to profile. Miters formed in true alignment and similar butting profiles accurately intersected. Sinkage or mortises for hardware reinforced and accurately formed to templates. Door edges including top and bottom, properly sealed. Joints in frames securely reinforced, weathered, and joined by means of concealed fastenings.

**2.05 - HOLLOW-METAL DOORS**

A. Manufacturers:

1. Ceco Door Products; a United Dominion Company.

2. Curries Company.

3. Steelcraft; a Division of Ingersoll-Rand.

4. Or acceptable equivalent product.

B. General:

1. Construct 1-3/4-in. thick full flush type hollow metal doors.
2. Face sheets: Not less than 14 gage for exterior doors and 16 gage for interior doors.
3. Core Construction:
    a. Interlocking vertical channels or Z-members of not lighter than 22-gage steel, spaced not more than 6-in. apart and spot welded to face sheets not less than 6-in. on centers.
4. Sound-Deadening and Thermal Insulation: Chemically-inert, non-combustible, moisture-resistant material in accordance with accepted manufacturer's recommendations. Conform to requirements of labeling authority for labeled door insulation.
5. Face sheets spot welded to the core.
6. Weld tops and bottoms of the doors flush or closed with a recessed channel.
7. Mortise and reinforce doors for hinges with not less than 7-gage steel.
8. Reinforce doors for surface applied hardware and lock faces with 12-gage steel.
9. Drill and tap doors for locks and hinges at the factory.
10. Drill and tap for surface applied hardware in the field.
11. Glazed doors: Furnish snap-in glazing strips not requiring screws.
12. Secure stationary, sightproof, 20-gage cold-rolled sheet steel louvers into openings in doors by metal moldings screwed on both sides of door.
13. Furnish doors bearing Underwriter's Laboratory, Inc., label as indicated.
14. Provide UL approved astragal on pairs of labeled doors.

**2.06 - PRESSED-METAL FRAMES**

A. Provide pressed-metal frames for hollow metal doors by same manufacturer as doors including frames for wood doors, vision panels and sidelights.

B. Fabricate frames of not less than 14 gage for exterior doors and 16 gage for interior doors of A60 galvanized steel with integral stops and rabbets.

C. Assemble heads and jambs with accurately fitted, fully welded, smoothly ground miter joints.

D. Weld angle spreaders to bottom of jambs to assure safe shipment and perfect alignment in field.

E. Anchors for frames:

1. Provide three corrugated adjustable loose T-anchors on each jamb of frames under 8 ft. and additional anchors for frames 8 ft. and higher.
2. Provide floor anchor clips, on each jamb, with holes for securing to concrete floor slab.

F. Provide anchors for frames attachment to metal studs as recommended by frame manufacturer.

G. Mortise frames for strike plates and hinges.

H. Weld steel reinforcing plates to frames for hinges; drill and tap plates to accommodate mortise type template hinges; and weld galvanized dust covers over reinforcing plates to prevent clogging of tapped holes by mortar.

I. Provide label frames with three Underwriters Laboratories, Inc., labeled, adjustable loop anchors per jamb.

**2.07 - INSULATED ALUMINUM PANELS**

A. Core Construction: Laminated sandwich panels consisting of 0.032-inch thick aluminum face sheets with both sides bonded to 1/8-inch thick tempered hardboard and a 1-1/2-inch thick incombustible perlite core with a total thickness of 1-3/4-inch. Set panels into framing with screwed-on glazing beads.

**2.08 - HARDWARE PREPARATION**

A. Provide frames and doors with cut-outs and reinforcement for mortise hardware and reinforcement for surface mounted hardware in accordance with templates supplied by hardware manufacturers. Additionally, drill and tap as required for hardware.

B. Make total thickness of reinforced conditions equal to nominal diameter of fasteners required by hardware items.

C. Provide plaster guards or mortar boxes in back of hardware cut-outs in and welded to frames.

D. Provide frames and doors having fire-resistive ratings with hardware preparation conforming to requirements of labeling authority.

E. Welding hinges to door frames not permitted.

F. Drill door frames for installation of mutes. Do not drill frame stops of soundproof openings.

**2.09 - FINISHES**

A. General: Comply with NAAMM's "Metal Finished Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Aluminum Work:

1. Finish Designations refixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

2. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

a. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluorocarbon topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; comply with AAMA 2605.

b. Custom colors to be selected by Engineer.

C. Steel Work:

1. Hollow Metal Doors: Chemically wash, rinse, and dry followed by one shop coat of metallic primer.

2. Hollow Metal Doors and Frames: Galvanized in accordance with ASTM A653, cleaned, phosphatized and followed by one shop coat of baked-on primer.

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Examine accepted hardware schedules and verify proper coordination of hardware, doors and frames.

B. Examine opening locations and verify following:

1. Correctness of dimensions, backing or support conditions.

2. Absence of defects that would adversely affect frame or door installation.

C. Do not begin work until unsatisfactory conditions are corrected.

**3.02 - PREPARATION**

A. Protect aluminum components of aluminum doors, frames and vision panels in contact with plaster, concrete, or masonry, or connected to dissimilar metals in accordance with SECTION 05500, MISCELLANEOUS METAL.

**3.03 - INSTALLATION**

A. Install and adjust doors, frames, and appurtenances in accordance with the manufacturer's printed recommendations.

1. Clips, bolts, screw and rivets: Type 304 Stainless steel, type and sized as recommended by door manufacturer.

B. Set frames and anchor in position, plumb, square, level and in alignment.

C. Brace frames until the anchors are set.

D. Fill the backs of pressed metal frames with mortar as specified in SECTION 04200, UNIT MASONRY AND ACCESSORIES.

E. Hang doors in frames with proper clearances.

F. Make final adjustments for proper and easy operation of doors after hardware installation and glazing.

G. Standard Steel Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch [3mm] plus or minus 1/16 inch [1/6 mm].

b. Between Edges of Pairs of Doors: 1/8 inch [3 mm] plus or minus 1/16 inch [1.6 mm].

c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch [9.5 mm].

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum ¾ inch [19 mm].

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

**3.04 - ADJUSTING**

A. Prime Coat Touch-Up: Immediately after installation, sand smooth and touch-up rust areas and other areas where prime has been damaged, with prime touch-up paint.

B. Make adjustments as required for correct function and smooth operation.

C. Protect frames and doors from damage to surface or profile.

**3.05 - PROTECTION**

A. After erection, protect doors, frames and finishing hardware from damage due to installation of other work or from lime, acid, cement, or other harmful compounds.

B. Replace damaged doors, frames and finishing hardware as determined by the Engineer with new items and at no additional expense to the Owner.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08150**

**FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide fiberglass reinforced plastic doors and frames as indicated and in compliance with Contract Documents.

1. Section Includes:

a. Fire-rated and non-rated fiberglass reinforced plastic doors and frames.

b. Door hardware.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Submit manufacturer's technical product data, substantiating compliance with corrosive environment requirements.

2. Shop Drawings:

a. Include details of each frame type, elevations of door and reinforcement, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

b. Provide schedule of doors and frames using same reference numbers for details and openings as those shown on Drawings.

c. Show coordination of glazing frames and stops with glass and glazing requirements.

3. Samples: Submit two samples of door and frame face material, 6 x 6 inch in size illustrating selected colors and surface texture.

4. Manufacturer's Installation Instructions: Indicate special installation requirements.

5. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide as specified herein.

1. Deliver materials to site in sealed, undamaged containers identified with manufacturer’s name, door location, style, pattern, and color.

2. Inspect doors and frames for damage.

3. Store in original cartons, on end on such manner to prevent falling or damage to face, corners, and edges. Block between doors and floors to allow air circulation.

4. Store indoors out of weather or extreme temperatures.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide doors and frames which comply with current applicable IECC (International Energy Conservation Code) requirements for the project location.

**1.07 - QUALITY ASSURANCE**

A. Provide as specified herein.

B. Doors, frames, and accessories shall be produced by one manufacturer.

C. Conform to requirements of ANSI A117.1, ADAAG and UFAS as applicable.

D. Maintain one copy of each document on site.

E. Fire Rated Door and Frame Construction: Conform to NFPA 252 UL 10B CAN/ULC S104 and CAN/ULC S105 as applicable.

F. Fire Rated Door Construction: Rate of rise of 250 degrees F (138 degrees C) across door thickness.

G. Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as scheduled.

H. Flame spread: All fiberglass reinforced resin component parts, including the gel coat finish, to achieve a flame spread classification of 25 or less per ASTM E84 and shall be self-extinguishing.

**1.08 - REFERENCES**

A. American National Standards Institute, (ANSI):

1. A117.1: Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. American Society for Testing and Materials International (ASTM):

1. E84: Standard Test Method for Surface Burning Characteristics of Building Materials

C. Code of Federal Regulations (CFR):

1. 28 CFR Part 36, Appendix A - ADAAG - Americans with Disabilities Act Accessibility Guidelines.
2. 41 CFR Part 101, Subpart 101-19.6, Appendix A - UFAS - Uniform Federal Accessibility Standards.

D. National Fire Protection Association, (NFPA):

1. 80: Standard for Fire Doors and Other Opening Protectives
2. 252: Standard Methods of Fire Tests of Door Assemblies

E. Underwriters Laboratories, Inc. (UL):

1. 10B: UL Standard for Safety Fire Tests of Door Assemblies

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - QUALIFICATIONS**

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum five years documented experience.

**1.10 - OPERATION AND MAINTENANCE DATA**

A. Operation Data: Include description of hardware operation, and adjusting requirements.

B. Maintenance Data: Identify door, and frame, and hardware maintenance requirements.

**PART 2 - PRODUCTS**

**2.01 - FIELD MEASUREMENTS**

A. Verify that field measurements are as indicated on shop drawings.

**2.02 - MANUFACTURERS – DOORS AND FRAMES**

A. Manufacturers:

1. Basis of Design Chem-Pruf Door Co. Product: standard and fire rated fiberglass reinforced plastic doors and frames.
2. Special-Lite, Inc. Product: AF-100 Pultruded FRP Door.
3. Fenestra Corporation Product: Corrim Door System.
4. Substitutions: Or equal.

**2.03 - FRP FLUSH DOORS**

A. Model: AF-100 Pultruded FRP Door.

B. Door Opening Size: As indicated on the Drawings.

C. Fire Ratings: As indicated on door schedule.

D. Construction:

1. Door Thickness: 1-3/4 inches.
2. Construction: Doors shall be FRP, pultruded as one monolithic panel, with integral stiles.
3. Reinforcement: Solid FRP shapes to be chemically welded at factory. All structural members shall utilize a chemically resistant UV stabilized resin system.
4. Stile Edge: Seamless 9/16-inch thick solid FRP.
5. Top Rail: 6-inch pultruded tube profile designed to fit flush and be chemically welded inside the door.
6. Bottom Rail: Pultruded FRP inverted U channel designed to fit flush and be chemically welded inside the door, allowing doors to be field trimmed. Closed bottom rail to be supplied as an option.

E. Face Sheet:

1. Material: Pultruded FRP, 0.125-inch thickness.
2. Texture: Smooth.
3. Fiberglass Content: Minimum 47% by weight.
4. Color: As selected from Manufacturer's full range of available colors to match colors indicated on drawings.

F. Core:

1. Material: Polyurethane foam.
2. Density: Minimum of 6 pounds per cubic foot.
3. Per ASTM E 84 flame spread and smoke developed: Class B.

G. Cutouts:

1. Manufacture doors with cutouts for required vision lites, louvers, and panels.
2. Factory install vision lites, louvers, and panels.

H. Hardware:

1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

**2.04 - FRP FRAMING SYSTEMS**

A. Framing:

1. Size and Type: As indicated on the Drawings.
2. Fire Ratings: As indicated on door schedule.
3. Materials: ¼-inch thick solid pultruded FRP profiles having no corrosive components or reinforcement.
4. Width: 2-inch face.
5. Depth: As indicated on Drawings. Custom sizes available from 4 ½-inch to 12-inch.
6. Assembly: One piece chemically welded at factory.
7. Door Stop: 5/8-inch x 2 ¼-inch.
8. Corner Construction: Mitered with 4-inch x 4-inch x 3/8-inch pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.
9. Reinforcing: ¼-inch pultruded FRP chemically welded at all hinge, strike and closer locations.
10. Mullions: Removable Pultruded 2-inch x 2 3/4-inch Rim Mullion.
11. Anchors: Furnished with type as specified on drawings.
12. Fasteners for reinforcing: 18-8 Stainless Steel.

**2.05 - HARDWARE**

A. See SECTION 08710, FINISH HARDWARE.

**2.06 - FINISH**

A. Finish For Doors and Frames:

1. Painted Finish: Two-part aliphatic polyurethane, low VOC, Industrial Coating.
2. Thickness: 5 mils
3. Sheen: Gloss
4. Impact Resistance per ASTM D 2794: 140 in lbs.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Verify that opening sizes and tolerances are acceptable.

**3.02 - PREPARATION**

A. Provide anchors for placement by SECTIONS 03300, CAST-IN-PLACE CONCRETE and 04200, UNIT MASONRY AND ACCESSORIES.

**3.03 - INSTALLATION**

A. Install doors and frames in accordance with manufacturer's written instructions.

B. Coordinate with masonry or concrete wall construction for anchor placement.

C. Coordinate with installation of glass and glazing specified in SECTION 08810, GLASS AND GLAZING.

D. Install door louvers in accordance with manufacturer's instructions such that no moisture or contaminants penetrate the door cavity.

E. Touch-up minor damaged surfaces caused during installation as recommended by the manufacturer.

**3.04 - ERECTION TOLERANCES**

A. Maximum Diagonal Distortion: 1/16 measured with straight edges, crossed corner to corner.

**3.05 - ADJUSTING**

A. Adjust door for smooth and balanced door movement.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08210**

**FLUSH WOOD DOORS**

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## PART 1 - GENERAL

### 1.01 - DESCRIPTION

A. Provide flush wood doors as indicated and specified including the following:

1. Solid core flush wood doors.
2. Factory fitting flush wood doors to frames and factory machining for hardware.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS, and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Submittals for SECTIONS 08100, METAL DOORS AND FRAMES, 08210, FLUSH WOOD DOORS and 08710, FINISH HARDWARE shall be made concurrently.

2. Product Data: Submit door manufacturer's product data for each type of wood door, including details of core and edge construction trim for openings. Include sample warranty. Submit door manufacturer's storage, handling, finish, installation and maintenance instructions.

3. Shop Drawings: Submit Shop Drawings indicating door identification, location and size, thickness, swing (hand), elevation of each kind of door, face veneer, location and extent of hardware blocking, and fire ratings.

4. Certificates: Submit certificates signed by the manufacturer indicating the doors comply with the specified requirements.

5. Samples: Submit samples for the following:

a. Door Construction: Include faces, edges, and core. Minimum size 6 inches by 6 inches.

b. Submit 2 samples of each veneer species specified.

**1.05 – PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

B. Protect wood doors during transit, storage, and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standard and recommendations of NWWDA I.S. 1, Appendix, "How to Store, Handle, Finish, Install and Maintain Wood Doors," as well as with manufacturer's instructions.

1. Package doors at factory prior to shipping, using manufacturer's standard method.

2. Protect doors from extremes of heat and cold. Relative humidity shall not be less than 30% nor more than 60%.

3. Compare doors to approved finish sample upon delivery. Notify the Engineer if sample does not match.

C. Identify each door with individual opening numbers using temporary, removable, or concealed markings.

1. Correlate door identification with designation system used on Shop Drawings.

**1.06 - DESIGN CRITERIA**

C. The design conditions for the equipment are specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE:**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Single Source Responsibility: Obtain flush wood doors through one source from a single manufacturer.

C. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated," Section 1300.

D. Acceptable Fire Rating Label: Underwriters' Laboratories, Inc. (UL) or Warnock Hersey.

E. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure.

2. Oversize, Fire Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.

**1.08 - REFERENCES**

A. ASTM E152 - Methods of Fire Tests of Door Assemblies.

B. AWI - Quality Standards of the Architectural Woodwork Institute.

C. HPMA HP - Hardwood and Decorative Plywood.

D. NFPA 80 - Fire Doors and Windows.

E. NFPA 252 - Standard Method of Fire Tests for Door Assemblies.

F. NWWDA – National Wood Window and Door Association.

G. UL 10B - Fire Tests of Door Assemblies.

H. Warnock Hersey - Certification Listings for Fire Doors.

I. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

### 1.09 - WARRANTIES

A. General: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, installer, and contractor, agreeing to repair or replace defective doors which warp (bow, cup or twist), which show telegraphing of core construction in face veneers, or which do not conform to tolerance limitations of specified quality standards. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the contract documents.

1. Include reinstallation and finish which may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.

2. Warranty shall be in effect during the following period of time after date of Substantial Completion:

a. Solid Core Flush Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.01 - MANUFACTURERS:

A. Algoma Hardwoods, Inc.

B. Eggers Industries; Architectural Door Division.

C. Marshfield Door Systems, (Weyerhaeuser).

D. VT Industries Inc.

E. Or approved equal.

### 2.02 - SOLID CORE DOORS:

A. Flush face; 1 3/4 inches thick.

B. Construction: AWI Section 1300.

1. Core:

a. Non Rated and 20 Minute Fire Rated: Particleboard core.

b. Fire rated 45, 60, 90 Minute: FD Mineral Core (asbestos free).

2. Construction: 5 plies; Hot press, Type I adhesive for core construction and veneer plies.

3. Facing:

a. Wood Veneer: Closed-grain hardwood.

b. Veneer Grade: A

c. Veneer Species: Natural Birch

d. Veneer Cut: Plain Sliced

e. Veneer Match: Book Matched (Uniform Pattern)

f. Assembly of Veneer on Door Face: Running Match (Non-Symmetrical Appearance Veneer Pieces of Unequal Widths)

### 2.03 - ACCESSORIES

A. Glazing Beads: Flush, solid wood or veneer wrapped, of same species as door facing, mitered corners. Glazing beads for rated and non-rated doors shall have the same profile.

B. Astragals: Fire rated doors shall be constructed of fire retardant stiles if allowed by fire label testing agency. Metal astragals where required by testing agency, shall be cold rolled sheet steel, 20 gage minimum, prime coated finish. Prepare astragals to receive hardware.

**2.04 - FABRICATION**

A. Openings: Cut, trim and seal openings in doors at factory.

B. Prefitting: Fabricate and trim doors to size at factory to conform to prefabricated frames as shown on approved frame shop drawings and floor finishes as indicated in the finish schedule.

C. Premachining: Make all mortises and cutouts required for hardware at the factory to conform to approved hardware schedules, hardware templates, and door frame Shop Drawings.

**2.05 - FINISH**

A. Doors shall receive a factory applied finish as specified.

## PART 3 – EXECUTION

**3.01 - INSPECTION**

A. Inspect door frame openings to determine that the frames have been correctly installed, plumb, square, true, and capable of accepting the correct installation and swing of the wood doors. If errors in hardware preparations, hardware locations, or frame installation are discovered, correct before installation of the wood doors.

**3.02 - INSTALLATION**

A. Door Installation: Comply with manufacturer's written instructions, referenced quality standard, and as indicated.

B. Hardware: For installation, see SECTION 08710, FINISH HARDWARE.

1. Hinges shall be shimmed with metal shims at each door to provide equal clearance at each jamb.

2. Locks, exit devices, door closers and other hardware shall be installed in accordance with the manufacturer's instructions. Pilot holes of recommended size, for wood screws required to fasten the hardware, shall be drilled by the installing Contractor before screws are fastened to the wood doors.

**3.03 - ADJUSTING**

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Doors: Replace doors that are damaged or do not comply with requirements at no additional cost to Owner. Doors may be repaired if work complies with requirements and shows no evidence of repair.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTUIB 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08311**

**ACCESS PANELS AND FRAMES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Access Panels and Frames for Walls and Ceilings and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS:

1. Product Data:

a. Materials description for access panels and frames including details showing mounting type, relationships to surrounding construction, panel and frame type, materials, and construction, and locking features.

b. Installation instructions for each product specified.

2. Shop Drawings:

a. Include details of each frame type, elevation of panel, anchorage and accessory items.

b. Schedule showing each type of access panel and frame, locations, sizes, latching or locking provisions, and other data pertinent to installation.

c. Indicate installation procedures and accessories required for a complete installation.

3. Samples: For each panel face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver, store, and handle access panels and frames using means and methods that will prevent damage, deterioration, or loss.

1. Deliver units in manufacturer's original packaging, properly labeled for identification.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Comply with standards referenced herein.

C. Provide access panels and frames produced by a single manufacturer.

D. Wherever a fire-resistance classification is indicated, provide access assembly with panel, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.; "Classified Building Materials Index" for rating shown.

1. Provide UL Label on each fire-rated access panel.

**1.08 - REFERENCES**

A. American International (ASTM):

1. ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel
2. ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
4. ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar]
5. ASTM A879/A879M-12, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
6. ASTM A1008/A1008M-12a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
7. ASTM B209-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
8. ASTM B221-12a, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
9. ASTM F2329-11, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

B. International Code Council (ICC):

1. International Building Code (IBC) - current Edition.

C. Intertek Testing Services/Warnock-Hersey International (ITS/WHI).

D. National Fire Protection Association (NFPA):

1. NFPA 80-2013, Standard for Fire Doors and Other Opening Protectives
2. NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies
3. NFPA 288-2012, Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies.

E. Underwriters Laboratories, Inc. (UL):

1. UL 10B-2008, Fire Tests of Door Assemblies
2. Classified Building Materials Index

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - ACCESS PANELS AND FRAMES MANUFACTURER**

A. Acceptable Manufacturers: Provide products by the following or an approved equal.

1. J. L. Industries, Inc., a division of Activar Construction Products Group
2. Accudor Products
3. Cendrex
4. MIFAB
5. MAXAM Metal Products

B. Substitutions: Manufacturers seeking approval of their products are required to comply with the Owner's Instructions to Bidders, generally contained in the Project Manual.

**2.02 - PERFORMANCE REQUIREMENTS**

A. Fire Rated Access Panels and Frames: Units complying with NFPA 80 that are identical to access panel and frame assemblies tested for fire test response characteristics according to the following test method, and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire rated access panel assemblies installed vertically.
2. NFPA 288 for fire rated access panel assemblies installed horizontally.

**2.03 - INTERIOR FIRE-RATED ACCESS PANELS AND FRAMES**

A. Fire-rated and insulated flush access panel.

1. Manufacturer’s standard recessed ceiling access panel providing required fire rating.
2. Frame and Trim: 16-gauge steel with 1-inch flange and welded-on masonry anchor.
3. Panel: Insulated 20-gauge steel with continuous hinge; 2-inch thickness.
4. Finish: Powder coat paint - white.
5. Standard Latch/Lock: Universal turn ring and key lock “U”.
6. General Use: Ceilings.
7. Fire-Rating as indicated on drawings.
    a. Ceilings: Warnock Hersey listed for floor or ceiling installations with 3-hour noncombustible rating, or 1-hour combustible rating; maximum size 22-1/2 inches by 36-1/2 inches.

8. Style Options:
    a. Color: Gray
    b. Frame and Trim, and Panel Material: Galvanized steel.
    c. Lock Feature: Mortise Slam Lock prep (U3)

**2.04 - MATERIALS**

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.

E. Frame Anchors: Same type as panel face.

F. Inserts, Bolts, and Anchor Fasteners: Hot dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

G. Furnish inserts and anchoring devices which must be built into other work for installation of access panels

**2.05 - FABRICATION**

A. General: Furnish each access panel assembly manufactured as an integral unit, complete and ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Panels and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panel frames to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.

2. For concealed flanges with plaster bead for full bed plaster applications, provide zinc coated expanded metal lath and exposed casing bead welded to perimeter of frames.

3. Provide mounting holes in frames for attachment of units to metal or wood framing.

4. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Panels: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold panels in flush, smooth plane when closed.

1. For cylinder locks, furnish 2 keys per lock and key all locks alike.

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 - INSTALLATION**

A. General: Comply with manufacturer's written instructions for installing access panels and frames.

B. Install panels flush with adjacent finish surfaces or recessed to receive finish material.

**3.03 - ADJUSTING AND CLEANING**

A. Adjust access panels to operate easily without binding. Verify that integral locking/latching devices operate properly.

B. Remove panels and frames that are warped, bowed, or otherwise damaged, and replace with new components.

C. On completion of access panel installation, clean interior and exterior surfaces as recommended by manufacturer.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08331**

**INSULATED OVERHEAD COILING DOORS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Insulated, Prefinished Overhead Coiling Doors as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product data and specifications.

2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.

3. Submit Operation and Maintenance Manuals.

4. Submit wiring diagrams.

5. Submit color charts for specified finish.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide as specified herein.

a. Deliver all units from the factory to the site crated, braced and protected against distortion and damage during transit and unloading. Label all parts to comply with shop drawings for designations.

b. Store in clean and dry locations, properly supported above floor to allow free movement of air and to prevent bending or warping. Units showing effects of rough handling will be rejected.

D. Follow manufacturer's instructions.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide doors and frames which comply with current applicable IECC (International Energy Conservation Code) requirements for the project location.

D. Design Requirements:

a. Wind Loading: Design doors to withstand up to 25psf wind load.

b. Cycle Life - Design doors of standard construction for normal use of up to 20 cycle per day maximum.

**1.07 - QUALITY ASSURANCE**

A. Provide as specified herein.

1. Manufacturer Qualifications: Provide each overhead coiling door as a complete unit produced by a single manufacturer, including frames, curtains, brackets, guides, hoods, counterbalance mechanisms, weatherstripping, hardware, electric operator, pushbutton stations, control wiring and installation accessories.

2. Wind Loading: Design and reinforce overhead coilings doors to withstand a 25-psf wind-loading pressure.

**1.08 - WARRANTY**

A. Provide manufacturer’s standard warranty.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Cornell Iron Works, Inc.

B. North American Door/Division of Jim Walkers Co.

C. The Cookson Company

D. Overhead Door Co. Inc.

**2.02 - MATERIALS**

A. Curtain:

1. Slat Material: (Interior and Exterior):

a. Powder Coated Aluminum: 18-guage (0.044 inch) aluminum.

b. Insulation: 7/8 inch foamed-in-place, closed cell urethane.

c. Total Slat Thickness: 15/16 inch.

d. R-Value: As required by IECC.

2. Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge.

3. Fabricate interlocking sections with high strength endlocks on alternate slats each secured with two ¼" rivets. Provide windlocks on every fourth slat as a minimum.

B. Guides: Fabricate with minimum 3/16 inch structural steel angles. Provide windlock bars of same material. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

1. Top of coil side guide angles to be removable for ease of curtain installation.

C. Counterbalance Shaft Assembly:

1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.

2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.

D. Brackets: Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

E. Hood: 24-gauge powder coated aluminum with reinforced top and bottom edges. Provide minimum 1/4-inch steel intermediate support brackets.

F. Finish:

1. Provide the following factory finish for slats (interior and exterior), bottom bar, guides, brackets, and hood:

2. Powder Coated Aluminum: Phosphate treatment followed by baked-on polyester powder coat, color as selected by Design Builder from manufacturer's standard color range, minimum 32 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better.

G. Weatherstripping:

1. Bottom Bar: Replaceable, 3-point, compressible vinyl gasket extending into guides.

2. Bottom Bar, Motor Operated Doors: Weather/sensing edge with neoprene or rubber astragal extending full width of door bottom bar.

3. Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.

4. Lintel Seal: Nylon brush seal fitted at door header to impede air flow.

5. Hood: Neoprene/rayon baffle to impede air flow above coil.

**2.03 - ACCESSORIES**

A. Locking:

1. Padlockable slide bolt on coil side of bottom bar at each jamb extending into slots in guides.

2. Provide heavy duty padlocks with two (2) keys for each door.

**2.04 - OPERATION**

A. Supply Model GH, heavy duty, UL listed, gearhead hoist type operator(s) rated ¾ H.P., 480 Volts, 3 Phase.

B. Provide UL listed electric door operator assembly of size and capacity recommended by door manufacturer; complete with electric motor and factory pre-wired motor controls, worm-gear reduction unit, solenoid operated brake, 3-button OPEN/CLOSE/STOP control station.

C. Motor shall be high starting torque, continuous duty, industrial type, protected against overload by a current sensing or thermal overload device. Speed reduction shall be worm-gear-in-oil-bath gear reducer with synthetic "All Climate" oil and shall provide 45:1 speed reduction.

D. Door drive shall utilize minimum #50 roller chain and sprockets.

E. Operator shall be equipped with an electrically interlocked floor level disconnect and chain hoist for manual operation and an electric solenoid-actuated brake to stop the motor and hold the door in position. Operator shall be capable of driving the door at a speed of 8 to 9 inches per second. Fully adjustable, driven linear type limit switch mechanism shall synchronize the operator with the door. Low friction nylon limit nuts fitted on threaded steel shaft, rotating on oilite self-lubricating bronze bushings. The motor shall be removable without affecting the limit switch settings.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

**3.02 - INSTALLATION**

A. General: Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

B. Follow manufacturer's installation instructions and approved shop drawings.

**3.03 - ADJUSTING**

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

**3.04 - CLEANING**

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

**3.05 - DEMONSTRATION**

A. Demonstrate proper operation to Design Builder.

B. Instruct Design Builder in maintenance procedures.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08360**

**INSULATED SECTIONAL OVERHEAD DOORS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide sectional overhead doors and accessories as indicated and specified including the following:

1. Steel frame and insulated steel panels.
2. Electric motor operated doors.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product data, specifications and installation instructions for each type and size of overhead door. Include manufacturer's operating instructions and maintenance data.
2. Shop Drawings: Special components and installations, which are not fully dimensioned or detailed in manufacturer's data.
3. Submit wiring diagrams.
4. Submit color charts for specified finish.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide doors and frames which comply with current applicable IECC (International Energy Conservation Code) requirements for the project location.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Manufacturer Qualifications: Provide each sectional overhead door as a complete unit produced by a single manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, electric operator, pushbutton stations, control wiring and installation accessories.

C. Wind Loading: Design and reinforce sectional overhead doors to withstand a 25 psf wind loading pressure.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Overhead Door Corp.: 595 Thermacore.

B. Richards-Wilcox: T175-20.

C. Haas Door Company

D. Or approved equal.

**2.02 - INSULATED STEEL SECTIONS**

A. Construct door sections from hot-dipped galvanized steel sheets laminated with polyurethane foam insulation core.

1. Exterior steel sheet thickness: 0.036 inch (20 gage).

2. Exterior section face: Flat, ribbed or fluted, to suit manufacturer's standards.

3. Interior sheet thickness: 0.019 inch (26 gage).

B. Insulate inner core of steel sections with polyurethane foam type insulation, minimum R-value as required by IECC, minimum density of 2.4 pounds per cubic foot. A variance of 4 percent in density will be acceptable. Shrinkage of foam and the resulting effects on either the interior or exterior skins shall not exceed 5 percent of total door thickness when measured at any point between the top and bottom of each section.

C. Fabricate sections from a single sheet to provide units not more than 24 inches high, and nominally 1-5/8 to 2 inches deep. Roll horizontal meeting edges to a continuous shiplap, rabbeted, or keyed weather seal, with a reinforcing flange return.

D. Enclose open section with 16 gage galvanized steel channel, end stiles welded in place. Provide intermediate stiles, cut to door section profile, spaced at not more than 48 inches o.c. and welded in place.

E. Reinforce bottom section with a continuous channel or angle conforming to bottom section profile.

F. Reinforce sections with continuous horizontal and diagonal reinforcing, as required by door width and design wind loading. Provide galvanized steel bars, struts, trusses or strip steel, formed to depth, and bolted or welded in place.

G. Finish: Apply manufacturer's standard factory-applied prime and finish coats to interior and exterior door faces. Color to be selected by Engineer.

**2.03 - TRACKS, SUPPORTS, AND ACCESSORIES**

A. Tracks: Provide manufacturer's heavy duty, 3-inch, galvanized steel high lift track system, and designed for clearances shown. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball bearing roller guides for required door type and size. Slope tracks as indicated and ensure tight closure at jambs when door unit is closed. Bolt to track supports.

B. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

C. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks. Bracket mounted or clip mounted angle track will not be acceptable.

D. Weather Seals: Provide continuous Therm-L-Brush SD445 CLA weatherstripping at head and jambs, full length resilient seals between door sections.

E. Vision Panels: Provide clear insulated float glass or polycarbonate glazing in arrangement shown. Set glass in rubber or neoprene channel glazing strips.

**2.04 - HARDWARE**

A. General: Provide heavy duty, rust resistant hardware, with galvanized or cadmium plated or stainless steel fasteners, to suit type of door.

B. Hinges: Provide minimum 11 gage steel hinges at each end stile and at each intermediate stile, per manufacturer's recommendations for size of door. Attach hinges to door sections through stiles and rails with self tapping fasteners. Provide double end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.

C. Rollers: Provide heavy duty rollers, with steel ball bearings in case hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide case hardened steel roller tires to suit size of track.

**2.05 - COUNTERBALANCING MECHANISM**

A. Torsion Spring: Operation by torsion spring counterbalance mechanism, consisting of adjustable tension, tempered steel torsion springs mounted on a solid steel shaft. Connect to door with galvanized aircraft type lift cables. Provide springs calibrated for 25,000 cycles minimum.

B. Provide cast aluminum or grey iron casting cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball bearing brackets at each end of shaft.

**2.06 - ELECTRIC DOOR OPERATORS**

A. General: Furnish medium duty electric door operator assembly of size and capacity recommended and provided by door manufacturer; complete with electric motor and factory prewired motor controls, gear reduction unit, solenoid operated brake, clutch, remote control stations and control devices.

B. Provide hand operated disconnect or mechanism for automatically engaging sprocket chain operator and releasing brake for emergency manual operation. Include interlock device to automatically prevent motor from operating when emergency sprocket is engaged.

C. Design operator so that motor may be removed without disturbing limit switch adjustment and without affecting emergency auxiliary operator.

D. Door Operator Type: Provide the following:

1. Sidemount or centermount type, with V belt and roller chain drive connected to counterbalance shaft, and with auxiliary chain hoist and disconnect switch.

E. Electric Motors: Provide high starting torque, reversible, constant duty, electric motors with overload protection, sized to move door in either direction, from any position, at not less than 2/3 foot or more than 1 foot per second.

1. Coordinate wiring requirements and current characteristics of motors with building electrical system, 208 V, 3 phase. See Panel LP-1 on sheet 00 E-602 Electrical Panel Schedule.

2. Provide open drip proof type motor, and controller with NEMA Type 1 enclosure.

F. Control Accessories:

1. Keypad Personal Identification Number operated control stations with “Up/Down” buttons. One set of buttons for each door.

2. Remote controls with “open”, “close”, “stop” buttons for exterior location. One control for each door.

G. Automatic Reversing Control: Furnish each door with automatic safety switch, extending full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail. Contact with switch will immediately reverse downward door travel. Furnish manufacturer's standard self coiling cable.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's instructions, and as specified.

B. Fasten vertical track assembly to framing at not less than 24 inches o.c. Hang horizontal track from structural overhead framing with angle or channel hangers, welded and bolt fastened in place. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door operating equipment.

C. After completing installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08500**

**FIXED WINDOWS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 8, WINDOWS AND DOORS shall include the complete Work specified in all of the following Sections:

1. SECTION 08500, FIXED WINDOWS
2. SECTION 08550, WINDOWS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 08500, FIXED WINDOWS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 | 10 A-404 | 10 A-405 |
| 10 A-406 | 10 A-407 | 10 A-602 | 10 A-603 | 10 A-604 | 10 A-607 | 00 S-001 |
| 00 S-002 | 10 S-101 | 10 S-102 | 10 S-103 | 10 S-104 | 99 S-505 | 99 S-506 |

2. The Work of SECTION 08500, FIXED WINDOWS for Alternative No. A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-401 |
| 20 A-601 | 20 A-602 | 20 A-603 | 00 S-001 | 00 S-002 | 20 S-101 | 99 S-505 |
| 99 S-506 | | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 08500, FIXED WINDOWS

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide High-Performance, Thermal-Barrier, Custom Architectural Grade, Preglazed Aluminum Windows and Frames, and Auxiliary System Components as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer’s product data and specifications, including installation instructions.
2. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, masonry openings, operable units, and attachments to other work.
3. Submit details showing construction parts, metal thicknesses, installation and erection details, thermal-break and glazing details including connections, anchorage, fastening and sealing methods. Manufacturer to provide a recommendation of the thermal-break system as part of the submittal.
4. Submit sections of typical members, dimensioned elevations, frame sizes, type and spacing of anchors and fasteners, and details of accessories.
5. Submit three (3) color charts for aluminum finish.

6. Submit two samples each of sash corner, glass, finishes, hardware, anchorage and fastener. Engineer reserves the right to reject material finishes with objectionable variations from the established samples.
7. Submit certified test reports with results and written compliances conforming to the Design Requirements specified in this section.
8. Design calculations verifying compliance with performance criteria specified, acceptable to governing authorities having jurisdiction, prepared, signed and stamped with the seal of a registered professional engineer, as specified.
9. Certificates: Submit for approval the following:
    a. Proof of testing laboratory AAMA certification and copies of testing agencies background and experience in performing similar tests to those specified.
    b. Registered professional engineer who prepares signs and stamps its seal shall provide a written statement confirming responsibility for the design and attest that the work prepared meets the Specifications and the requirements of governing authorities having jurisdiction and conforms to the prevailing standards of practice for the type of work specified.
10. Test Reports: Submit for approval the following:
    a. Valid AAMA "Authorization for Product Certification" indicating that the aluminum windows and frames to be provided for this Project conform to AAMA/NWWDA 101 I.S.2.
11. Warranties: Submit for review copies of written warranties agreeing to replace aluminum window and frame system components that fail to perform as specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Delivery of Materials:
    a. Deliver aluminum window and frame system materials, components and accessories dry and undamaged, with manufacturer's protective wrapping intact.
    b. Deliver aluminum window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.
    c. Inspect aluminum window and frame system components upon delivery for damage. Remove and replace all damaged items at no additional cost.

E. Storage of Materials:
    a. Do not store aluminum window and frame system components in contact with concrete or other materials that might cause corrosion or staining.
    b. Store aluminum window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.
    c. Provide a ¼-inch space between aluminum window and frame system components in order to promote air circulation.

F. Handling of Materials:

a. Do not subject aluminum window and frame components to bending or stress.

b. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

c. Handle material using appropriate handwear and tools that do not damage finish of items to remain exposed.

**1.06 - DESIGN CRITERIA**

A. Standards:

1. Comply with applicable standards and recommendations by AA, AAMA, and ASCE, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.

2. Comply with AAMA/NWWDA 101/I.S.2 including “non-mandatory” Appendix B, C, and D except where more stringent Wind Velocity Maps are included in ASCE 7 or other governing authorities having jurisdiction.

B. Modifications: Aluminum window and frame requirements shown are intended to establish basic dimensions of units, modules, profiles, mullion depths, sight lines, support locations of members and the visual design intention. Within these limitations Contractor shall be responsible for the structural adequacy, weather resistance, thermal and condensation resistance, and the detailing and fabrication of all aluminum window and frame system, including anchorage, and to make whatever modifications of, and additions to, the details as may be required to fulfill the minimum performance requirements of AAMA Optional Performance Grade and the requirements of non-mandatory Appendixes specified, at no additional expense to the Owner. Maintain the visual design concept as shown, including member sizes, profiles, support locations and alignment of components.

C. Performance Criteria:

1. Loading Analysis Criteria:

a. Wind Loads: Provide structural analysis, calculations and details indicating compliance with the ASCE 7-93 and ASCE 7-88, based on project location, heights and wind speed of 115 miles per hour (MRI 100 years), Ground Roughness (Exposure) Category D; Importance Factor based on ASCE 7 - Category IV - Essential Facility, and corresponding formula coefficients, to determine velocity pressures.

b. Seismic Loads: Provide aluminum window and frame system, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of the ASCE 7, Section 9, whichever are more stringent.

c. Dead Loads: Provide aluminum window and frame system components that do not deflect an amount that will reduce glazing bite below 75 percent of required glazing bite dimension when carrying full dead load. Provide minimum of 1/8 inch clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum of 1/16 inch clearance between members and operable windows and doors.

d. Live Loads: Provide aluminum window and frame system, including anchorage that accommodates supporting structure’s deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

e. Deflection of Framing Members, ASTM E330: Maximum deflection of L/175 at center of single span when subjected to both positive and negative applicable design pressures, with no permanent deformation or damage of any main frame, sash, panel or sash member in excess of 0.2 percent of the span when the load is removed.

2. Water and Air Infiltration Tests: A 5 foot-0 inch by 3 foot-0 inch window shall comply with the following:

    a. Static Test Pressure Water Penetration Testing, ASTM E331 and AAMA 910: After the AAMA 910 life cycle test, no evidence of uncontrolled water penetration to the interior of the building through the aluminum windows and frames when subjected to a static air pressure difference of 12 pounds per square foot.

    b. Air Infiltration Testing, ASTM E283: After the AAMA 910 life cycle test, maximum air infiltration of 0.08 cubic feet per minute per square foot, when subjected to a static air pressure difference of 6.24 pounds per square foot.

3. Aluminum Window Classification (Grade): Based on AAMA/NWWDA 101/I.S.2, provide the following:

    a. Performance Class: In addition to General Requirements of Section 1, Gateway Performance Requirements established in Table 2.1, the Specific Performance Requirements of Section 2.2 and the Material and Component Requirements of Section 3, provide Optional Performance Class – Architectural AW, for all aluminum windows and frames.

    b. Performance Grade: As a minimum, provide Optional Performance Grade 65 aluminum windows and frames tested for structural test pressure of 1.5 times design pressure, unless structural calculations based on performance criteria specified identifies the need for more stringent optional performance grade for any area of the Project.

    c. Product Type: Provide AW - Fixed Window, as shown on the Drawings.

4. Provide design, detailing and fabrication based on the most stringent combination of standards, testing and engineering analysis specified.

5. Thermal Movements: Aluminum window and frame system, including anchorage, shall withstand thermal expansion and contraction movements of system and supporting elements resulting from not less than an ambient temperature change of 120 degrees F, which may cause a surface material temperature change of 180 degrees F. Limit the deflection as for wind pressure loading. Thermal movements shall not cause permanent deformation, cracking, opening of joints, undue stress on fasteners, or other effects detrimental to weathering performance.

6. The design of the aluminum window and frame system, including anchorage, as shown and specified is intended to prevent excessive condensation on the indoor faces of the work, with the heating and ventilating system in operation, and under the following conditions. Provide aluminum window and frame system design, detailing and fabrication in compliance with AAMA 1503.1 that achieves and maintains this design intention:

    a. Outdoor: Ambient temperature 0 degrees F; 15 mph wind.

    b. Indoor: Ambient temperature of 75 degrees F; relative humidity of 25 percent.

    c. Excessive condensation is defined as visible water.

    d. Condensation Resistance Factor: 58 minimum for frame.

7. Provide internal drainage to lead all infiltrated water to the exterior through weep slots.

8. Provide Fire-Rated glazing materials installed as borrowed lites in fire-rated frames and wall applications

9. Testing: Manufacturer's standard window units shall comply with the requirements and testing in accordance with the specified tests. Provide certification by the manufacturer of compliance with such tests; otherwise, perform the required tests through a AAMA accredited and recognized testing laboratory or agency and provide certified test results.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications:

1. Engage a single installer skilled, trained and with successful experience in the installation of aluminum window and frame systems and with specific skill and successful experience in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work.

C. Erection Tolerances:

1. Limit variations from plumb, level or dimensioned angle to the following:

a. 1/8-inch maximum deviation in 10 foot vertical or angular run and in 20 foot horizontal runs.

b. 1/4-inch maximum deviation in 40 foot runs, all directions.

2. Limit variations from theoretical member locations shown, based on established floor lines and column lines, including variations from plumb and level, to the following:

a. 3/8-inch total maximum deviation for members at all locations.

b. 1/8-inch maximum change in deviation for members for 10 foot runs, all directions.

3. Limit offsets in end-to-end and edge-to-edge alignments of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:

a. 1/16-inch maximum offset in flush alignment, including members which are to be 1/2-inch or less out-of-flush, and including members which are separated 2-inches or less by a reveal or protrusion in the plane of the aluminum windows and frames.

b. 1/8-inch maximum offset in alignments which are to be out-of-flush by more than 1/2-inch or separated by a reveal or protrusion of more than 2- inch width.

D. Source Quality Control:

1. Obtain all aluminum window and frame system components, operating hardware, custom panning, flashing and accessories from the same manufacturer.

2. Provide aluminum windows and frames labeled with AAMA Hallmark labels.

E. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer’s satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work in accordance with ASTM E329 and AAMA qualifications.

**1.08 - WARRANTY**

A. General Warranty: The special warrantees specified in this Article shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.

B. Special Warrantees: Provide the following:

1. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:

a. Coating shall not spall, check, craze, peel or otherwise lose adhesion for a period of ten years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet - 0 inches from the item.

b. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified standards the manufacturer shall, at its own expense, replace or field paint, at the discretion of the Owner, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.

c. The warranty shall not apply where any failure is caused by accidents, or any external conditions or forces beyond the control of the manufacturer.

2. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame system components including the failure of insulating glass. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weatherstripping, and other components of the system.

C. Warranty Period:

1. Windows: Three years from date of substantial completion.

2. Glazing: Five years from date of substantial completion.

3. Metal Finish: Fifteen years from date of substantial completion.

**1.09 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM B209: Aluminum and Aluminum-Alloy Sheet and Plate, Standard Specification for

2. ASTM B221: Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Standard Specification for

3. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications

4. ASTM D395: Rubber Property-Compression Set, Standard Test Methods for

5. ASTM D573: Rubber - Deterioration in an Air Oven, Standard Test Method for

6. ASTM D2000: Rubber Products in Automotive Applications, Standard Classification System for

7. ASTM E283: Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Windows Under Specified Pressure Differences Across the Specimen, Standard Test Methods for

8. ASTM E329: Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction, Standard Specification for

9. ASTM E330: Structural Performance of Exterior Windows, Curtain Walls, and Windows by Uniform Static Pressure Difference, Standard Test Methods for

10. ASTM E331 - Water Penetration of Exterior Windows, Curtain Walls, and Windows by Uniform Static Air Pressure Difference, Standard Test Method for

11. National Fire Protection Association (NFPA):

a. NFPA 80: Fire Doors and Windows

B. Aluminum Association Standards (AA):

1. AA: The Aluminum Association Incorporated, American National Standard Alloy and Temper Designation Systems for Aluminum

2. AA: The Aluminum Association Incorporated, Designation System for Aluminum Finishes

C. American Architectural Manufacturers Association and the Window and Door Manufacturers Association, (AAMA/NWWDA):

1. 101/I.S.2 – Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

D. American Architectural Manufacturers Association (AAMA):

1. AAMA 611-98: Voluntary Guide Specification for Anodized Architectural Aluminum.
2. AAMA 800: Voluntary Specifications Test Methods for Sealants
3. AAMA 910: Voluntary 'Life Cycle'/Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors
4. AAMA 1503.1: Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
5. AAMA 2605-02: Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

E. American Society of Civil Engineers (ASCE):

1. 7 - Minimum Design Loads for Buildings and Other Structures

F. Federal Specification (FS):

1. RR-W-365: Wire Fabric (Insect Screening)

G. National Association of Architectural Metal Manufacturers (NAAMM).

H. Society of Protective Coating (SSPC)

1. Paint 12 - Paint Specification No. 12: Cold-Applied Asphalt Mastic (Extra Thick Film)

I. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - PROJECT CONDITIONS**

A. Protection: Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

1. Do not install aluminum windows and frames until all work that could damage aluminum window and frame systems has been completed.

2. Provide temporary closures until construction sequencing allows installation of aluminum window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the work specified herein.

C. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Working Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

**1.11 - SYSTEM DESCRIPTION**

A. This Section describes exterior, high-performance, minimum 3-1/4-inch frame depth, factory-fabricated and factory-glazed, aluminum windows with integral structural polyurethane thermal-breaks and applied muntins complying with the requirements of AAMA/NWWDA 101/I.S. 2 - Architectural Performance Class and Section 4 - Optional Performance Grades, all with Architectural Class I anodized finish or with a complete selection of factory-applied, three coat, custom and premium exotic color, custom blended full strength polyvinylidene fluoride finishes and colors with extended life topcoat, as selected; all designed, detailed and fabricated as required to resist specified loadings, and resistance to air and water penetration specified and in accordance with the requirements of governing authorities having jurisdiction; associated high-performance operating hardware, auxiliary system items, accessories, fasteners and similar items for completely functioning systems.

B. Fire-rated, clear and wireless glazing and frame material for use in locations such as doors, sidelites, interior windows, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45 minutes to 2

hours with required hose stream test; for use in interior and exterior applications. Coordinate with spec section 08810 Glass and Glazing.

**PART 2 – PRODUCTS**

**2.01 - MANUFACTURERS**

A. EFCO Corporation.

B. Graham.

C. Kawneer.

D. Or acceptable equivalent product.

E. Basis of Design: (1) Kawneer, Norcross, GA: NX-3800 Window Series and (2) Fire Rated Window: Fyre-Tec – Series H950 Heavy Fixed Lite. Other acceptable manufacturers are: Technical Glass Products (TGP), Perrysburg, OH and Steel Windows and Doors USA, Bridgeport, CT.

F. Source Limitations

1. Windows shall be from a single source and from a single manufacturer.

2. A single manufacturer providing windows under this section and SECTION 08550, WINDOWS is acceptable assuming that the manufacturer meets all the performance criteria specified in both sections and as shown on the drawings.

**2.02 - MATERIALS**

A. Extrusions:

1. Provide extruded, double tubular aluminum mullions, applied muntins, pressure plates, snap covers, two-piece snap trim, sills and glazing stops and trim, equal to ASTM B221, 6063-T5 alloy and temper as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.

a. Minimum Thickness: 0.125-inches.

2. Provide extrusions within commercial tolerances, formed true to details shown and free of defects impairing strength, durability, color or finish.

B. Sheets:

1. Provide aluminum sheet closures, auxiliary components and accessories, equal to ASTM B209, 5005 alloy for exposed sheet and 3003 alloy for nonexposed sheet or as recommended by the aluminum window and frame manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color for finishes.

a. Provide thicknesses for Principal Formed Sheet Members: 0.125-inches minimum thickness.

2. Provide sheet free of defects impairing strength, durability, color or finish.

C. Fasteners: 300 Series non-magnetic stainless steel, guaranteed by the manufacturer to be non-corrosive and compatible with the aluminum window members, trim, hardware, anchors and other components of the window units.

1. Do not use exposed fasteners, except where unavoidable for the application of operating hardware. Match the finish of the metal surrounding fastener, unless otherwise specified.

2. Provide Philips flat-head machine screws for exposed fasteners, unless otherwise specified.

D. Thermal Separators: Integral, structural polyurethane.

E. Glass and Glazing:

1. Glass: 1-in. thick clear, insulating-glass units, with low-E coating pyrolytic on third surface for tinted windows.

a. Tint: Solar gray with visible light transmittance of 18%.

2. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

3. Factory-Glazed Fabrication: Glaze aluminum windows in the factory and comply with AAMA/WDMA 101/I.S.2/NAFS.

4. Glazing Stops: Provide snap-on glazing stops. Provide glazing stops to match sash and ventilator frames.

F. Wire Fabric Insect Screen and Frames: Provide insect screen and frames for each operable sash.

1. Provide 18 by 16 mesh of 0.009-inch diameter stainless steel wire, complying with FS RR-W-365, Type VI, mounted with polyvinylchloride splines into 5/16-inch by 1-1/2-inch by 0.050-inch extruded tubular aluminum frames with finish to match window in color and performance; corners mitered, gusset reinforced and crimped.

2. Provide insect screens that mount into exterior or interior extruded tracks using two stainless steel leaf springs.

3. Where windows swing outward, and insect screens are mounted on interior, provide sliding wickets framed as for fixed insect screens and trimmed for a tight fit and durability during operation.

G. Weatherstripping: Provide double rows of manufacturer's replaceable epdm stripping complying with ASTM D2000, secured in extruded aluminum ports at all vent perimeters.

H. Brackets, Gussets, Reinforcements and Splice Clips:

1. Provide aluminum brackets and reinforcements wherever possible. Where steel units are required for higher strength or other unavoidable necessity, hot-dip galvanize the pieces after fabrication, with 2.0 ounces zinc coating.

I. Auxiliary Components and Accessories:

1. Provide extruded aluminum, minimum 0.125-inch thick wall, with exposed surfaces finished to match aluminum windows and frames in color and performance; concealed fasteners; all weatherseals; designed for unrestricted expansion and contraction.

2. Provide complete selection of exterior wrap-around custom panning accessories; two-piece head and jamb receptors; sills and subsills with thermal-breaks, anchors and end dams; two-piece interior snap trim and clips; interior glazing adapters, expanders, receptors, stools and other trim necessary for a complete installation, as determined by Engineer.

3. Provide intermediate, thermally broken, expansion-type, vertical and horizontal integral mullions (stack; offset stack; and three-piece) and mullion covers in configurations and types as required for combinations of windows and sizes of window areas shown.

J. Bituminous Paint: Cold applied asphalt mastic complying with SSPC-Paint 12, compounded for 30-mil thickness per coat.

K. Expansion Anchor Devices: Where inserts have not been provided in supporting concrete structure, provide drilled-in expansion bolt anchors of either toothed-stainless steel or lead shield design.

L. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.

**2.03 - WINDOW OPERATION**

A. General:

1. Not Used

B. Operating Hardware:

1. Strike and Cam: White bronze, UNS C86200 cast white manganese bronze complying with ASTM B584.
2. Concealed Stainless Steel Hinges: Heavy-duty four-bar hinges with nonmagnetic stainless steel balance arms. Provide sliding pivots with nylon friction-adjustable shoe in a stainless steel track.
3. Limit Opening Device: Provide stainless steel adjustable hold-open limit arm with release key for all project-out operable windows.
4. Lock: Lift type throw. Cam-action lock with keeper, one per ventilator.
5. Provide on gear type rotary operator located on jamb at sill with standard crank handle. Provide on per window.

**2.04 - FABRICATION**

A. General: Provide specified manufacturer's standard fabrication and accessories, except to the extent more stringent requirements are specified. Include complete system for assembly of components and anchorage of window units.

B. Sizes and Profiles: The required sizes for window units and the profile requirements are shown on the Drawings. The details shown are based upon standard details by one manufacturer. It is intended that similar details by other manufacturers will be acceptable, provided they comply with the size requirements, performance requirements and with minimum/maximum profile requirements shown and specified.

C. Frame and Vent: All members shall be minimum 0.125-in. thick, double tubular; corners mitered, double gusset reinforced, factory-sealed with sealant complying with AAMA 800 and crimped.

D. Water Control: Provide pressure equalization gasket on vent interior; vent and frame weeps, foam baffles, and exterior hoods to allow water to drain by gravity and resist wind-blown rain.

E. Provide field-mounted drip caps on vent exteriors above frame sill.

F. Operating Hardware:

1. Cut, reinforce, drill and tap frames and windows as required to receive operating hardware. Comply with manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
2. Design, detail and fabricate reinforcement for maximum heavy-duty use, consisted with required guarantee period and performance criteria specified.

G. Provide extruded aluminum applied muntins, and custom panning shapes as shown and specified.

H. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

I. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

**2.05 - FINISHES, GENERAL**

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.06 - ALUMINUM FINISHES**

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

1. Color: As selected by Engineer from manufacturer's full range.

## PART 3 – EXECUTION

### 3.01 - INSPECTION

A. Contractor shall examine the alignment of substrates and the sequence of work before erection of the custom aluminum window and frame systems work begins and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the custom aluminum window and frame systems work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Custom aluminum window and frame systems work shall not be installed when there is no assurance of adequate, long term protection by Contractor.

### 3.02 - INSTALLATION

A. All windows shall be installed by factory-trained erectors in strict accordance with installation data provided by approved shop drawing submittal, and the requirements of these Specifications.

B. Do not install component parts that are observed to be defective in any way, including warped, bowed, dented, abraded and broken members, and including damaged glass.

C. Do not cut, or trim, component parts during erection, in a manner that would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the custom aluminum window and frame systems. Return component parts which require alteration to the shop for refabrication, if possible, or for replacement with new parts.

D. Install component parts level, plumb, true to line and with uniform joints and reveals. Provide required support secured to structure with non-staining and noncorrosive shims, anchors, fasteners, spacers and fillers. Use erection equipment that will not mar or stain finished surfaces, and will not damage the component parts.

E. Apply a bituminous coating of approximately 30-mil dry film thickness, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.

F. Apply sealant in accordance with manufacturer’s written recommendations at joints, wipe off excess and leave exposed sealant surface clean and smooth.

G. Anchor components parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements which are intended or necessary.

### 3.03 - PROTECTION

A. Contractor shall provide protective treatment and other precautions required through the remainder of the construction period, to ensure that window units will be without damage or deterioration, other than normal weathering at time of Final Acceptance.

B. Contractor shall advise Engineer, in writing, of protection and surveillance requirements that Contractor shall provide at no additional expense to the Owner, to ensure that aluminum windows and frame system will be without damage or deterioration at the time of Final Acceptance by the Owner.

C. Where protective coating has been supplied, remove coating completely immediately before installation and when construction activities no longer requires its retention.

### 3.04 - ADJUSTMENT

A. All windows shall be adjusted for smooth operation and weathertight closure providing a tight fit at contact points and at weatherstripping after installation is complete and readjusted when necessary prior to Substantial Completion.

B. At the completion of the work, restore adjacent work, marred by the work of this Section, to an undamaged and clean condition.

C. Adjacent work that has been physically damaged, or that does not respond adequately to cleaning, shall be replaced with new materials at no additional expense to the Owner.

**3.05 - CLEANING**

A. Clean aluminum surfaces immediately after installation, exercising care to avoid damage of finish. Lubricate hardware and other moving parts.

B. Maintain the aluminum window and frame systems and glazing in a clean condition throughout the construction period, so that they will be without any evidence of deterioration or damage, other than the effects of normal weathering, at the time of Final Acceptance.

C. Select methods of cleaning that will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08550**

**WINDOWS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 08550, WINDOWS is a part of DIVISION 08, OPENINGS: WINDOWS AND DOORS which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 08500 – WINDOWS.

B. The Work of SECTION 08550, WINDOWS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Aluminum Window Types (1) Double-Hung Window Units and (2) Non-operative (Fixed) Window Units as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

**A.** Product Data: For each type of product. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows. Manufacturer to provide a recommendation of the thermal-break system as part of the submittal.

2. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

3. Samples: For each exposed product and for each color specified, 2-inches x 4 inches in size.

4. Samples for Initial Selection: For units with factory-applied color finishes. Include similar Samples of hardware and accessories involving color selection.

5. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below:

   a. Exposed Finishes: 2-inches x 4 inches.

   b. Exposed Hardware: Full-size units.

6. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

7. Qualification Data: For manufacturer and Installer.

8. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

9. Field quality-control reports.

10. Sample Warranties: For manufacturer's warranties.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE and HANDLING and as specified.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Delivery of Materials:

1. Deliver aluminum window and frame system materials, components and accessories dry and undamaged, with manufacturer’s protective wrapping intact.

2. Deliver aluminum window and frame system components in clearly and legibly labeled with AAMA designations and in undamaged cartons to provide protection during transit and storage.

3. Inspect aluminum window and frame system components upon delivery for damage. Remove and replace all damaged items at no additional cost.

D. Storage of Materials:

1. Do not store aluminum window and frame system components in contact with concrete or other materials that might cause corrosion or staining.

2. Store aluminum window and frame component under cover and in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Immediately remove wrapping if it becomes wet.

3. Provide a 1/4-inch space between aluminum window and frame system components in order to promote air circulation.

E. Handling of Materials:

1. Do not subject aluminum window and frame components to bending or stress.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

3. Handle material using appropriate handwear and tools that do not damage finish of items to remain exposed.

**1.06 – DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

**1.07 - QUALITY ASSURANCE**

C. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

D. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

E. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

F. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project. Engage a single installer skilled, trained and with successful experience in the installation of aluminum window and frame systems and with specific skill and successful experience in the erection of the types of units and components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of work.

G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.

2. Acceptance of mockups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Engineer specifically accepts such deviations in writing.

**1.08 - WARRANTY**

A. General Warranty: The special warrantees specified in this Article shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.

B. Special Warrantees: Provide the following:

1. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:

a. Coating shall not spall, check, craze, peel or otherwise lose adhesion for a period of ten years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet - 0 inches from the item.

b. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified standards the manufacturer shall, at its own expense, replace or field paint, at the discretion of the Owner, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.

c. The warranty shall not apply where any failure is caused by accidents, or any external conditions or forces beyond the control of the manufacturer.

2. Provide written warranty, signed by the manufacturer and running to benefit of the Owner, agreeing to replace aluminum window and frame system components including the failure of insulating glass. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weather stripping, and other components of the system.

C. Warranty Period

1. Windows: Three years from date of substantial completion.

2. Glazing: Five years from date of substantial completion.

3. Metal Finish: Fifteen years from date of substantial completion.

4. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

(1) Failure to meet performance requirements.

(2) Structural failures including excessive deflection, water leakage, and air infiltration.

(3) Faulty operation of movable sash and hardware.

(4) Deterioration of materials and finishes beyond normal weathering.

(5) Failure of insulating glass.

b. Warranty Period:

(1) Window: 10 years from date of Substantial Completion.

(2) Glazing Units: Five years from date of Substantial Completion.

**1.09 - REFERENCES**

A. American Architectural Manufacturers Association (AAMA):

1. 502: Voluntary Specification for Field Testing of Newly Installed Fenestration Products

2. 901: Voluntary Specification for Rotary & Linear Operators in Window Applications

3. 902: Voluntary Specification for Sash Balances

4. 907: Voluntary Specification for Corrosion Resistant Coatings on Carbon Steel Components

5. 2605: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

B. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures - Includes Supplement No. 1

C. ASTM International (ASTM):

1. C1036: Standard Specification for Flat Glass

2. D3656: Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

3. E405: Standard Test Methods for Wear Testing Rotary Operators for Windows
4. E1886: Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
5. E1996: Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
6. E2112: Standard Practice for Installation of Exterior Windows, Doors and Skylights
7. E2190: Standard Specification for Insulating Glass Unit Performance and Evaluation

D. Forest Stewardship Council (FSC):

1. STD-01-001: FSC Principles and Criteria for Forest Stewardship
2. STD-40-004: FSC Standard for Chain of Custody Certification

E. National Wood Window and Door Association (NWWDA):

1. I.S. 2: Wood Window Units

F. Screen Manufacturer's Association (SMA):

1. 1201: Insect Screens For Windows, Sliding Doors, And Swinging Doors

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - PREINSTALLATION MEETINGS**

A. Preinstallation Conference: Conduct conference at Framingham, MA.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

**1.11 - PROJECT/SITE CONDITIONS**

A. Protection: Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

1. Do not install aluminum windows and frames until all work that could damage aluminum window and frame systems has been completed.
2. Provide temporary closures until construction sequencing allows installation of aluminum window and frame systems at a time when the systems will not be subject to construction damages of any kind.

B. Scheduling and Coordination:

1. Review installation procedures under other Sections and coordinate them with the work specified herein.

C. Field Measurements:

1. Verify dimensions in areas of installation before fabrication and indicate dimensions on Working Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

## PART 2 - PRODUCTS

### 2.01 - WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: LC.

2. Minimum Performance Grade: 25.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x degrees F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

F. Outside-Inside Transmission Class (OITC): Rated for not less than 30 OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.

G. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.

### 2.02 - MANUFACTURERS

**A.** Aluminum Double Hung Windows:

1. Crystal Window and Door Systems, Ltd.

2. Superior Window Company.

3. Wojan Windows.

4. BASIS OF DESIGN: CRYSTAL WINDOW AND DOOR SYSTEMS, LTD., SERIES 5500 HEAVY COMMERCIAL / ARCHITECTURAL ALUMINUM THERMAL-BREAK TILT WINDOWS

B. Source Limitations

a. Windows shall be from a single source and from a single manufacturer.

b. A single manufacturer providing windows under this section and SECTION 08500, FIXED WINDOWS is acceptable assuming that the manufacturer meets all the performance criteria specified in both sections and as shown on the drawings.

### 2.03 - ALUMINUM WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Double hung.

2. Fixed.

B. Frames and Sashes: Aluminum.

1. Exterior Finish: Aluminum.

a. Color: As selected by Engineer from manufacturer's full range.

2. Interior Finish: Manufacturer's standard colors/finishes.

a. Color: As selected by Engineer from manufacturer's full range.

C. Insulating-Glass Units: ASTM E2190, certified through IGCC as complying with requirements of IGCC.

1. Glass: ASTM C1036, Type 1, Class 1, q3.
   a. Tint: Clear.
   b. Kind: Fully tempered.
2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating:
   a. Glass: 1-in. thick clear, insulating-glass units, with low-E coating pyrolytic on third surface for tinted windows.
   b. Tint: Solar gray with visible light transmittance of 18%.
5. Integral Louver Blinds: Glass manufacturer's standard, horizontal louver blinds with aluminum slats and polyester fiber cords, located in space between glass lites, and operated by hardware located on inside face of sash
   a. Operation: Tilt, raising, and lowering.
   b. Color: As selected by Engineer from manufacturer's full range.

D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
1. Dual Glazing:
   a. Interior Lite: Glass.
   b. Exterior Lite: Insulating-glass unit.

E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907 or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Engineer from manufacturer's full range.

F. Hung Window Hardware:
1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

**2.04 - ACCESSORIES**

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.
1. Quantity and Type: Two per sash, permanently located at exterior and interior lites
2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings
4. Profile: As selected by Engineer from manufacturer's full range.

B. Color: As selected by Engineer from manufacturer's full range

C. Horizontal Louver Blinds: Provide manufacturer's standard, removable, horizontal louver blinds with aluminum slats and polyester fiber cords that are operated by hardware located on inside face of sash.

1. Operation: Tilt, raising, and lowering.

2. Color: As selected by Engineer from manufacturer's full range.

3. Location: Window W4

**2.05 - INSECT SCREENS**

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

2. Finish for Interior Screens: Baked-on organic coating in color selected by Engineer from manufacturer's full range.

3. Finish for Exterior Screens: Matching color and finish of cladding.

4. Mesh Color: Manufacturer's standard.

C. Aluminum Wire Fabric: 18- by 16-inches mesh of 0.011-inch- diameter, coated aluminum wire.

1. Wire-Fabric Finish: Charcoal gray.

**2.06 - FABRICATION**

A. Fabricate aluminum windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 - INSTALLATION**

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

**3.03 - FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.

2. Air-Infiltration Testing:

a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.

b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.

b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Engineer and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.

5. Test Reports: Prepared according to AAMA 502.

C. Remove and replace noncomplying windows and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

**3.04 - ADJUSTING, CLEANING, AND PROTECTION**

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08710**

**FINISH HARDWARE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Finish Hardware as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Section Includes:

1. Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions.

2. Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.

D. General Requirements:

1. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Engineer of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Hardware Schedule: Submit hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Hardware schedule shall clearly indicate Engineer’s hardware group and manufacturer of each item proposed. The schedule shall be reviewed and certified to meet requirements prior to submission by a certified Architectural Hardware Consultant (AHC).

   a. Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, function, design, finishes, and options.

   b. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.

   c. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

   d. Furnish other Contractors, and Subcontractors concerned, with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to door fabricators in accordance with schedule that is required for fabrication.

   e. Samples: Lever design or finish sample: Provide samples if requested by Engineer.

2. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware after approval of finish hardware.

3. Templates: Submit templates and final approved hardware schedule to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

4. Closeout Submittals: Comply with SECTION 01700, CONTRACT CLOSEOUT, including specific requirements indicated.

   a. Operating and maintenance manuals: Submit sets containing the following:

      (1) Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.

      (2) Catalog pages for each product.

      (3) Name, address, and phone number of local representative for each manufacturer.

      (4) Parts list for each product.

   b. Copy of final approved hardware schedule, edited to reflect "As installed.”

   c. Copy of final keying schedule.

   d. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

   e. Copy of all warrantees; including all appropriate reference numbers for manufacturers to identify the project.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver hardware to the Project Site in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.

E. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Manufacturer: Obtain each type of hardware (ie. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.

C. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be prepared and signed by a certified AHC.

D. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated.

E. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with the Drawings or Specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.

F. Handicapped Requirements: Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

G. Pre-Installation Conference: Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Engineer and Owner.

**1.08 - WARRANTY**

A. General: Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.

B. Provide five year factory warranty on exit devices against defects in material and workmanship from date of occupancy of Project.

C. Provide ten year factory warranty on door closer body against defects in material and workmanship from date of occupancy of Project.

D. Replace shortages and incorrect items with correct material at no additional cost to Owner.

E. At completion of project, a qualified factory representative shall inspect closer installations. After this inspection, letter shall be sent to Engineer reporting on conditions, verifying that closers have been properly installed and adjusted.

**1.09 - REFERENCES**

A. ANSI 156: American National Standards Institute

B. DHI: Door and Hardware Institute

C. BHMA: Builders Hardware Manufacturers Association

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - SEQUENCING AND SCHEDULING**

A. Deliver finish hardware to the Project site in a timely manner so as not to delay progress of other trades.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function.

**2.02 - BUTTS AND HINGES**

A. Acceptable Manufacturers and Products:

| No. | Type | McKinney | Hager | Stanley |
|---|---|---|---|---|
| 1. | Type 1 | T4A3795 | BB1262 | FBB268 |
| 2. | Type 2 | TA2714 | BB1279 | FBB179 |
| 3. | Type 3 | TA2314 | BB1191 | FBB191 |
| 4. | Type 4 | T4A3786 | BB1168 | FBB168 |
| 5. | Type 5 | T4A3386 | BB1199 | FBB199 |

B. Application:

1. Exterior over 36 inches wide: Type 5
2. Exterior 36 inches wide or less: Type 3
3. Interior doors over 36 inches wide: Type 5
4. Interior doors 36 inches wide or less: Type 3
5. Interior corridor pairs of doors swinging in same direction: Type 1 (unless reveal or clearance does not allow)
6. Provide NRP (non-removable pins) at out-swinging lockable doors (interior or exterior).

C. Size:

1. 2-1/4 inch Doors: 5 inch by 5 inch
2. 1-3/4 inch Doors: 4-1/2 inch by 4-1/2 inch
3. 1-3/8 inch Doors: 3-1/3 inch by 3-1/2 inch

D. Quantity:

1. 2 - Hinges per leaf for openings through 60 inches high.
2. 1 - Additional hinge per leaf for each additional 30 inches in height or fraction thereof.

E. Drill 5/32 inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

**2.03 - LOCKSETS – MORTISE**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer | Series |
|---|---|---|
| 1. | Sargent | 8200 x LNL |
| 2. | Schlage | L9000 x 06A |
| 3. | Corbin-Russwin | ML2000 x NSA |

B. Provide lock series and functions as specified in Hardware Groups, with the provisions below. Sargent product numbers are referenced in the Hardware Groups.

1. Cylinders: Refer to keying requirements
2. Backsets: 2-3/4 inches.
3. Strikes: Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf. Where required, provide open back strike and protected to allow practical and secure operation.
4. Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

**2.04 - DEADLOCKS**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer | Series |
|---|---|---|
| 1. | Sargent | 4870 |
| 2. | Schlage | L460 |
| 3. | Corbin-Russwin | DL4000 |

B. Provide deadlock series and functions as specified in Hardware Groups, with the provisions below. Sargent product numbers are referenced in the Hardware Groups.

1. Cylinders: Refer to keying requirements.
2. Backsets: 2-3/4 inches.
3. Strikes: Provide manufacturers standard wrought brass, bronze, or steel strike.

**2.05 - EXIT DEVICES**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer | Series |
|---|---|---|
| 1. | Sargent | 80 Series |
| 2. | Von Duprin | 98/35 Series |
| 3. | Precision | Apex Series |

B. Provide exit device series and functions as specified in Hardware Groups. Sargent product numbers are referenced in the Hardware Groups.

C. All exit devices shall be UL listed for panic. Exit devices for labeled doors shall be UL listed as "Fire Exit Hardware".

D. Where lever trim is specified, provide lever design to match lockset levers.

E. Provide cylinders for exit devices with locking trim and cylinder dogging.

F. Provide cylinder dogging feature for non-rated exit devices.

G. Provide keyed removable mullions, as specified in the Hardware Groups.

**2.06 - KEYING**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer |
|---|---|
| 1. | Sargent |
| 2. | Schlage |
| 3. | Corbin-Russwin |

B. Provide manufacturers standard removable core cylinders. Provide construction cores with construction master keying for use during construction. The hardware supplier shall install permanent master keyed cores upon completion of the project.

C. Factory key all cylinders with manufacturer retaining permanent keying records.

D. Submit proposed keying schedule to Engineer. Meet with Owner and Engineer to review schedule.

E. All cylinders, unless noted otherwise, shall be operated by one of a series of New Master Keys, as noted by their respective key set number herein, to be established for this project. Allow for twenty (20) Master Keys under each of the above Grand Master Keys. (Do not use the letter "I" in any of the master key sets.)

F. All cylinders shall be keyed in alike or different sets as noted by their respective key set number. Allow for fifty (50) change keys under each of the above master keys.

G. Visual key control:

1. All keys shall be stamped with their respective key set number and stamped “DO NOT DUPLICATE".
2. Grand master and master keys shall be stamped with their respective key set letters.
3. Do not stamp any keys with the factory key change number.
4. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.

H. All change keys, key blanks; master and grandmaster keys shall be shipped directly from the factory to the Owner via registered mail, confidential, OR delivered directly to the Owner by the hardware supplier in sealed containers, who shall obtain a receipt for delivery of same. Restricted keyway cylinders shall be delivered directly to the Owner by the manufacturer who shall obtain a receipt for delivery of same. All master, grandmaster, and great grandmaster keys, must be delivered in tamperproof packaging. Tamperproof packaging shall mean boxes of keys shall be shrink wrapped, with material identified with imprinting reading "SEALED FOR YOUR SECURITY", by the manufacturer.

**2.07 - DOOR TRIM**

A. Acceptable Manufacturers and Products:

| No. | Type | Rockwood | Hager | Donjo |
|---|---|---|---|---|
| 1. | Push Plate | 70 | 30S | 71 |
| 2. | Pull | BF111 | H4J | H20 |
| 3. | Pull, offset | BF157 | H12J | H1157 |
| 4. | Push Bar | 47 | 130S | 147 |
| 5. | Kick Plate | K1050 B4E | 194S | 90 B4E |
| 6. | Door Edges | 306B | 182P | 1299 |

B. Kick Plates and Armor Plates:

1. Minimum of 0.050 inch thick, beveled 4 edges.
2. At single doors provide width 1-1/2 inch less than door width on stop side and one inch less than door width on face side.
3. At pairs of doors provide width 1-inch less than door width on either side.
4. Provide Height:
   a. Mop Plates: 4 inches, unless otherwise indicated.
   b. Kick Plates: 8 inches, unless otherwise indicated.
   c. Armor Plates: 34 inches, unless otherwise indicated.

C. Edge Guards:

1. Minimum .050" thick, stainless steel.
2. Rockwood #306B x 42 inches high as noted in Hardware Groups.

**2.08 - COORDINATORS**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer | Series |
|---|---|---|
| 1. | Rockwood | 1600 Series |
| 2. | Hager | 297D |
| 3. | Donjo | 2010/2020 Series |

B.

C. Provide 1600 Series coordinator for labeled pairs of doors equipped with automatic flush bolts and those with vertical rod/mortise lock fire exit device combinations with astragals.

D. Provide filler bars for total opening width, closer mounting brackets, carry bars, and special preparation for top latches where applicable.

**2.09 - DOOR CLOSERS**

A. Acceptable Manufacturers and Products:

| No. | Type | Sargent | LCN | Norton |
|---|---|---|---|---|
| 1. | Stop Arm | 351-CPS | 4040S-CUSH | UNI-7500-BF |
| 2. | Stop/Holder Arm | 351-CPSH | 404S-H-CUSH | UNI-7500BF-H |
| 3. | Regular Arm | 351-O | 4040 | 7500BF |
| 4. | HD Parallel Arm | 351-P10 | 4040EDA | PR7500BF |

B. Provide all closers on exterior openings with a stop arm, unless noted otherwise.

C. Provide all closers on interior openings with a regular arm or heavy duty parallel arm, unless noted otherwise.

D. Provide non-sized closers, adjustable to meet maximum opening force requirements of ADA.

E. Provide drop plates, brackets, or adapters for arms as required to suit details.

F. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors. Closers shall not be visible in corridors, lobbies and other public spaces unless necessary.

G. Provide back-check for closers.

H. Provide holder arms where indicated.

I. Provide stop arms where indicated.

J. Provide delayed action where indicated.

K. Provide closers for doors as noted in Hardware Groups and, in addition, provide closers for labeled doors whether or not specifically noted in group.

L. Provide closers meeting the requirements of UBC 7-2 and UL 10C positive pressure tests.

M. Provide bolt attachments or blocking for mineral core door application as directed by Engineer and/or door specifications.

**2.10 - STOPS AND HOLDERS**

A. Acceptable Manufacturers and Products:

| No. | Type | Rockwood | Hager | Donjo |
|---|---|---|---|---|
| 1. | Wall, convex | 406 | 232W | 1406 |
| 2. | Floor | 440/442 | 241F/243F | 1440/1442 |
| 3. | Floor, heavy duty | 470/471 | 267F267S | 1471 |
| 4. | Stop/Holder, heavy duty | 472/472 | 268F/268S | 1473 |

B.

C. Provide Rockwood #406 wall stop for each door leaf except where floor stops are scheduled in Hardware Groups. Where conditions do not allow a wall stop or a floor stop presents a tripping hazard than provide an overhead stop.

D. Provide 1540 Series overhead stop for interior doors and 590 Series overhead stop for exterior doors that swing more than 140 degrees before striking a wall.

E. Floor or base stops shall be used only where definitely specified or absolutely unavoidable.

**2.11 - THRESHOLDS**

A. Acceptable Manufacturers and Products:

| No. | Manufacturer | Interior Door Saddle Type | Exterior Door Stop Type |
|---|---|---|---|
| | | Series | Series |
| 1. | Pemko | 171 | 2000B |
| 2. | Reese | S205 | 5483 |
| 3. | National Guard | 425 | 896 |

B. Provide thresholds as indicated on drawings and as specified.

1. Refer to drawings for special details. Provide accessories, shims and fasteners.

2. Where thresholds occur at openings with one or more mullions, they shall be cut for the mullions and extended continuously for the entire opening.

**2.12 - WEATHERSTRIPPING**

A. Acceptable Manufacturers and Products:

| No. | Type | Pemko | Reese | National Guard |
|---|---|---|---|---|
| 1. | Sweeps | 315CN | 323 | 200N |
| 2. | Jambs | 316AV | DS75 | 152 |
| 3. | Astragals | 18061CP | 964C | C607 |
| 4. | Rain Drip | 346C | R201 | 16D |

B. Where weatherstripping is specified in hardware groups, provide 316AV at jambs, unless detailed or scheduled otherwise.

1. Provide self-tapping fasteners for weatherstripping being applied to hollow metal frames.

C. Where astragals are specified in hardware groups, provide 2 pieces of 18061CP unless detailed or scheduled otherwise.

D. Where sweeps are specified in hardware groups, provide 315CN unless detailed or scheduled otherwise.

E. Where rain drips are specified in hardware groups, provide 346C x full frame width, unless detailed otherwise.

**2.13 - GASKETING**

A. Acceptable Manufacturers and Products:

| No. | Type | Pemko | Reese | National Guard |
|---|---|---|---|---|
| 1. | Smoke | PK55D | F-897B | 2525 |

B.

C. Where smoke gasket is specified in hardware groups, provide PK55D, unless detailed otherwise.

D. Provide accessories, shims and fasteners.

E. Provide gaskets for 20-minute doors and doors designated for smoke and draft control.

F. Where frame applied intumescent seals are required by the manufacturer, provide gaskets that comply with UBC 7-2 and UL 10C positive pressure tests.

**2.14 - ASTRAGALS**

A. Acceptable Manufacturers:

1. Reese
2. Pemko
3. National Guard.

B. Provide overlapping type astragal (tee type) on key side of pair of doors.

C. Provide extruded aluminum overlapping type astragal (tee type) with integral (vertical groove) weathering gasket on key side of pairs of exterior doors.

**2.15 - SILENCERS**

A. Acceptable Manufacturers and Products:

| No. | Type | Westguard | Hager | Donjo |
|---|---|---|---|---|
| 1. | Hollow Metal Frame | 650ST | 307D | 1608 |
| 2. | Wood Frame | 640WD | 308D | 1609 |

B. Where weatherstipping or gasketing is not used provide the appropriate silencer for each frame.

**2.16 - FASTENERS**

A. Including, but not limited to, wood or machine screws, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware.

B. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.

C. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.

D. Install all hardware with only fasteners provided by the manufacturer for use with the specific product and according to the manufacturers written instructions.

**2.17 - TYPICAL FINISHES AND MATERIALS**

A. Finishes, unless otherwise specified:

1. Butts: Exterior Doors
   a. US32D (BHMA 630) on Stainless Steel
2. Butts: Interior Doors
   a. US32D (BHMA 630) on Stainless Steel
3. Flush Bolts:
   a. US26D (BHMA 626) on Brass or Bronze
4. Exit Devices:
   a. US32D (BHMA 630) on Stainless Steel

5. Locks and Latches:
   a. US32D (BHMA 630) on Stainless Steel
6. Coordinators:
   a. US26D (BHMA 626) on Brass or Bronze
7. Kick Plates:
   a. US32D (BHMA 630) on Stainless Steel
8. Closers: Surface mounted:
   a. Sprayed Aluminum Lacquer
9. Miscellaneous Hardware:
   a. US32D (BHMA 630) on Stainless Steel or US26D (BHMA 626) on Brass or Bronze

**2.18 – FLUSH BOLTS AND DUSTPROOF STRIKES**

A. Acceptable Manufacturers and Products:

| | Type | Rockwood | Hager | Donjo |
|---|---|---|---|---|
| 1. | Manual, Hollow Metal Doors | 555 | 282D | 1555 |
| 2. | Manual, Wood Doors | 555 | 282D | 1555 |
| 3. | Automatic, Hollow Metal Doors | 1842 | 292D | FLM-1 |
| 4. | Automatic, Wood Doors | 1942 | 291D | FLW-22 |
| 5. | Dust Proof Strike | 570 | 280X | 1570 |

B. Non-labeled Openings: Provide 2 flush bolts 555 for inactive leaf of pairs of locked and latched doors. Locate centerline of top bolt not more than 78 inches from finished floor. Provide dust proof strike 570 for bottom bolt.

C. Labeled Openings: Provide automatic flush bolt set 1842 or 1942, as applicable, for inactive leaf of pairs of doors. Provide dust proof strike 570 for bottom bolt.

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

B. Field verify existing doors, frames, hardware, and conditions prior to scheduling hardware.

**3.02 - INSTALLATION**

A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied. Remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.

B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.

C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).

F. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates with 3M adhesive #1357, as recommended by 3M Co., on lead-lined doors.

**3.03 - FIELD QUALITY CONTROL**

A. After installation has been completed, a qualified person from the hardware supplier is to check the Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of all hardware items.

B. Installer shall deliver to owner, upon completion, one set of installation and maintenance instructions and specialty tools for all hardware items.

**3.04 - ADJUSTING AND CLEANING**

A. At completion, hardware shall be left clean and free from disfigurement. Make adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.

B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.

C. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make/ check adjustments of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

E. Final Adjustment: Installer shall return six months after substantial completion to make final adjustments of all hardware items.

F. Installer shall instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.

G. Clean adjacent surfaces soiled by hardware installation.

**3.05 - PROTECTION**

A. Provide for proper protection of items of hardware until Owner accepts Project as complete.

**3.06 - HARDWARE GROUPS AND SUFFIXES**

A. The following schedule of hardware groups shall be considered a guide only, and the supplier is cautioned to refer to general conditions, special conditions, and the preamble to this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. Refer to the door schedule for special hardware notes, applications, and/or requirements.

**3.07 - HARDWARE GROUPS**

A. GROUP 10: Door # 101A, 101B, 101D: Exterior single egress with lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Entrance Function – F09. Latchbolt retracted by either side unless outside trim is locked by key inside. Key outside retracts latchbolt when outside trim is locked. |
| c. | Closer | 1 each | |
| d. | HD Floor Stop | 1 each | |
| e. | Threshold | 1 each | |
| f. | Weatherstripping | 1 set | |
| g. | Sweep | 1 each | |
| h. | Rain Drip | 1 each | |
| I | Kick Plate | 1 each | |

B. GROUP 20: Door # V-1A: Exterior single at storage room with lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Storeroom Function – F07. Latchbolt retracted by trim inside or key outside. Outside trim rigid at all times. |
| c. | Closer | 1 each | |
| d. | HD Floor Stop | 1 each | |
| e. | Threshold | 1 each | |
| f. | Weatherstripping | 1 set | |
| g. | Sweep | 1 each | |
| h. | Rain Drip | 1 each | |

C. GROUP 30: Door # 002, 010: Exterior single egress with exit device allowing entry.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 8813 ET. [F08 - Key locks or unlocks lever.] |
| c. | Closer | 1 each | |
| d. | Kick Plate | 1 each | |
| e. | HD Floor Stop | 1 each | |
| f. | Threshold | 1 each | |
| g. | Weatherstripping | 1 set | |
| h. | Sweep | 1 each | |
| i. | Rain Drip | 1 each | |

D. GROUP 40: Door # S1-A, S2-B: Exterior single egress with exit device, exit only.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 8810. [F01 – No outside operation.] |
| c. | Closer | 1 each | |
| d. | Kick Plate | 1 each | |
| e. | HD Floor Stop | 1 each | |
| f. | Threshold | 1 each | |
| g. | Weatherstripping | 1 set | |
| h. | Sweep | 1 each | |
| i. | Rain Drip | 1 each | |

E. GROUP 50: Door # 109B, 119A, 119B, CR-A: Exterior single at electric/utility room with exit device, exit only.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 8810. [F01 – No outside operation.] |
| c. | Closer | 1 each | with Holder/Stop Arm. |
| d. | Kick Plate | 1 each | |
| e. | HD Floor Stop | 1 each | |
| f. | Threshold | 1 each | |
| g. | Weatherstripping | 1 set | |
| h. | Sweep | 1 each | |
| i. | Rain Drip | 1 each | |

F. GROUP 60: Door # - NOT USED: Exterior pair at storage room with lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 6 each | |
| b. | Lockset | 1 each | Storeroom Function – F07. Latchbolt retracted by trim inside or key outside. Outside trim rigid at all times. |
| c. | Closers | 2 each | |
| d. | Flush Bolts | 2 each | |
| e. | Coordinator | 1 each | |
| f. | HD Floor Stops | 2 each | |
| g. | Threshold | 1 each | |
| h. | Weatherstripping | 1 set | |
| i. | Sweeps | 2 each | |
| j. | Rain Drip | 1 each | |
| k. | Astragal | 1 each | Provide on key side and on active leaf. |

G. GROUP 70: Door # - NOT USED: Exterior egress pair with exit devices allowing entry at one leaf.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 6 each | |
| b. | Exit Device | 1 each | 8813 ET. [F08 – Key locks or unlocks lever.] |
| c. | Exit Device | 1 each | 8810. [F01 – No outside operation.] |
| d. | Keyed Removable Mullion | 1 each | 12-L980 Steel |
| e. | Closers | 2 each | |
| f. | Kick Plates | 2 each | |
| g. | HD Floor Stops | 2 each | |
| h. | Threshold | 1 each | |
| i. | Weatherstripping | 2 sets | |
| j. | Sweeps | 2 each | |
| k. | Rain Drip | 1 each | |

H. GROUP 80: Door # 011: Rated egress pair with exit devices allowing entry at one leaf.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 6 each | |
| b. | Exit Device | 1 each | 8813 ET. [F08 – Key locks or unlocks lever.] |
| c. | Exit Device | 1 each | 8810. [F01 – No outside operation.] |
| d. | Keyed Removable Mullion | 1 each | 12-L980 Steel |
| e. | Closers | 2 each | |
| f. | Kick Plates | 2 each | |
| g. | HD Floor Stops | 2 each | |
| h. | Threshold | 1 each | |
| i. | Weatherstripping | 2 sets | |
| j. | Sweeps | 2 each | |

I. GROUP 90: Door # 104B, 117A, 135A, 118A, 108B: Exterior pair at electric/utility room with exit device, exit only.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 6 each | |
| b. | Exit Device | 2 each | 8810. [F01 – No outside operation.] |
| c. | Keyed Removable Mullion | 1 each | 12-L980 Steel |
| d. | Closers | 2 each | With Holder/Stop Arm |
| e. | Kick Plates | 2 each | |
| f. | HD Floor Stops | 2 each | |
| g. | Threshold | 1 each | |
| h. | Weatherstripping | 2 sets | |
| i. | Sweeps | 2 each | |
| j. | Rain Drip | 1 each | |

J. GROUP 100: Door # - NOT USED: Interior non-rated single with passage function.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Passage | 1 each | Passage Function – F01. Latchbolt retracted by either trim. |
| c. | Stop | 1 each | |
| d. | Silencers | 3 each | |

K. GROUP 105: Door # V-1B: Interior rated single with passage function.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Passage | 1 each | Passage Function – F01. Latchbolt retracted by either trim. |
| c. | Closer | 1 each | |
| d. | Stop | 1 each | |
| e. | Silencers | 3 each | |

L. GROUP 110: Door # - NOT USED: Interior non-rated and rated single bathrooms.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Privacy | 1 each | Passage Function – F22. Latchbolt retracted by either trim. Turn lever automatically locks outside lever. Operating inside trim automatically retracts latchbolt, unlocking outside trim. Outside emergency release unlocks outside trim. Will automatically unlock when door latches. |
| c. | Closer | 1 each | |
| d. | Stop | 1 each | |
| e. | Silencers | 3 each | |

M. GROUP 120: Door # 111A, 111B, 113A, 113B: Interior non-rated multi-toilet rooms.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Deadlock | 1 each | Classroom Function – F??. Deadbolt operated from outside by key. Turn lever inside retracts deadbolt, but will not project it. |
| c. | Push Plate | 1 each | |
| d. | Pull Plate | 1 each | |
| e. | Closer | 1 each | |
| f. | Kick Plate | 1 each | |
| g. | Stop | 1 each | |
| h. | Silencers | 3 each | |

N. GROUP 130: Door # 115A, 116A: Interior non-rated single with office function lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Office Function – F04. Latchbolt retracted by either trim unless outside trim is locked by toggle in lock front. Key outside retracts latchbolt when outside trim is locked. |
| c. | Stop | 1 each | |
| d. | Silencers | 3 each | |

O. GROUP 135: Door # 102A: Interior rated single with office function lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Office Function – F04. Latchbolt retracted by either trim unless outside trim is locked by toggle in lock front. Key outside retracts latchbolt when outside trim is locked. |
| c. | Closer | 1 each | |
| d. | Stop | 1 each | |
| e. | Silencers | 3 each | |

P. GROUP 140: Door # - NOT USED: Interior non-rated single with classroom function lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Deadlock | 1 each | Classroom Function – F05. Latchbolt retracted by either trim unless outside trim is locked by key. Key outside locks or unlocks outside trim. Inside trim always operative. |
| c. | Stop | 1 each | |
| d. | Silencers | 3 each | |

Q. GROUP 145: Door # 104A: Interior rated single with classroom function lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Classroom Function – F05. Latchbolt retracted by either trim unless outside trim is locked by key. Key outside locks or unlocks outside trim. Inside trim always operative. |
| c. | Closer | 1 each | |
| d. | Stop | 1 each | |
| e. | Silencers | 3 each | |

R. GROUP 150: Door # - NOT USED: Interior non-rated and rated single with storeroom function lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Lockset | 1 each | Storeroom Function – F07. Latchbolt retracted by trim inside or key outside. Outside trim rigid at all times. |
| c. | Closer | 1 each | |
| d. | Stop | 1 each | |
| e. | Silencers | 3 each | |

S. GROUP 160: Door # 103A, 105A, 106A, 107A: Interior non-rated single corridor with exit device with classroom function.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 8813 ET. [F08 – Key locks or unlocks lever.] |
| c. | Closer | 1 each | |
| d. | Kick Plate | 1 each | |
| e. | Stop | 1 each | |
| f. | Silencers | 3 each | |

T. GROUP 165: Door # S1-C, S2-C, 104A, S1-B, S2-B, 108A: Interior rated single corridor and stairs with exit device with classroom function.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 12-8813 ET. [F08 – Key locks or unlocks lever.] |
| c. | Closer | 1 each | |
| d. | Kick Plate | 1 each | |
| e. | Stop | 1 each | |
| f. | Silencers | 3 each | |

U. GROUP 170: Door # 109A: Interior rated single electrical/utility room with exit device with storeroom function.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 3 each | |
| b. | Exit Device | 1 each | 12-8813 ET. [F03 – Key retracts latchbolt.] |
| c. | Closer | 1 each | |
| d. | Kick Plate | 1 each | |
| e. | Stop | 1 each | |
| f. | Silencers | 3 each | |

V. GROUP 180: Door #110A, 120A, 120B, 130A: Interior non-rated and rated non-egress pair with lockset.

1. Hardware:

| | Type | Quantity | Comments |
|---|---|---|---|
| a. | Hinges | 6 each | |
| b. | Lockset | 1 each | Storeroom Function – F07. Latchbolt retracted by trim inside or key outside. Outside trim rigid at all times. |
| c. | Closers | 2 each | |
| d. | Flush Bolts | 2 each | |
| e. | Coordinator | 1 each | |
| f. | Stops | 2 each | |
| g. | Silencers | 2 each | |
| h. | Astragal | 1 each | Provide on key side and on active leaf. |

W. GROUP 200: Door # 013, 014, 015, 016, 101C, 101F, 102B: Overhead and Sectional Doors.

1. All Hardware by Overhead and Sectional Door Manufacturers as applicable

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 08810**

**GLASS AND GLAZING**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 8, DOORS AND WINDOWS shall include the complete Work specified in all of the following Sections:

1. SECTION 08810, GLASS AND GLAZING

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of DIVISION 8, DOORS AND WINDOWS for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-304 | 10 A-305 | 10 A-401 | 10 A-402 | 10 A-403 | 10 A-404 | 10 A-405 |
| 10 A-406 | 10 A-407 | 10 A-602 | 10 A-603 | 10 A-604 | 10 A-607 | |

2. The Work of DIVISION 8, DOORS AND WINDOWS for Alternative A-1 is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 20 A-101 | 20 A-201 | 20 A-202 | 20 A-301 | 20 A-302 | 20 A-401 |
| 20 A-601 | 20 A-602 | 20 A-603 | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

2. Subbid for: SECTION 08810, GLASS AND GLAZING

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide and set glass required to complete glazing at interior windows as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's specification for glass and glazing materials and working drawings showing methods of glazing installation.

2. Samples:

a. Glass samples not less than 6 in. square.

b. Three properly labeled samples of each type of glass and glazing material for review.

3. Manufacturer's certification that materials meet or exceed specifications requirements.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver each pane of glass affixed with manufacturer's labels; do not remove labels prior to installation, inspection or final acceptance.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Fire-rated, clear and wireless glazing material for use in locations such as doors, sidelites, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45 minutes to 2 hours with required hose stream test; for use in interior and exterior applications

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Requirements of Regulatory Agencies: Provide glass installation meeting requirements of applicable state and local codes.

C. Design Criteria:

1. Exterior Glass and Glazing:

a. Provide exterior glass and glazing capable of withstanding wind loads as specified.

b. Provide watertight glass and glazing systems.

D. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 degrees F (250 degrees C), and the fire-resistance rating in minutes

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. Z97.1: Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

B. American Society for Testing and Materials (ASTM) Publications:

1. C1036: Specification for Flat Glass.

2. C1048: Specification for Heat Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

3. C1172: Specification for Laminated Architectural Flat Glass.

4. E773/774: Specification for Sealed Insulating Glass Units.

C. ASTM E 119: Fire Tests of Building Construction and Material

D. National Fire Protection Association (NFPA)

1. NFPA 80: Fire Doors and Window

**1.09 - JOB CONDITIONS**

A. Apply glazing compounds on dry surfaces, at temperatures above 40 degrees F.

## PART 2 - PRODUCTS

### 2.01 - GLASS MATERIALS

A. General:

1. Safety glass conforming to ASTM C1048 and ANSI Z97.1.
2. Glass Thickness:
    a. Provide glass thicknesses as specified unless accepted glass manufacturer recommends greater thickness to meet windload requirements.
    b. Provide glass in adjacent windows or glazed panels of same thickness unless shown otherwise.

### 2.02 - GLASS TYPES

A. Exterior Insulating Glass Units:

1. 1/4-in. float glass.
2. Solar control low-e type.
3. 1-in. overall thickness of unit.
4. Low-e coating to be applied to the number two (2) surface for clear windows.
5. Winter night time u-value equal to or less than .29.
6. Clear class with visible light transmission of 69%.

B. Interior Glass Units:

1. Laminated Safety Glass:
    a. 1/4-in clear laminated glass conforming ASTM C1036 and C1172, Type 1 – Flat.
    b. Construction shall consist of two sheets of 1/8-in. thick, clear floatglass bonded to interlayer of polyvinyl butyral plastic sheeting.
    c. Glazing: Conform to glass manufacturer’s printed instructions with regard to sealant, setting blocks, glazing tapes and heel beads.
2. Fire-resistive glazing products.
    a. Products:
        (1) Basis of Design: Oldcastle Glass, Inc.; Pyroguard
        (2) Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated
    b. Fire-Protection-Rated Glazing: Glass Type: 90-minute fire-rated glazing; film-faced ceramic glazing or laminated ceramic glazing. Provide safety glazing labeling OH-90
    c. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

### 2.03 - GLAZING SYSTEM COMPONENTS FOR METAL WINDOWS

A. Provide glazing tape, heel bead sealant, removable snap-on metal glazing bead. Furnish components in color approximating window finish.

**2.04 - ELASTIC GLAZING COMPOUND**

A. Channel Glazing and Face Glazing Manufacturers:

1. 795 manufactured by Dow.
2. 895 manufactured by Pecora Corporation.
3. Spectrum 2c manufactured by Tremco Manufacturing Co.
4. Or acceptable equivalent product.

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Check openings and glazing channels scheduled to receive glass: Free of projections, burrs, irregularities, and debris and other defects that would affect glass or plastic and glazing materials.

B. Inspect glass for edge damage or face imperfections.

C. Correct defects before glazing.

**3.02 - PREPARATION**

A. Examine frames receiving glass or plastic sheet to ensure if clean and dry.

B. Verify sealants are compatible with glazing materials.

C. Remove oil and dust from glass and plastic materials by wiping clean immediately prior to installation.

D. Use solvents to remove protective coatings or film from aluminum surfaces, that neither etches nor mars surfaces.

**3.03 - GLAZING**

A. General:

1. Conform to Flat Glass Marketing Association's "Glazing Manual", manufacturer's recommendations and accepted working drawings.
2. Do not glaze when temperature is below 40 degrees F.
3. Glaze doors and operating windows in closed position.
4. Maintain edge clearance, in accordance with manufacturers recommendation, from perimeter of glass to inside of rabbet.
5. Maintain minimum 1/8-in. clearance between faces of glass and plastic and adjacent stop or bead.
6. If any glass dimension exceeds 50 inches, provide setting blocks at the sill and spacer shims on other edges.
7. Clean and dry glazing rabbets, glass edges, and applied stops before glazing.
8. Glaze windows neatly and evenly.
9. Do not extend glazing tapes and glazing compounds over edges of glazing stops.
10. Do not apply glazing tapes and glazing compounds more than 1/32 in. under edges of glazing stops.

B. Vision Panels:

1. Double glazed with applied glazing beads and elastic glazing compound.
2. Minimum edge clearance of glass: 1/4-in. all around.
3. Minimum face clearance of glass: 1/8-in. from sash rabbet, all around.

**3.04 - GLASS REPLACEMENT**

A. Replace broken, scratched or damaged glass due to faulty materials or installation with new glass, at no additional cost to the Owner.

**3.05 - PROTECTION**

A. Protect installed glass and plastic against breakage, damage from sandblasting, welding spatter or other sources.

**3.06 - CLEANING**

A. Clean glass and surrounding surfaces of spatter and blemishes resulting from glazing operations.

B. Prior to final acceptance clean and polish lights inside and outside.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 08920**

**TRANSLUCENT WALL PANELS**

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## PART 1 - GENERAL

### 1.01 - DESCRIPTION

A. Provide exterior translucent panel-unit walls as indicated and specified.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENTS AND PAYMENT.

B. The Work of this section requires the Contractor to perform all Work specified under this section.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Submit manufacturer's product data, specifications and installation instructions.

2. Submit completely detailed shop and erection drawings. Indicate alloy, temper, and finish for aluminum work.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

B. Deliver panels to the site in rigid structural units and store off the ground.

C. Cover panels to protect from weather and damage from accumulation of cement, mortar and other building materials.

D. Store with operating sash in closed position.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Products shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All panels shall be provided by the same manufacturer.

C. QUALITY ASSURANCE

1. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

2. Conform to quality assurance programs, supplemented by independent laboratory inspections, monitored by the International Conference of Building Officials (I.C.B.O.) and the following performance characteristics.

a. Thermal requirement: Provide in accordance with applicable current IECC requirements.

b. Tensile strength: Minimum 750 psi by ASTM C-297 after two exposures to six cycles each of the severe aging conditions prescribed by ASTM D-1037.

c. Flamespread and smoke development: Interior flamespread - maximum 45; and smoke development - maximum 350 by ASTM E-84.

d. “U” Factor: Minimum of 0.53.

e. Wind Load Requirement: Panel system and fasteners to withstand a wind load as shown on Drawing 00 S-002, STRUCTURAL NOTES II.

**1.07 - REFERENCES**

A. Aluminum Association Standard Anodic Finish (AASA).

B. American Society for Testing and Materials (ASTM) Publications:

1. C236: Test Method for Steady-State Thermal Performance of Building Assemblies by Means of Guarded Hot Box.
2. C297: Method for Tension Test of Flat Sandwich Construction in Flatwise Plane.
3. D1037: Method for Evaluating the properties of Wood-Base Fiber and Particle Panel Materials.
4. E84: Test Method for Surface Burning Characteristics of Building Materials.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Manufacturer:

1. Kalwall Corporation.
2. Or acceptable equivalent product.

B. Face Sheets:

1. Fiber glass reinforced polyester of uniform color and thickness.
2. Exterior and interior face sheets shall have thickness with a variation in thickness not greater than plus or minus 10 percent capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.
3. Color: As selected by Architect from manufacturer's full range of industry colors.
4. Exterior and interior faces given a special factory-applied acrylic protective surface of 1.2 mils minimum thickness for resistance to erosion, weather and chemical action.
5. Exterior and interior face sheets 0.060-in. thick with a variation in thickness not greater than plus or minus 10 percent.
6. Color:
   a. Exterior sheets: Bronze.
   b. Interior sheets: Crystal.
7. Panel thickness: 2-3/4-in.
8. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
9. Face sheets shall not deform, deflect or drip when subjected to fire or flame.

C. Laminate Adhesive:

1. Provide waterproof resin type especially compounded for use in laminating plastic sheets to aluminum.
   a. Capable of withstanding impact and temperature shock normally encountered in exterior construction.
   b. Color: Black.
2. Initial bond between face and core a minimum tensile strength of 700 psi in accordance with ASTM C297.

D. Grid Core:

1. Constructed of 6063-T6 aluminum I-beams with 7/16-in. flange width.

a. Mechanically interlocked to provide even mullion-muntin intersection.

b. Principle members: tensile strength of 22,000 psi.

2. Exposed surfaces given an AASA C22A31 clean anodized finish.

E. Perimeter Closures:

1. Fabricated of aluminum alloy 6063-T5.

2. Screw clamp type closure system furnished with No. 410 Type A stainless steel screws.

4. Exposed surfaces given a factory finish fluoropolymer system exceeding the requirements of AAMA 2604. Finish in “White”

F. Sealing Tape:

1. One-way elastic sealing tape with extruded butyl compound.

2. Factory-applied to system.

**2.02 - CONSTRUCTION**

A. Provide preassembled panels and operating sash and sealed into units at the factory.

B. Grid pattern: 12-in. by 24-in. "shoji."

C. Cover entire width of I-beams with adhesive to assure maximum bonding strength.

1. For complete bond: no more than four white spots allowed at intersections of muntins and mullions for each 40 sq. ft. of panel, nor any white spot more than 3/64-in. in width.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install panel-unit walls with factory-trained workmen experienced in the installation of structures of the type specified.

B. Install in strict accordance with the accepted shop drawings and manufacturer's printed instructions, within the standards and tolerances of the translucent wall panel industry.

C. Install plumb, level, straight and square at the correct elevation and plane.

D. Check sash for proper operation.

**3.02 - PROTECTION AND CLEANING**

A. Remove shipping protective coverings.

B. Clean aluminum and panels.

C. Replace damaged panels at no additional cost to Owner. Leave work in proper condition.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 09200**

**FURRING AND GYPSUM CEILING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Furring and Gypsum Ceiling as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Complete materials list of items proposed to be provided.
2. Manufacturer’s product data and specifications.
3. Manufacturer’s recommended installation procedures.

C. Samples:

1. Submit two samples, 12 x 12 inch in size illustrating gypsum material and finish.
2. Submit two samples, 12 x 12 inch in size illustrating control joint materials and finish.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Deliver manufactured materials in original packages, or containers, bearing the name of the manufacturer and the brand.

E. Store materials in an enclosed dry area, off the ground, under cover until ready to be used.

F. Protect metal materials against rusting, deformation, and breakage.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Perform Work in accordance with ASTM C841, GA-600, NAAMM ML/SFA 540, NAAMM ML/SFA 920, and ASTM C1063.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. C150: Standard Specification for Portland Cement.
2. C206: Specification for Finishing Hydrated Lime.
3. C841: Specification for Installation of Interior Lathing and Furring.
4. C847: Specification for Metal Lath.
5. C897: Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
6. C933: Standard Specification for Welded Wire Lath
7. C1002: Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
8. C1063: Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster

B. Gypsum Association (GA):

1. 600: Fire Resistance Design Manual Sound Control

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. ML/SFA540: Lightweight Steel Framing Systems
2. ML/SFA920: Specifications for Metal Lathing and Furring

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SYSTEM DESCRIPTION**

A. Horizontal Finish Surface Deflection: Ceiling and soffit framing to limit finish surface to 1:240 deflection under superimposed dead loads and wind uplift.

**1.10 - QUALIFICATIONS**

A. Installer: Company specializing in performing the Work of this section with minimum three years of experience.

**1.11 - PRE-INSTALLATION MEETING**

A. Convene minimum one week prior to commencing Work of this section.

## PART 2 - PRODUCTS

### 2.01 - NON-LOAD-BEARING METAL FURRING AND GYPSUM CEILING

A. Manufacturers:

1. United States Gypsum USG.
2. Gold Bond Building Products Div., National Gypsum.
3. Domtar Gypsum.
4. Alabama Metal Industries Corp.
5. Dale Industries.
6. Larsen Products Corp.
7. National Gypsum Co.

B. Furnish materials in accordance with applicable Massachusetts standards.

### 2.02 - COMPONENTS

A. Furring Channels: Formed steel; minimum 0.020 inch thick, 3/8 -inch deep x 7/8 -inch high; length as required, splicing permitted; galvanized.

B. Hangers: Galvanized rolled steel sections, of size and type to suit application, to rigidly support ceiling components in place to deflection limits as indicated; galvanized.

C. Control Joint Accessories: formed sheet steel; accordion profile, 2 inch expanded metal flanges each side; galvanized manufactured by.

### 2.03 - ACCESSORIES

A. Access Panels, Non-Fire Rated, In Plaster on Metal Furring: Formed galvanized steel.

B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.

C. Fasteners: ASTM C1002, self drilling, self tapping screws.

D. Polyethylene Sheet: Clear, 6 mil thick.

E. Tie Wire: Annealed galvanized steel.

## PART 3 - EXECUTION

### 3.01 - EXAMINATION

A. Verify that surface conditions are ready to receive work.

### 3.02 - INSTALLATION

A. Ceiling and Soffit Framing:

1. Install furring: Erect after above ceiling or soffit work is complete. Coordinate location of hangers with other work.
2. Install furring independent of walls, columns, and above ceiling work.
3. Securely anchor hangers to structural members or embed in structural slab. Space hangers to achieve deflection limits indicated.
4. Space main carrying channels at maximum 72 inch centers; not more than 2 inch from wall surfaces. Lap splice securely.

5. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

6. Place furring channels perpendicular to carrying channels, not more than 2 inch from perimeter walls, and rigidly secure. Lap splice securely.

B. Control Joints:

1. Install control joints.

2. Control Joint Spacing: 12 feet o.c. and located as indicated on the drawings.

C. Access Panels:

1. Coordinate work with installation of metal access panels.

**3.03 - WORKMANSHIP**

A. Make good by patching any damaged plastering before final acceptance of the work.

B. Protect plaster from premature drying out and from frost.

C. Plastering with cracks, blisters, pits or discolorations not acceptable.

D. Provide plastering in a clean and workmanlike manner in every respect.

E. Protect finished work of other trades from damage during the entire plastering operation.

**3.04 - ERECTION TOLERANCES**

A. Maximum Variation from True Lines and Levels: 1/8-inch in 10 feet.

B. Maximum Variation from True Position: 1/8-inch.

**3.05 - CLOSEOUT ACTIVITIES**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09250**

**DRYWALL CONSTRUCTION**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Metal Stud Partitions, Gypsum Wallboard, Joint Treatment Finish, And Sound Attenuation Batts as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's product data and specifications.

2. Complete list of interior trim to be provided.

3. Submit levels for finishing gypsum board in compliance with specified requirements.

4. Manufacturer's printed installation instructions.

5. Recycled Content Submittals:

a. For products having recycled content, documentation indicating specified percentages by weight of postconsumer and preconsumer recycled content.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials in original packaging with manufacturer's labels indicating brand name and fire rating, legible and intact.

E. Store materials at the jobsite in original packaging in enclosed shelter providing protection from damage and exposure to the elements.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. C630: Specification for Water-Resistant Gypsum Backing Board.
2. C645: Specification for Nonstructural Steel Framing Members.
3. C665: Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
4. C840: Specification for Application and Finishing Gypsum Board.
5. C1002: Steel Drill Screws for the Application of Gypsum Board.
6. C1047: Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
7. C1396: Standard Specification for Gypsum Board
8. E84: Specification for Surface Burning Characteristics of Building Materials.

B. Underwriter's Laboratories, Inc. (UL) Publication:

1. UL-05: Fire Resistance Directory.

C. Gypsum Association (GA) Publication:

1. GA-600: Fire Resistance Design Manual.

D. Factory Mutual System (FM):

1. FM-02: Specification for Tested Products Guide.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - ENVIRONMENTAL CONDITIONS:**

A. Temperature:

1. Maintain temperature range between 55 and 70 degrees F (13 to 21 degrees C) for 24 hours before, during and after gypsum wallboard and joint treatment application during cold weather.

B. Ventilation:

1. Provide ventilation during the adhesives and joint treatment applications, using temporary air circulators in enclosed areas lacking natural ventilation.
2. Allow additional drying time between coats of joint treatment under slow drying conditions.
3. Protect installed materials from drafts during hot, dry weather.

## PART 2 - PRODUCTS

### 2.01 - MANUFACTURERS

A. National Gypsum Company.

B. United States Gypsum.

C. Georgia Pacific.

D. Or an acceptable equivalent product.

### 2.02 - GYPSUM WALLBOARD

A. Gypsum Wallboard: ASTM C1396.

1. Regular: 5/8-in. thick with tapered joints, 48-inches wide.

2. Fire resistant core: Type X, 5/8-in. thick with tapered joints, 48-inches wide.

B. Water-Resistant Gypsum Backing Board: ASTM C1396.

1. Water-resistant: 5/8-in. thick with tapered joints, 48-inches wide.

2. Water-resistant with fire resistant core: 5/8-in. thick with tapered joints, 48-inches wide.

C. Provide wallboard in maximum lengths to minimize horizontal joints exposed to view in areas.

D. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of eight (8) percent by weight.

### 2.03 - METAL DRYWALL STUDS

A. Metal Drywall Studs: ASTM C645, non-load bearing, (2-1/2-in.) (3-5/8-in.) (4-in.) (6-in.) wide screw studs roll-formed C-sections from 20-gage hot-dip galvanized steel.

1. Deep-Leg Deflection Track: ASTM C 645 top runner allowing ¾-inch deflection, formed from 20-ga. hot-dip galvanized steel.

2. Firestop Track: Top runner manufactured to allow partition heads to expand and contract and movement of the structure while maintaining continuity of fire- resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Fire Trak Corp.; Fire Trak, or equal.

B. Metal Drywall Studs: ASTM C645, non-load bearing, 4-in. wide screw studs roll-formed CH-sections or 6-in. wide E-sections from 20 gage hot-dip galvanized steel.

C. Runners: Width to match studs, formed from 25-ga. hot-dip galvanized steel.

D. Fasteners:

1. Drywall screws: Conform to ASTM C1002 for Type S Buglehead.

a. 1-1/8-in. long for 5/8-in. single layer application to steel studs and runners.

b. 1-5/8-in. long for 5/8-in. double layer application to steel studs and runners.

2. Studs to runners: 7/16-in. Type S12 Panhead screws.

3. Studs to door frames: 5/8-in. S12 low profile head screws.

4. Runners to concrete: 3/16-in. by 1-5/8-in. Acorn Slotted HWH Tapcon fastener.

E. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

**2.04 - JOINT TREATMENT MATERIALS**

A. General: Comply with ASTM C475.

B. Joint Tape: Embedding, tape as furnished by the manufacturer of the gypsum board.

C. Joint Compound: Ready-mixed nonasbestos, vinyl-based formulation as furnished by the manufacturer of the gypsum board.

**2.05 - TRIM ACCESSORIES**

A. Corner Beads: Hot-dip galvanized steel reinforcement for external corners with 1-1/4-in. by 1-14/-in. wide flanges conforming to ASTM C1047.

B. Control Joints: Hot-dip galvanized conforming to ASTM C1047.

**2.06 - AUXILIARY MATERIALS**

A. Sound Attenuation Blankets: Unfaced fiber glass batts conforming to ASTM C665, Type 1.

1. Fire-Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Provide in thickness and width to match drywall stud unless otherwise noted.

3. Recycled Content: Provide sound attenuation blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of twenty-eight (28) percent by weight.

B. Sealant: Provided by manufacturer of gypsum wallboard.

C. Adhesive: As recommended by manufacturer of gypsum wallboard.

**PART 3 - EXECUTION**

**3.01 - STUD ERECTION**

A. Attach steel runners at floor and ceiling to structural elements.

1. Locate fasteners 2-in. from each end and space 16-in. on centers between.

B. Erect studs vertically, engaging floor and ceiling runners.

1. Space 16-in. on centers, plumb and in alignment.

2. Install headers, fabricated from runners, over all openings and fasten with metal lock fasteners or screws.

3. Double studs at jambs of wide openings and where doors are used.

4. Install horizontal stiffeners and additional members to support wall-mounted items.

**3.02 - GYPSUM WALLBOARD INSTALLATION**

A. Single-Layer Screw Attachment: ASTM C840.

1. Apply single layer of 5/8-in. thick regular or water-resistant gypsum backing board parallel to studs on both sides except at pipe chases.

2. Stagger joints on opposite sides of partitions.

3. Space screws 16-in. on centers in field and at joints.

4. Installation of ceramic tile on water-resistant gypsum backing board specified in SECTION 09300, CERAMIC TILE.

5. Install sound attenuation batts in interior partitions and on ceilings where indicated and as specified.

B. Double-Layer Screw Attachment: Where fire-rated gypsum board construction is indicated, provide materials and application methods, including types and spacing of fasteners in accordance with fire ratings indicated.

1. Install base layer of 5/8-in. thick fire-rated gypsum wallboard parallel to studs.
   a. Space screws 16-in. on centers in field and at joints.
   b. Stagger joints on opposite sides of partitions.
2. Install finish layer of 5/8-in. thick fire-rated gypsum wallboard parallel to studs.
   a. Space screws 16-in. on centers at joints and in field, and 12-in. on centers at runners.
   b. Offset joints from base layer joints.
   c. Calk perimeter of partitions.

C. Control Joints: Install control joints in accordance with ASTM C840.

1. Control-Joint Locations:
   a. Ceilings:
      (1) Install control joints in areas exceeding 2500 sq. ft. (232 sq. m).
      (2) Space control joints not more than 50 feet (15.2 m) o.c.
      (3) Install control joints where ceiling framing or furring changes directions.
      (4) Install Control Joint in locations indicated on the drawings.
2. Partitions and Furring:
   a. Install control joints in partitions and wall furring runs exceeding 30 feet (9.1 m).
      (1) Space control joints not more than 30 feet (9.1 m) o.c.
      (2) Install control joints in furred assemblies where control joints occur in base exterior wall.
      (3) Install Control Joint in locations indicated on the drawings.

D. Schedule:

1. Provide 5/8-in. thick regular gypsum wallboard as indicated.
2. Provide 5/8-in. thick fire-resistant core gypsum wallboard for fire rated walls and partitions as indicated.
3. Provide 5/8-in. thick water-resistant gypsum backing board for installation of ceramic tile as indicated.
4. Provide 5/8-in. thick water-resistant gypsum backing board with fire resistant core as indicated.

**3.03 - FINISHING GYPSUM BOARD**

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for finish. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, (rounded or beveled edges), and damaged surfaces areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas and concealed areas.
2. Level 2: Surfaces that are substrate for tile.
3. Level 4: At surfaces that will be exposed to view, unless otherwise indicated.
   a. Primer and its application to surfaces are specified in SECTION 09941, FIELD PAINTING.

E. Seal opening around pipes, fixtures and other items projecting through gypsum wallboard. Apply sealant material with exposed surface flush with gypsum wallboard.

F. Finish metal corner beads and screw depressions with three coats of joint compound allowing proper drying time between coats.

G. Feather out joints onto panel face and sand smooth.

**3.04 - PATCHING**

A. Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive specified finish.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09300**

**TILE WORK**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 9, FINISHES shall include the complete Work specified in all of the following Sections:

1. SECTION 09300, TILE WORK

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

D. Reference Drawings

1. The Work of SECTION 09300, TILE WORK is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 A-001 | 10 A-102 | 10 A-104 | 10 A-301 | 10 A-408 | 10 A-409 | 10 A-601 |
| 10 A-602 | 10 A-605 | 10 A-606 | 99 A-607 | 00 M-001 | 10 M-104 | 10 M-107 |
| 99 M-501 | 99 M-502 | 00 P-001 | 00 P-002 | 10 P-103 | 10 P-104 | `10 P-105 |
| 10 P-106 | 10 P-107 | 10 P-108 | 10 P-109 | 99 P-501 | 99 P-502 | 00 E-001 |
| 10 E-202 | 10 E-205 | | | | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 09300, TILE WORK

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-01

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified

**1.01 - SCOPE**

G. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Modular Tile as specified herein and/or as shown on the Contract Drawings.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS:

B. Product data for each item specified, including installation instructions.
Samples: Submit representative samples of tile specified or proposed for use to Engineer/Architect for review and tests before materials are purchased. Materials delivered shall conform to submitted samples, subject to normal variation for quality of product specified.

C. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

D. Submittals required under this section include, but are not limited to the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in tiles.

2. tile type, color, and dye lot.

3. Type of subfloor.

4. Type of installation.

5. Pattern of installation.

6. Pattern type, location, and direction.

7. Type, color, and location of insets and borders.

8. Type, color, and location of edge, transition, and other accessory strips.

9. Transition details to other flooring materials.

E. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Tile: Full-size Sample.

2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.

F. Product Schedule: For tile. Use same designations indicated on Drawings.

G. Certificate of Compliance:

1. Submit certified test reports that modular tile meets all the performance requirements stated in paragraph 1.5 Performance Requirements. Submit certified test reports from a NVLAP Certified Lab that tile meets all performance criteria.

H. Qualification Data: For Installer.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

J. Maintenance Data: For tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

2. Precautions for cleaning materials and methods that could be detrimental to tile.

K. Warranty: Special warranty specified in this Section.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with Section 01610 and as specified

B. Deliver materials in manufacturer's original sealed container bearing standard grade-seal in accordance with ANSI A137 and with seals unbroken.

C. Deliver dry-set mortar in sealed, moisture proof containers.

D. Handle tile in manner to prevent chipping and breakage.

E. Store materials away from moisture and under cover in manner to prevent damage or contamination.

F. Extra stock:

1. For replacement and maintenances purposes, furnish, and deliver to Owner's maintenance department, additional ceramic tile materials of each size, color, pattern and type from same runs as actually used on job and in quantities as follows.

2. Not less than 5 percent of total amount used.

G. Provide sufficient amount of mortar and grout materials for proper installation of extra stock

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

C. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648, Class 1, by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

D. Mockups: Before installing tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

E. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to review methods and procedures related to tile installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.

2. Review ambient conditions and ventilation procedures.

**1.08 - WARRANTY**

A. Special Warranty for Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, more than 10 percent loss of bind strength, dimensional stability, excess static discharge, and delamination.

3. Warranty Period: From date of Substantial Completion - Lifetime limited stain warranty, lifetime limited modular warranty, lifetime limited colorfastness to light warranty, lifetime static warranty, 10 year limited colorfastness to atmospheric contaminants, and 10 year stain warranty.

**1.09 - REFERENCES**

A. ANSI A108.1: Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed with Portland Cement Mortar.

B. ANSI A108.4: Installation of Ceramic Tile with Organic Adhesives or Water Cleanable.

C. ANSI A108.5: Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

D. ANSI A118.1: Dry-Set Portland Cement Mortar Standard.

E. ANSI A137.1: Specification for Ceramic Tile.

F. ASTM C144: Specification for Aggregate for Masonry Mortar.

G. ASTM C150: Specification for Portland Cement.

H. ASTM C206: Specification for Finishing Hydrated Lime.

I. ASTM C207: Specification for Hydrated Lime for Masonry Purposes.

J. TCA, Tile Council of America, Inc

**1.10 - PROJECT CONDITIONS**

K. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

L. Environmental Limitations: Do not install tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

M. Do not install tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by tile manufacturer.

N. Where demountable partitions or other items are indicated for installation on top of tiles, install tiles before installing these items.

**1.11 - EXTRA MATERIALS**

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile: Full-size units equal to 5 percent of amount installed for each type indicated.

**PART 2 - PRODUCTS**

**2.01 - TILE (CPT)**

A. Glazed Ceramic Wall Tiles: Standard-grade, cushion-edged, 4-1/4-in. square, 5/16-in. thick, nonvitreous body, glaze tiles. Tile shall exhibit no cracking or crazing when subjected to standard autoclave (accelerated steam) test. Colors will be selected by Engineer. Provide surface bullnoses and other special shapes for thin-setting bed installation to produce a complete, neatly finished installation, as indicated on drawings.

B. Ceramic Mosaic Floor Tile: Standard grade, dust-pressed, unglazed porcelain type, cushion edged, and paper back-mounted or paper face-mounted. Tiles shall be approximately ____ by ____ by 1/4-in. thick. Colors will be selected by Engineer. Tile shall show no staining when subjected to attack by N/10 acids, alkalies, or organic.

C. Quarry Tile: 6-in. by 6-in. by 1/2-in. thick standard grade tile made from shale by the extrusion process, free from warpage, cupping or other distortions. Color selected by Engineer. Score backs of tiles and grind tile to size after firing. Acceptable manufacturers: American Olean Tile Co.; Summitville Tiles, Inc.; or an acceptable equivalent.

D. Portland Cement (including white portland cement): Conform to requirements of ASTM C150.

E. Hydrated Lime: Conform to requirements of ASTM C206 or ASTM C207.

F. Sand for Mortar Setting Beds: Conform to requirement of ASTM C144.

G. Clevage membrane: 15-lb. roofing felt or 4 mil polyethylene film.

H. Reinforcing: 2-in. by 2-in. by 16/16 gage welded wire mesh.

I. Dry-Set Portland Cement Mortar (for setting ceramic floor tile): Bear hallmark of TCA, (Tile Council of America, Inc.) and conform to ANSI A118.1.

J. Organic Adhesive (for setting ceramic wall tile); Bear hallmark of TCA (Tile Council of America) and conform to ANSI A136.1.

K. Grout (for glazed ceramic wall tiles): Manufacturer's prepared white, dry-set portland cement grout containing additives to produce proper curing and develop satisfactory hardness and bond in joints between dry tile.

**2.02 - INSTALLATION ACCESSORIES:**

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed tile and is recommended by tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

C. Miscellaneous Materials: As recommended by manufacturer to complete installation.

**PART 3 - EXECUTION**

**3.01 - EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting tile performance. Examine tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.

2. Subfloor finishes comply with requirements specified in DIVISION 3, CONCRETE, SECTION CAST-IN-PLACE CONCRETE for slabs receiving tile.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 – INSTALLATION OF GLAZED CERAMIC WALL TILES**

A. Install on concrete floor slabs using dry-set mortar method. Install tiles in strict accordance with ANSI A108.5. Apply in strict accordance with manufacturer's instructions.

B. Clean surface to receive tile of all dust, dirt, and other particles, and leave in suitable condition to receive ceramic floor tile. Tile setter: Inspect and approve subfloor before beginning installation.

C. (NTS: Use the following paragraph for tile floors over structural concrete subfloors subject to bending and deflection.)

D. Apply cleavage membrane and reinforced cement mortar setting bed over structural concrete subfloors, supporting reinforcing mesh so that it will be approximately in middle of bed.

E. Mortar Setting Bed: One part portland cement to six parts of damp sand by weight; it may not contain more than one-tenth of hydrated lime. Do not make mortar setting bed under 3/4-in. or over 1-1/4-in. thick. Firmly tamp and screed level, maintaining proper slope to drains.

F. Set ceramic floor tile and grout in a first-class manner by mechanics experienced in such work using materials recommended by manufacturer and in strict accordance with recommendations of TCA, (Tile Council of America, Inc). Set tiles with edges true and square and parallel to walls of room. Lay borders and defined lines before field or body of floor. Form all intersections and returns accurately and fit tiles closely and neatly at all plumbing fixtures, pipes, and fittings so that coverplates or escutcheons will overlap tiles properly. Secure all tiles firmly in place, and remove loose tiles, or tiles sounding hollow when rapped, and replace.

G. Firmly beat sheets of mounted tiles into mortar and bring surface to a true plane at proper elevations. Complete beating and leveling within one hour after placing of sheets. Within one hour after installation of sheets, if paper face-mounted, remove paper and glue by wetting without using excess water. At this time, adjust all tiles out of line.

H. Mix a neat cement paste of white portland cement with water to a creamy mixture, and brush into joints. Completely fill joints flush with surface of tiles. Clean off all excess grout with clean burlap bags or other cloths. Before grout sets, fill in all skips and gaps.

**3.03 INSTALLATION OF QUARRY TILE:**

A. Set quarry tile in a first class manner and in accordance with ANSI A108.1, using materials recommended by manufacturer. Press tiles firmly into position and properly beat in or vibrate to obtain proper contact on back. Grout quarry tile in same manner as ceramic floor tile.

**3.04 CLEANING AND CURING:**

A. Thoroughly sponge and wash all completed tile work, working diagonally across joints, and finally polish with clean dry cloths. Acid clean unglazed tiles only when necessary and not until 10 days after setting tiles. Wet tiles with clean water before cleaning with a 10 percent muriatic-acid solution. After acid cleaning, flush tiles thoroughly with clean water.

B. Cure floor tiles by keeping them damp at least three days, and during this time do not permit any traffic on tiles.

**3.05 PROTECTION:**

A. Cover finished tile floors with clean building paper before foot traffic is permitted on them. Place board walkways on floors that are to be used as passageways by workmen

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 09500**

**ACOUSTICAL CEILINGS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Suspended Acoustical Ceilings, Mechanical Suspension System and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's product data and specifications and recommended installation instructions for all items specified.

2. Layout of units and with location of lighting, ventilating units, and other ceiling interruptions. Include the following:

a. Method of attaching hangers to building structure, including insert and hanger spacing and fastening details including splicing method for main and cross runners.

b. Details of materials, furring and supports for acoustical ceilings.

c. Change in level details.

d. Access door dimensions, and locations.

e. Acoustical unit support at ceiling fixture.

3. Samples:

a. Submit three 6-inch square samples of each type of acoustical material to illustrate color and range of appearance.

b. Submit three 12-inch long samples of each suspensions system member, moldings, and hangers.

4. Certificates:

a. Provide certification of fire endurance rating and flame spread index of fire rating organization.

b. Provide certification that materials and systems conform to specifications.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating as applicable, legible and intact.

E. Store materials in original protective packaging to prevent soiling, physical damage or wetting.

F. Store cartons open at each end to stabilize moisture content and temperature.

G. Do not begin installation until sufficient materials to complete a room are received.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Qualifications of Installer:

1. Minimum of three project installations of comparable extent as proposed project.

2. Submit written description of material installer, listing name of material manufacturers, qualifications of installation personnel, and years of concurrent contracting experience.

C. Tolerances:

1. Surfaces to receive acoustical treatment: Free from irregularities and level to within 1/4-in. in 12 ft.

2. Deflection:

   a. Suspension system components, hangers, and fastening devices supporting light fixtures, ceiling grilles, and acoustical units: maximum deflection 1/360 of the span.

   b. Deflection test: ASTM C635

3. Allowable tolerance of finished acoustical ceiling system: Level within 1/8 in. in 12 ft.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.

2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
2. C423: Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
3. C635: Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
4. C636: Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
5. E84: Test Method for Surface Burning Characteristics of Building Materials.
6. E119: Method of Fire Tests of Building Construction and Materials.
7. E488: Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
8. E1264: Classification for Acoustical Ceiling Products.
9. E1512: Standard Test Methods for Testing Bond Performance of Bonded Anchors.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - ENVIRONMENTAL REQUIREMENTS**

A. Maintain humidity of 65 percent - 75 percent in area where acoustical materials are to be installed, 25 hours before, during, and 25 hours after installation.

B. Maintain a uniform temperature in the range of 55 degrees F to 70 degrees F prior to and during installation of materials.

**PART 2 - PRODUCTS**

**2.01 - ACOUSTICAL PANELS**

A. Acoustical Mineral Ceiling Tile: Conform to ASTM E 1264, Type III mineral base with painted finish, Form 2, Pattern CE, Class A.

1. 24-in. by 48 -in. by 5/8-in. thick lay-in panels with reveal edge.

B. Accoustical Mineral Ceiling Tile: Conform to ASTM E 1264, Type X, Form 2, Pattern CE, Class A.

1. 24-in. by 24-in. by 5/8-in. thick high-density moisture resistant lay-in panels with square edge and formed from inorganic mineral fibers in ceramic bond.

C. Acoustical Performance Ratings:

1. Light Reflectance Coefficient (LR): Not less than 0.83.
2. Noise Reduction Coefficient (NRC): Not less than 0.50.
3. Ceiling Attenuation Class (CAC): Not less than 35.

**2.02 - SUSPENSION SYSTEM**

A. Suspension systems for acoustical units shall be a steel lay-in exposed system and shall conform to the requirements of ASTM Specification C635 heavy duty type. Suspension system shall be completely compatible with the acoustical units and lighting fixtures.

B. Edge or wall molding shall be steel with colored factory applied vinyl paint finish, with a 3/4 inch reveal as detailed on the drawings, color to be selected by the Engineer. Wall moldings shall have a flange of not less than 15/16 inch and shall be provided with inside and outside corner caps.

C. Wire shall be zinc-coated, 12 gage steel wire unless otherwise recommended by suspension system manufacturer.

D. Hangers shall be the sizes and types recommended by the suspension system manufacturer.

## PART 3 - EXECUTION

### 3.01 - PREPARATION

A. Examine surfaces scheduled to receive suspended acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of work.

B. Mark access provisions as to size and location before beginning installation.

### 3.02 - INSTALLATION

A. Install acoustical materials and suspension systems in accordance with ASTM C636, and manufacturer's printed instructions.

1. Deflection of any one component not to exceed 1/360 of span.

2. Install additional support, supplemental hangers, or separate support for ceiling lighting fixtures depending on fixture weights.

B. Appurtenances: remove all ceiling mounted equipment and associated items as required to install replacement ceiling tile and reinstall all removed ceiling mounted equipment and associated items in original locations.

### 3.03 - CLEANING

A. Following installation, clean and leave free from defects, dirty or discolored surfaces of acoustical units. Remove and replace with new units, damaged or improperly installed units, at no additional cost to the Owner.

### 3.04 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09650**

**RESILIENT FLOORING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Resilient Flooring and Vinyl Base as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's product data, specifications printed installation instructions.

2. Submit manufacturer’s maintenance instructions.

3. Submit before ordering material, a minimum of three samples of each type and color pattern of resilient flooring and base material matching color/pattern indicated.

a. Mark samples with name of Contractor, project identification, and area where materials are to be used.

b. Install only product's matching approved samples.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING

D. Deliver materials to site in manufacturer's original, unopened containers with labels indicating brand names, colors/patterns, and quality designations legible and intact.

E. Extra Stock:

1. For replacement and maintenance purposes, furnish, and deliver to Owner's maintenance department, additional floor covering materials of each size, color, pattern and type from same runs as actually used on job and in quantities as follows:

a. Flooring material: Not less than 5 percent of total amount used.

b. Base material: Not less than 1/10 of total linear feet used.

2. Provide sufficient amount of adhesive materials for proper installation of extra stock.

F. Store and protect accepted materials in accordance with manufacturer's direction and recommendations.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 – QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. F1066: Specification for Vinyl Composition Floor Tile.

2. F1861: Specification for Wall Base: Vinyl Plastic.

B. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - ENVIRONMENTAL CONDITIONS**

A. Maintain temperature in space to receive tile between 70 degrees F. and 90 degrees F. for not less than 24 hours before and 48 hours after installation.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Vinyl-Composition Floor Tile

1. Non-asbestos formulated and composed of vinyl resins and fillers, free from lumps and unmixed coloring matter and conforming to ASTM F1066, Class 2.

2. Size: 12-in. by 12-in. by 1/8-in. thick.

3. Water-Resistant Type Adhesive: manufacturer's recommended type for installation of vinyl-composition tile over suspended or on-grade concrete subfloors.

4. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns

B. Bases

1. Vinyl Bases

a. 4-inch high by 1/8-inch. thick set-on type cove base with tapered top and ribbed back at tile and concrete; straight base at carpet, conforming to ASTM F1861, Type TV, Group 1. Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

2. Rubber Base

a. 4-inch high by 1/8-inch thick cove base at tile and concrete; straight base at carpet conforming to ASTM F 1861; Type TS or TP Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

3. PVC

a. 4-inch high by 1/8-inch thick cove base at tile and concrete; straight base at carpet conforming to ASTM F1861. Provide preformed internal and external corners with 4-in. returns where necessary.

b. Water-Resistant Type Adhesive: manufacturer's recommended type for installation over suspended and/or concrete subfloors.

c. Colors and Patterns as selected by Design Builder from manufacturer’s full range of colors and patterns.

## PART 3 - EXECUTION

### 3.01 - INSPECTION OF SURFACES

A. Examine substrate for excessive moisture content and unevenness which would prevent proper installation of resilient flooring.

B. Do not proceed with installation until defects have been corrected.

### 3.02 - PREPARATION

A. Remove dirt, oil, grease, or other foreign matter from surfaces to receive floor covering materials or bases. If cleaning material is used, rinse carefully after use to remove all traces of it.

B. Fill subfloor cracks less than 1/8-in. wide, and miner holes, crevices and depressions less than 1/8-in. deep with a crack filler as recommended by flooring material manufacturer.

C. Prime subsurfaces if recommended by flooring material manufacturer.

### 3.03 - INSTALLATION OF FLOOR TILE

A. Install using mechanics experienced in such work. Install resilient flooring material in strict accordance with manufacturer's printed installation instructions.

A. Cut tiles accurately to size with true, straight, square edges, and make flat and uniform in thickness.

B. Lay tile without use of lining paper on a steel trowelled concrete slab.

C. Lay tile true to line and pattern with close, even joints, all surfaces in a true plane, and edges parallel to walls. Arrange trimmed pieces symmetrically. Lay tile which has a directional pattern so that direction alternates at right angles in adjacent tiles. Make joints as inconspicuous as possible.

D. Wipe clean spots or smears on face of tiles.

E. Fit tile closely and neatly against walls of rooms.

### 3.04 - INSTALLATION OF VINYL BASES

A. Do not apply vinyl base to masonry surfaces until they have dried thoroughly. Cement base to backing material using adhesives and methods recommended by manufacturer of base. Scribe and neatly fit internal corners.

**3.05 - CLEANING, PROTECTION AND WAXING**

A. Lay no tile until other work in area has been completed. Stop traffic over tiled areas for a period of 24 hours after installation. Where necessary to use floors after this period, protect tile with heavy building paper or by other acceptable means.

B. On completion of work in building, thoroughly clean resilient floor tile and apply one coat of wax as recommended by manufacturer of tile. Leave finished surfaces in perfect condition.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09651**

**VINYL SHEET FLOORING**

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3.08 - CONTRACT CLOSEOUT ..... 5

## PART 1 – GENERAL

### 1.01 - SCOPE

A. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings, seaming plan, manufacturer's technical data, and installation and maintenance instructions for flooring and accessories.
2. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.
3. Submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit at no cost to the Owner.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.07 - QUALITY ASSURANCE**

A. Installer shall be competent in the installation of resilient sheet flooring using heat-welded seams. Provide flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives. Provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:

1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.

2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

**1.08 - ENVIRONMENTAL CONDITIONS**

A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.

B. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65ºF (18ºC) and a maximum temperature of 100ºF (38ºC) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55ºF (13ºC) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.

D. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

**PART 2 - PRODUCTS**

**2.01 - RESILIENT SHEET FLOORING MATERIALS**

A. Provide MEDINTONE™ Homogeneous Vinyl Sheet Flooring, nonlayered and nonbacked, manufactured by Armstrong World Industries, Inc., or equal, 72 in. (1.83 m) wide, having a nominal total thickness of 0.080 in. (2.0 mm). The polyurethane-coated wear surface shall be composed of polyvinyl chloride resin, plasticizers, stabilizers, fillers, and pigments comprising a through-grain vinyl chip visual with pattern and color uniformly dispersed throughout the entire thickness. The design shall merge subtle color accents with a detailed, terrazzo-like image providing a monolithic appearance. Vinyl sheet flooring shall meet ASTM F 1913, “Standard Specification for Vinyl Sheet Floor Covering Without Backing.”

1. Color to be selected by Design Builder from manufacturer’s full range of colors and patterns.

B. Provide system’s vinyl weld rods intended for heat welding of seams. Color shall be compatible with field color of flooring as selected by Design Builder.

**2.02 - ADHESIVES**

C. Provide Armstrong S-543 Premium Plus Commercial Sheet Flooring Adhesive or equal for field areas as recommended by the flooring manufacturer.

**2.03 - ACCESSORIES**

A. For patching, smoothing, and leveling monolithic subfloors, provide Armstrong S-183 Fast-Setting Cement-Based Underlayment or equal.

B. Provide transition/reducing strips tapered to meet abutting materials.

## PART 3 - EXECUTION

### 3.01 - INSPECTION

A. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.

B. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.

C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

### 3.02 - PREPARATION

A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong S-183 Fast-Setting Cement-Based Underlayment or equal as recommended by the flooring manufacturer.

B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.

C. Perform subfloor moisture testing in accordance with ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes” and Bond Tests as described in publication F-5061, "Armstrong Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Relative humidity shall not exceed 80%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.

D. Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

E. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

### 3.03 - INSTALLATION OF SHEET FLOORING

A. Install flooring in strict accordance with the latest edition of "Armstrong Guaranteed Installation System", F-5061.

B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.

D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

E. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.

F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.

G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

H. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.

**3.04 - INSTALLATION OF ACCESSORIES**

A. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

**3.05 - CLEANING AND PROTECTION**

A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09800**

**PROTECTIVE COATING**

Filed Sub-bid Required

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 09800, PROTECTIVE COATING is a part of DIVISION 9, FINISHES which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 09941, FIELD PAINTING.

B. The Work of SECTION 09800, PROTECTIVE COATING, requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Protective Coatings as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Non-wood Products specified in SECTION 06225, EXTERIOR FINISH CARPENTRY and SECTION 07461, SIDING do not require Protective Coatings.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

C. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's product data and printed application and safety requirements.
2. Submit manufacturer's color charts.
3. Submit notarized Contractor qualification statement for licensed applicator.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Ensure that mixing and installation of protective coating is performed by applicators licensed by the coating manufacturer.

C. Submit four copies of a notarized statement from the manufacturer's authorized technical representative certifying the Contractor is qualified to apply the protective coating.

**1.08 – SURFACES COATED**

A. Apply protective coating (PC-#) to areas indicated in the Finish Schedule and as specified.

1. Coat entire floor areas, bounded by curbs. Extend coating up the side and top of curbs and pads including columns and walls up to the same height as the curb. At this point, suitably and neatly mask off as specified all curbs, columns and wall areas. Provide floor areas with a non-skid surface as specified herein.

**1.09 – MANUFACTURER’S RECOMMENDATIONS**

A. Conform to manufacturer's printed instructions for surface preparation, use, safety requirements, mixing, application, curing and intercoat precautions for protective coating. Submit to Engineer, four copies of these printed instructions and manufacturer's product data sheets, 30 days prior to application of coating.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Provide only high-grade products of nationally known manufacturer's having an established good reputation in the field. Provide products having a minimum of five years' similar, satisfactory field service and suitable for the intended service. Apply products specified except, when permitted by the Engineer, other acceptable equivalent products may be applied if the Contractor satisfactorily proves that they are equivalent to the specified item in quality, durability, performing the required function, abrasion resistance, chemical resistance, adhesion, efficiency in protecting the substrate from corrosion and deterioration, life expectancy and recoating cycles, solids content by volume, film thickness per coat, mil. feet per gallon, coverage per gallon, total cost of services, ease of application, ease of repairing damaged areas, and other pertinent criteria. In any one coating system, provide compatible coatings. Provide only products of one manufacturer in any one coating system. Touch-up with coatings as originally applied. Provide materials meeting air pollution requirements in the area where they are applied.

B. Apply materials within the manufacturer's recommended shelf life.

C. After review, submit list of coating products that will be used on the job, 30 days prior to application of coatings.

D. Deliver materials to the application area in their original, unopened containers plainly marked with the name and analysis of the product, the producer's name and the shelf life date. Do not use contaminated, outdated, prematurely opened, or diluted material. Do not modify or extend coatings and only use in accordance with the coating manufacturer's current printed instructions.

**2.02 – CONCRETE CONTAINMENT PROTECTIVE COATING (PC-1)**

A. Locations:

1. Chemical Storage Room 1
2. Chemical Storage Room 2

B. Manufacturers

1. Tnemec Company, N. Kansas City, MO.
2. Plasite, Maple Shade, NJ.
3. Ameron, Alpharetta, GA.

C. Surface preparation to be as specified herein under Section 3.01.

D. The following list specified the material requirement for surfacing system at total (DFT) of (40-45). The acceptable products from Tnemec have been selected to establish a standard of quality. Producs of the other specified manufacturers meeting general physical characteristics and performance criteria are acceptable.

1. Tnemec:
   a. Concrete hole filler – Tnemec 218/215, Apply as scratch coat to fill bug holes and voids.
   b. Concrete Primer – Tnemec 201.
   c. Two top coats – Tnemec 282 Novalac at 10-15 mils DFT per coat.
2. Plasite:
   a. Concrete hole filler – Plasite No. 800 Series Patching Mortar.
   b. Concrete Primer – Plasite No. 800 Series Primer.
   c. Two top coats – Plasite Semstone 802 at 10-15 mils DFT per coat.
3. Ameron:
   a. Concrete hole filler – Nu-Klad 114A.
   b. Concrete Primer – Nu-Klad 105A.
   c. Two top coats – Ameron 35/W/Amercoat 880 glass flake.

**2.03 – STEEL TANKS (PC-2) – Not Used**

**2.04 - CONCRETE TANKS (PC-3)**

A. Locations:

1. Pre-Equalization Tanks
2. Waste Sludge Storage Tanks
3. Thickened Sludge Storage Tank
4. Post-Equalization Tank

B. Manufacturers:

1. Tnemec Company, N. Kansas City, Mo.
2. Plasite, Maple Shade, NJ.

3. Sauereisen, Pittsburg, PA.

C. Surface Preparation: CIP Concrete to be prepared per SSPC SP #13 Standard with ICRI CSP #5 profile.
1. Lining System
   a. Concrete Surfacer: Tnemec Series 218 Mortar-Clad at 1/16-inch thickness.
   b. Finish: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 100.0 mils DFT applied in two coats.

D. The following list specifies the material requirement for surfacing system. The acceptable products are as following:
1. Tnemec
   a. Base Coat: Tnemec 217 for Deep patch repair ( greater than ½") or 218 Mortar Clad, apply at 1/8-1/4 for repair resurfacing or 1/16th" for scrtach coat 80-125 mils scratch coat to fill bug holes and voids on new concrete.
   b. Topcoat: Tnemec Series 435 Perma Glaze Modified Polyamine Epoxy at 100 mils DFT applied in two coats.
2. Plasite:
   a. Primer: No. 500
   b. Surfacing System: Plasguard 5371, apply for Deep patch repair (greater than ½") or apply at 1/8-1/4 for repair resurfacing or 1/16th" for scrtach coat 80-125 mils scratch coat to fill bug holes and voids on new concrete 125 mils (DFT).
   c. Topcoat/gelcoat: Plasguard 5302 100-125 mils DFT.
3. Sauereisen:
   a. Primer: Peneprime No. 500
   b. Resurfacing system: Sewergard – Trowelable No. 210T for Deep patch repair (greater than ½") apply at 1/8-1/4 for repair resurfacing or 1/16th" for scrtach coat 80-125 mils scratch coat to fill bug holes and voids on new concrete, 125 mils (DFT).

**2.05 - CONCRETE CHANNELS (PC-4)**

A. Locations:
1. Headworks Influent Channel

B. Manufacturers:
1. Tnemec Company, N. Kansas City, MO.
2. Plasite, Maple Shade, NJ.
3. Ameron, Alpharette, Ga.

C. Surface preparation to be as specified here-in under Section 3.01.

D. The following list specifies the material requirement for surfacing systems. The acceptable products from Tnemec have been selected to establish a standard of quality. Producs of the other specified manufacturers meeting general physical characteristics and performance criteria are acceptable.
1. Concrete primer/filler – Tnemec 217/ 218 Mortar Clad
2. Surfacing System – Tnemec 434 or 436 at 80-100 mils DFT
3. Top Coat – Tnemec 435 at 20-25 mils DFT

**2.06 - ACCESSORIES**

A. Mortar Mix and fiberglass scrim mesh for 45 degree cants shall be provided as recommended by coating manufacturer.

**PART 3 - EXECUTION**

**3.01 – SURFACE PREPARATION**

A. Clean surfaces as specified and recommended by the coating manufacturer before coating is started.

B. Allow new concrete surfaces to cure for at least 28 days.

C. Open up concrete blow holes by mechanical means to reveal any underlying cavities and fill with the coating manufacturer's recommended, suitable filler-sealer.

D. Sandblast clean concrete to remove laitance, and remove loose materials, dirt and dust from these areas by vacuum cleaning. Provide approximate, a texture of medium sand-paper for blast-cleaned concrete. Do not use acid etching.

**3.02 - APPLICATION**

A. Provide surfaces, tools, and materials clean, dry and at the proper temperature in accordance with the manufacturer's recommendations. Conform to manufacturer's instructions with regard to safety requirements prior to and during application of coating system.

B. The Contractor's attention is directed to the manufacturer's requirements concerning the temperatures to be maintained before, during and following the application of the coatings, and to the need for protection from dirt, dust, and moisture during these periods.

C. Provide coatings continuous and free of defects and seams. Prior to the installation of equipment, apply the coatings to areas which will be subsequently made inaccessible by the installation of the equipment, supports, and other appurtenances. Blend into the overall coating by spot blasting and overlap spray coating in the manner specified by the manufacturer for making repairs to damaged linings for edges created by coatings applied prior to equipment installation.

D. Carefully apply coatings to avoid thin spots at edges, corners, joints, and seams. Effectively seal seams and interfaces of concrete within the specified areas.

E. Neatly mask off and suitably protect from overspray of both the coating materials and sandblasting grit areas and equipment in or adjacent to surface being coated. Following removal of masking materials, carefully examine edges of masked areas and touch up pinholes, holidays, and damaged coatings.

F. Provide finished coating free of pinholes, holidays, foreign inclusions, and bubbles. Carefully examine coated areas to ensure that these requirements have been complied with. Repair lining in defective areas by spot blasting and re-coating as recommended by the manufacturer

G. Concrete Containment Protective Coating (PC-1):

1. At the intersection of floors to walls, install coating manufacturer’s mortar applied 45 degree cant. Before the curing of the cant has occurred, apply coating manufacturer’s minimum 12-in. wide fiberglass scrim mesh into the “wet’ cant. Allow sufficient time, as recommended by coating manufacturer, for mortar cant and scrim mesh to cure and bond as one complete unit to the floors and wall, before applying protective coating.

2. Prime and seal concrete surfaces to be coated with the specified filler-sealer. Apply with a coverage of 100 square feet per gallon for each coat unless otherwise noted.

3. Overcoat primer within 24 hours.

4. Do not brush apply vinyl ester top coat, except for repairs.

5. Do not split vinyl ester furnished by the manufacturer in kits. Mix vinyl ester by a mechanical agitator, as recommended by the manufacturer.

6. Top coat material contains flake particles as a filler. Conform to manufacturer's recommendations regarding the orifice size, agitation, and operation pressures necessary to properly spray the mixture in a uniform coating.

7. Apply top coat material in two coats, and apply both coats using a multi-pass criss-cross spray pattern. Do not apply second coat until the first coat has air dried for a minimum of 2 hours at 75 deg. F. Follow manufacturer's recommendations to determine the proper cure time at other temperatures and to determine the need for force.

8. Provide prime coat in thicknesses recommended by the coating manufacturer.

9. Follow throughout the coating operation coating manufacturer's recommended methods for measuring the dry film thickness.

10. Apply top coat material in such a manner so as to Ensure that the vinyl ester film to have a total dry film thickness between 35 and 45 mils.

11. Coatings of the type specified, thicker than 45 mils, have reduced chemical resistance, and therefore, avoid buildups greater than 45 mils.

**3.03 - NONSKID SURFACE AT CONTAINMENT AREAS:**

A. Evenly and uniformly broadcast a sufficient quantity of 50 to 90 sieve size silica blasting sand on top of the last top coat before it cures, in order to create a nonskid surface.

B. Sand floor areas for the nonskid surface. After surfaces have cured, vacuum clean excess sand from the areas.

**3.04 - APPLICATOR'S CERTIFICATE**

A. Submit to the Engineer, four copies of a notarized statement sworn to by an authorized official of the organization that applies each coating system specified herein, on its letterhead, testifying to the following:

1. That immediately before coating, surfaces matched the specified cleaning, were in suitable condition, clean, dry, and free of dust, foreign and unsuitable matter, when coated.

2. Names of the products used and their manufacturer.

3. Shelf-life dates of each container of each product used.

4. That surface preparation and coating use, mixing, application, curing, and intercoat precautions were done in accordance with the current printed recommendations of the coating manufacturer and in accordance with the coating requirements in this section of the specifications.

5. That copies of coating manufacturer's invoices submitted with this statement cover the sale of products used on this job.

6. Actual dry film thickness of the coating after application.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 09850**

**HIGH PERFORMANCE COATING**

**Filed Sub-bid Required**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 09850, HIGH PERFORMANCE COATING is a part of DIVISION 9, FINISHES which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 09941, FIELD PAINTING.

B. The Work of SECTION 09850, HIGH PERFORMANCE COATING, requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide high performance coating to exterior aluminum railing assemblies, exterior aluminum ladders, exterior aluminum stair assemblies (excluding aluminum grating treads) as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Coating Manufacturer’s Literature: Detailed descriptive data for materials specified including recommendations for surface preparation, mixing, thinning, application and curing.

2. Custom Color and Gloss: Prepare three samples of aluminum railing by the applicator in accordance with the manufacturer’s printed instructions and submit to the Engineer for approval. The sample shall represent the degree of specular gloss and color to be selected.

3. Color Charts: Three (3) color charts of coating manufacturer’s full range of custom colors.

4. Manufacturer’s Certification: Coating manufacturer shall certify that products shall meet all requirements specified, including physical properties for primer and finish.

5. Submit applicator’s published data showing service record and experience conforming to paragraph 1.07.B.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Deliver coating materials in original sealed containers with manufacturer's labels intact.

E. Store coating materials in a protected and enclosed, heated area with a temperature between 20 degrees F and 110 degrees F.

F. Coating materials shall be used within six months from the date shipped from the coating manufacturer.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Coating shall be performed by an applicator having a minimum of five years experience in the application of similar coating to those specified in at least ten projects comparable to this project. Applicator shall be approved to apply the specified material by the manufacturer of the coating materials.

**1.08 – WARRANTY**

A. The Contractor shall warrant and shall obtain from the Subcontractor its' warranty that the high performance coating is in compliance with criteria specified in paragraph 2.02.C and will be free from defects in materials and workmanship for a period of 5 years from the date of final acceptance. Said Subcontractor's warranty shall be in a form acceptable to and for the benefit of the Owner and shall be submitted by the Contractor as a condition of final payment. The Contractor shall repair or replace, at the sole option of and at no cost to the Owner, any work found to be defective within said warranty period. Such repair or replacement shall include the cost of removal and reinstallation.

**1.09 – REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. B117: Method of Salt Spray (Fog) Testing.
2. D1730: Practices for Preparation of Hot-Dip Aluminum Surfaces for Painting.
3. D2247: Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
4. D3359: Method for Measuring Adhesion by Tape Test.
5. D3363: Test Method for Film Hardness by Pencil Test.

B. Federal Standards (Fed. Std.):

1. Fed. Std. – 141C/6192.1: Abrasion Resistance (Taber Abrader).

**1.10 – JOB CONDITIONS**

A. Apply coatings only under the following prevailing conditions:

1. Air and surface temperatures are not below 50 degrees F, or above 120 degrees F.

2. Relative humidity is not above 85 percent and the surface temperature is at least 5 degrees F above the dew point.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Manufacturers

1. Tnemec Company, Inc.

2. Carboline Co.

3. Dupont Industrial Coatings

B. Colors: To be selected by the Engineer.

C. Comply with Federal Clean Air Act for Volatile Organic Compound compliance for applied materials.

**2.02 – PRODUCT REQUIREMENTS/QUALITY STANDARDS**

A. Primer: Provide a two-component, thermosetting high solids polyamide epoxy primer as supplied by the manufacturer for the specified finish and with a minimum dry film thickness of 1.5 – 2.0- mils.

1. Physical Properties of Primer:

a. Temperature resistance: Continuous 250 degrees F and Intermittent 300 degrees F (Dry).

b. Minimum Solids by Volume: 69 + 2.0% (mixed/unreduced).

c. Total Solids by Weight: 77.07 + 10% (mixed/unreduced).

d. Weight per Gallon: 14.48 + 0.25 lbs.

e. Mixing Ratio: 1 part base to 1 part catalyst.

f. Pot Life at 77 degrees F: Minimum 5 hours.

B. Finish: Provide a high-performance, two-component, thermosetting, flouropolymer finish and with a minimum dry film thickness of 2.0 mils.

1. Physical Properties of Finish:

a. Temperature Resistance: Continuous 250 degrees F and Intermittent 300 degrees F (Dry).

b. Minimum Solids by Volume: 62.0 + 2.0% (mixed/ unreduced).

c. V.O.C. Max. – 3.68 lbs./gal.

d. Weight per Gallon: 11.25 + 0.25 lbs. (mixed/unreduced, value may vary with color).

e. Pot Life at 77 degrees F: Minimum 2 hours.

C. Performance Criteria for Applied System – Systems shall meet or exceed the following performance criteria:

1. Substrate: Aluminum treated in accordance with ASTM D 1730, Type B, Method 5 or 7 or Oakite LTS/747 pretreatment.

2. Adhesion: Not less than a rating of 916 psi, average of three tests (ASTM D 4541).

3. Humidity Resistance: No blistering, softening or delamination of film after 3,000 hours exposure (ASTM D 4585).

4. Salt Spray Resistance: No blistering, softening or delamination of film. No more than 1/16-inch creepage at scribe after 10,000 hours exposure (ASTM B 117).

5. Abrasion Resistance: No more than 103 mg. loss after 1,000 cycles (ASTM D 4060, CS-17 Wheel, 1,000 grams load).

6. Chemical Resistance: No blistering, softening, discoloration or other film defects after 24 hour exposure to the following reagents: 50% Sodium Hydroxide, 10% Sulfuric Acid, 20% Muriatic Acid, 5% Nitric Acid, Tricholoroethylene, Toluene, Gasoline (Regular), Ethyl Alcohol, 6% Sodium Hypochlorite (Clorox), (Covered Spot Test).

7. QUV: For approved colors no blistering, cracking or delamination of film and no color change greater than 0.8 DED FMCII MacAdam Units (FMC-2). (After 9500 hours.)

**2.03 - MATERIAL PREPARATION**

A. Mix and thin materials according to coating manufacturer's current printed instructions.

B. Do not use mixed material beyond coating manufacturer's recommended pot life.

**PART 3 – EXECUTION**

**3.01 - PRE-WORK INSPECTION**

A. Examine surfaces to be coated in the presence of the coating manufacturer to identify any conditions that would adversely affect the appearance or performance of the coating system and which cannot be put into a condition approved by the Engineer and coating manufacturer by the preparation work specified in paragraph 3.02. Replace rejected work at no additional cost to the Owner.

B. Do not proceed with surface preparation and application until surface is approved by and authorization to proceed, is given by the coating manufacturer.

**3.02 - SURFACE PRPARATION**

A. Pre-Treatment – Chromate Conversion Process:

1. Chemically treat all surfaces in accordance with ASTM D1730, Type B, Method 5 or 7. Chromate conversion weight shall be in accordance with ASTM B449 Section 6.2, Class 2 or utilize Oakite pretreatment process of 747 or LTS.

2. Finish: Primed surfaces must be clean, dry and free of oil, grease and other contaminants.

**3.03 - APPLICATION**

A. Methods: A system consisting of the primer and finish shall each be electrostatically spray applied by the approved applicator at the factory, and force cured in accordance with the coating manufacturer's current printed instructions. A list of approved applicators is available from the manufacturer.

**3.04 - QUALITY CONTROL/ INSPECTION**

A. System Appearance: Provide coatings, when cured, visibly free of dust, dirt, flow lines, streaks, sags, holidays, blisters, pin-holes, runs, curtains or other surface imperfections. Applicator shall follow coating manufacturer's guidelines for quality control testing on a prescribed schedule during productions.

B. Unacceptable Finishes: Unacceptable color or film characteristics shall be cause for rejection of the entire coated section, replace rejected section by another coated section at no additional cost to the Owner. Determination of such conditions and final approval to be made by the Engineer.

**3.05 - CLEANING/ADDITIONAL REQUIREMENTS**

A. Care and Handling: Care during fabrication, packaging of the finished product, shipping, unloading, onsite storage, installation prior to building completion and cleaning shall be in accordance with The Architectural Aluminum Manufacturers Association's publication "Care and Handling of Architectural Aluminum from Shop to Site."

B. Field Touch-Up and Repair: When approved by the Engineer brush apply minor touch-up in the field using no larger than a #2 Artist brush. Touch-up coating shall be the same as the formulation used for factory application.

C. Fasteners: Where required for installation and exposed in finished surfaces, apply finish in the same manner as other aluminum surfaces and with color to match adjacent surfaces.

D. Final Inspection: Correct, repair and touch-up work that is not acceptable to the Engineer and request final acceptance.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 09940**

**SHOP PAINTING**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide for the Surface Preparation and Application of Shop Primers and Finish Coats as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses, including list of items and surfaces to receive shop painting.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to application area in original, unbroken containers, plainly marked with name and analysis of product, manufacturer's name, and shelf lift date. Do not store or use contaminated, outdated, prematurely opened, or diluted materials.

E. Store coated items to prevent damage or dirtying of coatings. Avoid need for special cleaning, and store coated items out of contact with ground or pavement. Place suitable blocking under coated items during storage.

F. Do not expose surfaces to weather for more than six months before being topcoated, or less time if recommended by coating manufacturer.

G. Protect surfaces not to receive paint coatings during surface preparation, cleaning, and painting.

H. Protect coatings from damage during shipment and handling by padding, blocking, use canvas or nylon slings, and use care when handling.

I. At time of delivery of shop painted items to job site, ensure coatings are undamaged and in good condition.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - JOB CONDITIONS**

A. Environmental Requirements:

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

2. Do not apply coatings when dust is being generated.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Coatings are divided into the following service types, as determined by conditions:

1. Non-Potable Water:

a. All ferrous metals not subject to potable water provide one coat with a dry film thickness of 2.5 to 3.0 mils with one of the following or equal:

(1) #1 Purple Prime made by Tnemec Co.

(2) Carbozinc 859 by Carboline Co.

(3) Multiprime EFD Epoxy Fast Day Inhibitive Primer 94-109 made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

(4) Or acceptable equivalent product.

2. Potable Water:

a. Ferrous metals submerged or which are subject to splash action in contact with potable water, provide one coat with a dry mil thickness of 3.0 to 3.5 mils of a certified NSF Standard 61 product by one of the following or equal:

(1) 91 H20 Urethane Zinc Rich Primer made by Tnemec Co.

(2) Carboguard 561 made by Carboline Co.

(3) Aquapon High Build Potable Water Epoxy 95-132 Series made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

(4) Or acceptable equivalent product.

B. Shop prime with primers guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in SECTION 09941, FIELD PAINTING for use in the field and which are recommended for use together.

**PART 3 - EXECUTION**

**3.01 - APPLICATION**

A. Surface Preparation and Priming:

1. Sandblast clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming non-submerged components scheduled for priming, as defined above.

2. Sandblast clean in accordance with SSPC-SP-10, Near White, immediately prior to priming submerged components scheduled for priming, as defined above.

3. Before priming, provide surfaces dry and free of dust, oil, grease and other foreign material.

4. Shop prime in accordance with approved manufacturer's printed recommendations.

B. Non-primed Surfaces: Apply approved coating in accordance with manufacturer's printed recommendation.

**3.02 - TOUCH-UP**

A. Repair or replace damaged or defective coated areas. Resultant shop painting: Paint items as specified.

B. Remove damaged or defective coatings by specified blast cleaning to meet surface cleaning requirements, just before recoating. When small areas of coating need touch up, surface preparation may be done with suitable power needle gun to match specified blast cleaning.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 09941**

**FIELD PAINTING**

**Filed Sub-bid Required**

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## PART 1 – GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended

B. A sub-bid submitted for the Work of DIVISION 9, FINISHES shall include the complete Work specified in all of the following Sections:

1. SECTION 09800, PROTECTIVE COATING
2. SECTION 09850, HIGH PERFORMANCE COATING
3. SECTION 09941, FIELD PAINTING

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

E. Reference Drawings

1. The Work of DIVISION 9, FINISHES is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 A-101 | 10 A-102 | 10 A-201 | 10 A-202 | 10 A-301 | 10 A-302 | 10 A-303 |
| 10 A-601 | 10 A-602 | 10 A-603 | 10 D-101 | 10 D-102 | 10 D-103 | 10 D-104 |
| 10 D-105 | 10 D-301 | 10 D-302 | 10 D-303 | 10 D-304 | 10 D-305 | 10 D-306 |
| 10 D-307 | 10 D-308 | 10 M-105 | 10 M-106 | 10 M -173 | 10 M-108 | 10 P-101 |
| 10 P-102 | 10 P-103 | 10 P-104 | 10 P-105 | 10 P-106 | 10 P -107 | 10 P-108 |
| 10 P -109 | 20 P-101 | 10 F-101 | 10 F-102 | 20A-101 | 20 A-201 | 20 A-202 |
| 20 A-401 | 20 A-601 | 20 A-603 | | | | |

F. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 09800, SECTION 09850 and SECTION 09941

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

G. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. Provide and apply paints and coatings specified and indicated. Prepare, clean, and finish all existing and new surfaces to be field painted as specified and indicated.

1. The terms “paint” and “coating” used herein include emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as intermediate, or finish coats.

B. Complete painting and test patches for existing surfaces in accordance with specifications, paint manufacturer's current surface preparation and application instructions and safety requirements. In the event of conflict, the more stringent specifications will apply.

C. Furnish and apply pipe, valve, and equipment identification legends as specified.

D. Items Not to Be Field Painted:

1. SECTION 15056, PIPE SUPPORTS

a. All pipe supports will be delivered with finish paint and will not require field painting.

2. SECTION 15600, HEATING, VENTILATION AND AIR CONDITIONING EQUIPMENT

a. All equipment except piping valves, meters and fittings will be delivered with finish paint and will not require field painting. Painting Subcontractor shall paint piping, valves, meters and fittings as specified herein as indicated on the contract drawings.

b. HVAC ductwork shall not be field painted.

3. Stainless steel and CPVC piping, fittings and supports will not be field painted, except that identification of piping with stencil text shall be provided by the work of this section.

E. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. List of coating products (Paint Schedule) with brand, type and manufacturer including dry film thickness and volatile organic compound (V.O.C.) regulations conforming to these specifications. Refer to Paragraph 2.04.

2. Manufacturer's current printed recommendations and data sheets for each product including performance criteria, surface preparation, application instructions.

3. Product data and pertinent information including results of test patch data indicating compatibility of field applied coatings with shop applied primers including a schedule listing each primer with field applied coatings to be applied over the primer.

4. Color chip samples of manufacturer’s full range of colors for initial selection by Engineer.

5. Color chip samples matching colors indicated in Piping Identification Schedule, included in this specification. Submit list of piping to be included under each color.

6. Submit manufacturer's published data showing service record specified herein.

7. Submit letter(s) signed by paint manufacturer certifying that submitted products are suitable for application on the surfaces to be coated and for the service conditions.

8. Product data for mil thickness testing equipment including operating instructions.

9. Field Submittals

a. Submit letter(s), signed by Contractor, stating that existing and new surfaces to be coated are ready for preparation as specified herein.

b. Submit letter(s) signed by Painting Subcontractor, certifying that existing and new surfaces to be coated have been prepared in accordance with paint manufacturer's printed instructions and are ready for field paint application.

c. Approved mil thickness test results, including location, and surface or item for identification.

d. Provide samples of existing paint coatings to paint manufacturer for identification of existing coatings. Submit to Engineer final recommendations of the paint manufacturer for the proper type of coatings that can be applied to existing surfaces. If the specified paint coating for existing surfaces is not acceptable to paint manufacturer, then the painting subcontractor and paint manufacturer shall submit the recommended coating at no additional cost.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Deliver materials to painter's area in original, unbroken, containers with name and analysis of product, manufacturer's name, and shelf life date. Do not use or retain contaminated, outdated, prematurely opened, or diluted materials.

C. Store coated items and protect coating from damage and foreign matter, by not allowing contact with soil or pavement, exposure to wind-blown particles, or other harmful contacts which necessitate special cleaning. Use blocking during storage.

D. Protect coated items, whether prime or finish, from damage due to shipping and handling.

E. Paint Storage and Mixing Areas and Waste Disposal

1. Store paints and painter's materials in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of painting debris, to these areas before authorized disposal.

2. Do not use plumbing fixtures, piping or mechanical equipment for mixing or disposal of paint materials.
    a. Transport water to paint area by temporary hose or piping.
    b. Store waste temporarily in closed, nonflammable containers until final legal disposal. Keep no rubbish in painter's area longer than 24 hours. Legally dispose any hazardous materials and place all non-hazardous waste in the central trash trailer area.

**1.06 - DESIGN CRITERIA**

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. Job Conditions
    1. Environmental Requirements:
        a. Comply with manufacturer's printed recommendations as to environmental conditions under which coatings and coating systems can be applied.
        b. Do not apply coatings when dust is being generated.
    2. Protection
        a. Cover or otherwise protect finish work of other trades and surfaces not being painted concurrently or not to be painted.
        b. Do not paint over nameplates, tagging or other identification devices.

C. Quality Assurance
    1. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.
    2. Use products of one manufacturer in any one paint coating system with compatible coating materials. Provide same coating product for touch-up as for original coating.
    3. Do not use or retain contaminated, outdated, or diluted materials for painting. Do not use materials from previously opened containers.
    4. Provide paint products having a minimum of five (5) years of service, with no peeling, flaking, chipping, blistering, or fading, under similar service conditions.

**1.07 - REFERENCES**

A. Society for Protective Coatings (SSPC) Specifications:
    1. SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel.
    2. SSPC-PA-2: Measurement of Dry Coating Thickness with Magnetic Gages.
    3. SSPC-SP 1: Solvent Cleaning.
    4. SSPC-SP 3: Power Tool Cleaning.
    5. SSPC-SP 6: Commercial Blast Cleaning.
    6. SSPC-SP10: Near-White Blast Cleaning.

B. American National Standards Institute (ANSI)
    1. A13.1: Scheme for the Identification of Piping Systems, Designation.

C. National Sanitation Foundation (NSF)

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 – PRODUCTS

### 2.01 - MANUFACTURERS

A. Tnemec Co., Inc.

B. Carboline.

C. PPG Protective & Marine Coatings, Inc.

### 2.02 - MATERIALS – GENERAL

A. Products: Recommended by their manufacturer for intended service.

B. Material Compatibility:

1. Provide block fillers, undercoats and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2. Provide field applied coatings that are compatible with shop applied primers.

### 2.03 - COLORS AND FINISHES

A. Interior finish colors: As indicated in Finish Schedule and Pipe Identification Schedule.

B. To provide contrast between successive coats, lightly tint each coat to distinguish it from preceding coats.

C. Unless otherwise indicated for finish paint, use gloss or semi-gloss on metal, and satin finish on masonry and concrete.

### 2.04 - COATING TYPES

A. Coatings are described in the COATING IDENTIFICATION SCHEDULE by abbreviations, generic type, minimum solids by volume and minimum dry film thickness. Provide coatings that comply with the volatile organic compounds (VOC) regulations applicable to the project site and in no case to exceed 3.5 lbs/gal.

**COATING IDENTIFICATION SCHEDULE**

| | | | | Manufacturer | | |
|---|---|---|---|---|---|---|
| **Abbreviation** | **Generic Type** | **Solids by Volume (%) See Note 1** | **DFT Per Coat See Note 2** | **Tnemec Co., Inc.** | **Carboline** | **PPG Protective & Marine Coatings, Inc.** |
| AGE | Alkyd- Enamel | 49 | 2.0-3.0 | 23 Enduratone | Carbocrylic3359 or 3359 DTM | PPG Industrial Alkyd Enamel 7-824 Series |
| AGU | Alkyd | 56 | 2.0-3.0 | Series 36 | Undercoater | Undercoater |
| AL | Emulsified Acrylic | 43 | 2.0-3.0 | Series 6 | Carbocrylic 3350 | PPG Pitt-Tech EDF Exterior WB Acrylic Dry Fog 90-812 Series |
| APE | High Build Acrylic Polyurethane Enamel | 60/745 | 3.0-5.0 | Series 73 1074 | Carbothane 134HG | PPG Amercoat 450H |
| BF | Cementitious Acrylic Filler | 68 | 100 sq. ft. per gal. | Series 130 | Sanitile 100 | BF Cementitious PPG Amercoat 965 |

**COATING IDENTIFICATION SCHEDULE**

| | | | | Manufacturer | | |
|---|---|---|---|---|---|---|
| **Abbreviation** | **Generic Type** | **Solids by Volume (%) See Note 1** | **DFT Per Coat See Note 2** | **Tnemec Co., Inc.** | **Carboline** | **PPG Protective & Marine Coatings, Inc.** |
| HSE | High Solids Catalyzed Epoxy | 70 | 6.0-8.0 | Series N39 | Carboguard 893SG or 691 NSF | PPG Amerlock2/400 or Amerlock 2 NSF |
| LTE | Polyamide Epoxy | 58 | 4.0-6.0 | Series 161 or N69F | Carboguard 893SG or 691 NSF | PPG Amerlock2/400 or Amerlock 2 NSF |
| MAEP | Modified Aliphatic Amine Epxoy Mortar | 100 | 125 | Perma-Shield $H_2S$ | --- | --- |
| PE See Note 3 | Polyamide Epoxy | 60 | 5.0-7.0 | Series 61 or N69F | Carboguard 893SG or 691 NSF | PPG Amerlock2/400 or Amerlock 2 NSF |
| PRW | Pressure washing and cleanup with materials recommended by Paint Manufacturer. | | | | | |
| PVA | Poly Vinyl-Acrylic- | 28 | 1.0-1.5 | Series 51-792 | Carbocrylic120 | PPG Speedhide6-2 Primer |
| TY | Polyamide Epoxy | 56 | 2.0-3.0 | Series 66 | --- | --- |
| ZR | Zinc Rich Primer | 63 See Note 4 | 3.0-4.0 | Series 91-$H_2S$ or Series 90-97 or Series H90-97 | Carbozine 859 or Carbozinc 11 | PPG Amercoat 68HS or Dimetcote 9 |

Notes:

1. Solids by volume based on Tnemec Co., Inc.
2. Dry film thickness and performance criteria based on Tnemec Co., Inc. Provide dry film thicknesses for equivalent products as recommended by manufacturer.
3. If application of PE type coating occurs during low temperatures, provide and apply LTE type coating in lieu of PE and substitute throughout in Paint Schedule at end of Section, unless otherwise recommended by coating manufacturer.
4. 80% minimum zinc by weight. If intended for bolted connections, provide minimum Coefficient of Friction as recommended by bolt manufacturers.

B. Description of coating types includes minimum acceptable percent, by volume, of component solids. Brand identification is to establish standard of quality. Products meeting general physical characteristics and performance criteria, are acceptable.

C. Provide coatings submerged in potable water with National Sanitation Foundation approval.

**2.05 - PIPE, VALVE/EQUIPMENT IDENTIFICATION AND COLOR CODING**

A. Provide identification of existing and new pipes, valves, pumps, tanks and similar vessels by color as specified in the Pipe Identification Schedule and with name of contents, directional flow arrows and other required legend.

B. For existing and new pipe systems, use stenciled letters and arrows or self-adhesive labels or tapes located at intervals no greater than 20 ft. apart on straight runs except that stainless steel piping at intervals shall be no greater than 15 ft. apart on straight runs. Mark each valve, branch, wye change in direction and each side of floor and wall penetrations.

C. Labels or tapes shall be moisture and U.V. resistant.

D. Provide legend of size, character and location conforming to ANSI A13.1 for stenciled letters or labels.

E. Refer to notes at end of Pipe Identification Schedule for further clarifications.

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Examine existing and new surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work.

B. Do not proceed with surface preparation or coating application until after submitting to the Engineer a letter signed by Contractor, stating that existing and new surfaces to be painted are in acceptable condition for preparation and painting according to the Painting Subcontractor and in accordance with paint manufacturer’s printed instructions.

C. Do not proceed with coating application until after submitting to the Engineer a letter signed by paint manufacturer certifying that submitted products are suitable for application in accordance with paint manufacturer’s printed instructions.

**3.02 - PREPARATION**

A. Basic Steps:

1. Prepare and paint existing and new surfaces in heated enclosure unless the ambient weather conditions ensure still, dry air above 50 degree F temperature, and humidity above manufacturer's printed recommended level. Do not apply paints to surfaces in direct sunlight. Conform to manufacturer's printed instructions for safety requirements.

2. Coordinate cleaning and painting operations to eliminate contamination of one by the other.

3. Maintain coating materials at manufacturer's recommended mixing and application temperatures for not less than 24 hours before use. Have clean containers, spray equipment, applicators and accessory items ready for use before decanting or mixing paint materials.

4. Coordinate materials to be applied with previous coatings on affected surfaces. Obtain, in all cases, manufacturer's written directions, and follow them strictly, except where otherwise specified.

5. Coordinate preparation and material compatibility requirements with the work specified in SECTION 15400, PLUMBING SYSTEMS and SECTION 15600, HEATING, VENTILATING AND AIR CONDITIONING.

B. Before any paint application, clean existing and new surfaces to be coated of dust, dirt, grease, white rust, paint unsuitable for top coating, efflorescence, oil, moisture, foreign matter or similar conditions detrimental to coating bond and durability.

1. Following cleaning, apply preparatory treatment in strict accordance with manufacturer's written instructions.

2. Fill imperfections and holes in surfaces to be painted with material recommended by paint manufacturer.

C. Metals to Receive Paint Finishes:

1. Prepare ferrous metals, including field welds and unprimed shop welds, without shop prime coats as follows:

a. Near White blast cleaned (SSPC-SP-10), for submerged components.

b. Commercial blast cleaned (SSPC-SP-6), for non-submerged components.

c. Use needle gun for field welds and shop welds which occur in narrow, unprimed areas in an otherwise shop primed surface, followed by SSPC-SP1-solvent wipe.

2. Clean previously shop primed ferrous metals in accordance with manufacturers printed recommendations prior to field painting.

3. Non-ferrous and galvanized metal surfaces scheduled for paint finish:

   a. Clean in accordance with manufacturers recommendations prior to field painting (SSPC-SP-1 including power washing).

   b. Brush blast all exterior and interior exposures above constant 35% relative humidity or treat with Oakite LTS or equal etching solution. Brush blasted galvanized metal surfaces to receive a uniform profile of 0.75-1.25 mils.

   c. For interior galvanized and non-ferrous metals not exposed to wet environments apply in accordance with manufacturers written instructions.

D. Concrete to Receive Paint Finishes:

1. Clean thoroughly of form oil, release agents, dirt, dust, grease, paint, loose material and foreign matter. Remove laitance, roughen smooth surfaces by brush sand blasting, remove fins and projections, fill voids and honeycombs with material recommended by paint manufacturer.

2. Prime after concrete has dried in strict accordance with manufacturer's printed instructions.

3. Concrete in Immersion: Brush blast all new and existing surfaces to receive coating to achieve profile of 2.0-4.0 mils. Previously coated surfaces shall be inspected and evaluated prior to commencing work.

E. Concrete unit masonry for paint finishes: Clean thoroughly by brushing, scraping and sanding or grinding slick areas. Remove loose or projecting mortar, solvent wash oil, grease, paint spots before applying block filler.

F. Provide higher degree of cleaning for acceptable equivalent paint products when paint manufacturer recommends in his printed surface preparation recommendations.

G. Delay painting of areas which will be damaged by heat from welding, until welding is complete. Reclean and recoat substrate as specified for original coats, when coated areas have been damaged by welding or have not been painted to allow welding.

H. PVC Pipe: Sand all surfaces with 60-80 grit paper to provide profile to adhere coatings.

**3.03 - TOUCH-UP**

A. Before applying field coat, touch-up abraided areas of shop coats with paint of the same type. Apply an entire coat to abraided area. Touch-up coats are in addition to, and not a substitute for first field coat. Clean deteriorated surfaces as specified herein and in accordance with manufacturer’s recommendations before applying touch-up coat.

B. Equipment, motors, pumps, instrumentation panels, electrical switchgear, and similar items with shop coats, paint filler, enamel or other treatment customary with manufacturer; after installation, touch-up scratches and blemishes before applying field coats.

**3.04 - APPLICATION**

A. Refer to Paint Schedule at end of this specification for coating requirements. Provide additional prime, undercoat, and finish coats as specified, indicated, and recommended by coating manufacturer's printed instructions.

B. Conditions

1. Do not apply paints or other finish to wet or damp surfaces, except in accordance with instructions of manufacturer. Do not apply exterior paint during cold, rainy, or frosty weather, or when temperature is likely to drop to freezing. Do not apply paints to surfaces in direct sunlight.

2. Paint surfaces which have been cleaned, pretreated, or otherwise prepared for painting with first field coat as soon as practicable after such preparation has been completed, but in any event prior to deterioration of prepared surface.

3. Coat blast cleaned metal surfaces in accordance with SSPC guidelines, before any rusting or other deterioration or contamination of the surface occurs. Do not coat blast cleaned surfaces later than 8 hours after cleaning.

C. Methods

4. Spraying with apparatus may be substituted for brush application of paints in locations approved for spraying.

5. Prepare surfaces, mix and apply paint materials in strict accordance with manufacturer's printed instructions and recommendations. Control temperature of materials upon mixing and application, surface temperature and condition, thinning and modifying.

6. Protect surfaces to be coated, before, during and after application.

D. Workmanship

7. Apply coating materials to meet manufacturer's spreading rate and dry film thickness recommendations. Dry film thicknesses specified are constant for brush, spray, roller or other form of application.

a. Control thinning in accordance with V.O.C. regulations for spray use and to manufacturer's printed instructions, and produce specified dry film thickness on level surfaces, interior and exterior angles.

8. Apply paints and coatings using painters continuously employed in the painting profession for no less than five (5) years, brushed or rolled out carefully to a smooth, even coating without runs or sags. Curing time in accordance with manufacturers printed instructions.

9. Finish surfaces: Uniform in finish and color, and free from flash spots and brush marks.

**3.05 - PROTECTION AND CLEAN-UP**

A. Protect existing and new surfaces to be painted or coated under this Section as follows:

1. Arrange for preparation and coating activities to be performed in areas and during times when no continuous traffic and no dust generating activity will be present.

2. During time between preparation and coating, protect work from dust and dirt with dropcloth. Do not allow contact with surfaces in this time period.

3. During painting activity, clearly mark the area being used by painters to prevent interference with painting being applied as specified.

4. After painting, clearly barricade painted surfaces with cones, plastic barrier tape, or other visible barrier. Locate "WET PAINT" signs near painted surfaces. Do not remove barriers and signs until paint surface dries throughout entire film thickness.

B. Cover existing water surfaces to protect them from dust and debris.

C. Remove or completely mask existing and new accessory items, finish hardware, lighting fixtures, escutcheon plates, trim and similar finish items not to be painted before painting adjacent surfaces. Carefully replace and reposition upon completion of adjacent painting and cleaning work.

D. Upon completion of the work, clean up paint spots, oil, and stains from floors, glass, hardware, and similar finished items and remove tape.

**3.06 - SCHEDULE OF PAINTING**

A. Coordinate and schedule the various cleaning, touch-up and finishing operations. Transmit and coordinate the transmission of materials data, color selections and coating system methods between the coating applicators. Do not exceed exposure and recoat time limits.

**PIPE IDENTIFICATION COLOR SCHEDULE**
**VALVES, BLOWERS, PIPE, PUMPS, TANKS**

| | | Paint Color | | |
|---|---|---|---|---|
| **Pipe System** | **Legend Symbol** | **Component** | **Letters and Arrows** | **Stencil Text** |
| Air | Air | Dark Green w/Two White Bands | White | Air |
| Backwash Water Supply | BWS | Light Blue w/Blue Band | Black | Backwash Water Supply |
| Chemical Drain | CD | Light Green | White | Chemical Drain |
| Chemical Fill Line | FILL | Same as Individual Chemical Color | Same as Fill Line | "Chemical Name" |
| Chemical Vent | CV | Light Green | Black | Chemical Vent |
| Compressed Air | CA | Dark Green | White | Compressed Air |
| Decant | DEC | Tan | Black | Decant |
| Dilution Water | DW | Medium Blue w/Tan Band | Black | Dilution Water |
| Drain | D | Black | White | Drain |
| Effluent | EFF | Gray with 2-in. White Bands | Black | Effluent |
| Filter Effluent | FE | Dark Blue w/Two White Bands | White | Filter Exhaust |
| Filter to Waste | FTW | Light Blue w/Tan Band | Black | Filter to Waste |
| Filtrate | FIL | Black with 2-in. Yellow Bands | Yellow | FIltrate |
| Finished Water | FINW | Light Blue w/Purple Band | White | Finished Water |
| Overflow | OVF | Light Brown | Black | Overflow |
| Plant Water | W3 | Blue | White | Plant Water |
| Polyaluminum Chloride | POC | Orange w/Black Band | Black | Polyaluminum Chloride |
| Polymer | POL | Green | Black | Polymer |
| Potassium Hydroxide | KOH | Orange w/ Orange Band | Black | Potassium Hydroxide |
| Raw Wastewater | RWW | Gray | Black | Raw Wastewater |
| Sample | SPL | Dark Orange w/White Band | Black | Sample Line |
| Seal Water | SLW | Medium Blue | White | Seal Water |
| Sludge Drain | SLD | Medium Brown | White | Sludge Drain |
| Thickened Sludge | TSL | Light Brown with 2-in. Light Green Bands | Light Green | Thickened Sludge |
| Vent | V | Black | White | Vent |
| Waste Sludge | WSL | Light Brown | Black | Waste Sludge |

**PIPE IDENTIFICATION COLOR SCHEDULE**
**VALVES, BLOWERS, PIPE, PUMPS, TANKS**

| Pipe System | Legend Symbol | Paint Color | | |
|---|---|---|---|---|
| | | Component | Letters and Arrows | Stencil Text |
| **Plumbing** | | | | |
| Drain | D or W | Black | White | Drain |
| Fire Protection | FP | Safety Red | White | Fire Protection |
| Potable Water Supply (Cold or Hot) | W1 or HW1 | Light Blue | White | Potable Water – Cold or Potable Water – Hot |
| Rain Leader | RL or SD | Light Gray | Black | Rain Leader |
| Sanitary Sewage | SAN | Dark Gray | White | Sanitary Sewage |
| Service Water | W2 | Dark Blue | White | Service Water |
| Sump Pump Discharge | PD | Black | White | Sump Pump Discharge |
| Tempered Water | TW | Light Blue | White | Tempered Water |
| Tempered Water - Return | TWR | Light Blue | White | Tempered Water - Return |
| Vent | VT | Black | White | Vent |
| **HVAC – Piping** | | | | |
| Hot Water – Primary Supply | H1S | Light Red | White | Hot Water – Primary Supply |
| Hot Water – Primary Return | H1R | Medium Red | White | Hot Water – Primary Return |
| Hot Water – Secondary Supply | H2S | Light Red | White | Hot Water – Secondary Supply |
| Hot Water – Secondary – Return | H2R | Medium Red | White | Hot Water – Secondary Return |
| Chilled Water – Supply | CHWS | Light Blue | White | Chilled Water – Supply |
| Chilled Water – Return | CHWR | Dark Blue | White | Chilled Water – Return |
| Condensed Water – Supply | CWS | Light Green | White | Condensed Water – Supply |
| Condensed Water – Return | CWR | Dark Green | White | Condensed Water – Return |

Notes:

1. Chemical piping shall be labeled with actual chemical name.
2. The color stenciled text and directional arrow designation required for chemical piping located inside containment trays shall be applied to the containment trays and not the chemical piping.
3. Provide and place a 2-inch color band (4-in. bands for the color yellow) extending around the complete perimeter of the tray on each side of the stencil text and directional arrow designation.
4. Legend symbols listed above in Pipe Identification schedule shall also be added in parenthesis to the end of all stencil text designations indicated.
5. Provide banding 4 ft. 0 in. on center for sludge lines not otherwise specified above.
6. Provide in dark brown and stenciled.

## PAINT SCHEDULE

| Item No. | Surface or Item | Field Coats | | |
|---|---|---|---|---|
| | | 1st | 2nd | Final |
| 1a | Interior concrete indicated in finish schedule to be painted | PE | --- | PE |
| 1b | Interior concrete indicated in finish schedule to be painted in Chemical Rooms | PE | --- | HSE |
| 2a | Interior concrete masonry units indicated in finish schedule to be painted | BF | PE | PE |
| 2b | Interior concrete masonry units indicated in finish schedule to be painted in Chemical Rooms | BF | HSE | HSE |
| 3a | Interior galvanized hollow metal doors, frames and windows and interior shop painted structural steel, interior galvanized monorails and supports, miscellaneous ferrous metal-work, ferrous piping, ferrous parts of operating devices, valve handles and supports, interior surfaces of roll-up door frames and light gage steel trusses | PE | - | PE |
| 3b | Interior galvanized hollow metal doors, frames and windows and interior shop painted structural steel, interior galvanized monorails and supports, miscellaneous ferrous metal-work, ferrous piping, ferrous parts of operating devices, valve handles and supports, interior surfaces of roll-up door frames and light gage steel trusses in Chemical Rooms | PE | - | HSE |
| 4 | Exterior shop painted structural steel, exterior galvanized structural steel, lintel angles, ferrous piping, ferrous parts of operating devices and supports, guard posts, bollards and exterior surfaces of roll-up door frames | PE | PE | APE |
| 6 | Interior drywall surfaces | PVA | AL | AL |
| 7a | Underside of metal deck, steel joists and steel beams (Interior) | PE | - | PE |
| 7b | Underside of metal deck, steel joists and steel beams (Interior) in | PE | - | HSE |

**PAINT SCHEDULE**

| Item No. | Surface or Item | Field Coats | | |
|---|---|---|---|---|
| | | 1st | 2nd | Final |
| | Chemical Rooms | | | |
| 8 | Underside of metal deck, steel joists and steel beams (Exterior) | PE | - | APE |
| 9 | Emulsified asphalt-coated ferrous piping | PE | - | PE |
| 10 | Exposed electrical conduit, conduit fittings, and outlet boxes attached directly to painted walls and ceilings and all and outlet boxes in Chemical Rooms exposed-to-view conduit fittings | PE | - | PE |
| 11 | Items with factory finish | Touch-up with materials supplied by manufacturer | | |
| 12 | Shop painted ferrous metals, galvanized metals and equipment submerged | PE | HSE | HSE |
| 13 | Interior shop painted ferrous metals, galvanized metals and equipment non-submerged and subject to splashing | PE | HSE | HSE |
| 14 | Exterior shop painted ferrous metals, galvanized metals and equipment non-submerged and subject to splashing | PE | HSE | APE |
| 15 | Exterior plaster | AL | - | AL |
| 16 | Concrete in immersion | HSE | - | HSE |
| 17 | PVC piping | PE | --- | PE |
| 18 | Existing interior concrete ceiling, ceiling pans, walls, beams and columns; concrete masonry unit walls including existing conduit attached to ceilings and walls. (Notes 1, 2, 3 & 4) | PE | - | PE |
| 19 | Existing interior steel columns (Notes 1, 3 & 4) | PE | - | PE |
| 20 | Existing interior aluminum railings (Notes 1, 3 & 4) | TY | - | PE |
| 21 | Existing non-submerged pumps, piping, fittings, valves, supports (See Notes 1, 3 & 4). | | | |
| 22 | Existing concrete filter beds (walls and floors) (See Note 2). | - | - | PRW |

Notes:

1. If prime coat has been exposed for more than 6 months, Painting Subcontractor will provide test patches to insure adhesion of field-applied coatings. Test patches in accordance with paint manufacturer's instructions.
2. Provide patching compound for existing and new concrete surfaces before beginning field painting, in accordance with Paint Manufacturer's recommendations. Patch existing concrete masonry unit walls immediately after demolition has been completed and areas have been cleaned.
3. Repaint all existing piping which is modified (existing piping which is partially demolished or to which new piping and equipment will be connected) for the services listed in the Pipe Identification Schedule. Piping, valves, supports, and accessories are to be repainted. Floors, walls, and ceiling surfaces are also to be repainted.
4. Conform to paint manufacturer's written instructions with regard to surface preparation and compatibility of new paint coatings over existing paint coatings. Painting Subcontractor shall take samples of existing paint coatings and coordinate with paint manufacturer and identify the generic type existing. Final recommendations of the paint manufacturer shall be given to the Painting Subcontractor in writing for the proper generic type coating that can be applied to the existing surfaces. If the specified paint coating for existing surfaces is not acceptable by paint manufacturer, then the Painting Subcontractor shall submit the recommended coating and at no additional cost. Paint coating submitted shall have the performance criteria for the intended purpose of that existing item/surface with regard to corrosion-resistance, self-priming, and ease of application.

**3.07 - FINAL TOUCH-UP**

A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish areas to leave touched-up areas with same appearance as and even with the surrounding finish specified.

B. After doors have been fitted and hung, refinish edges, tops and bottoms.

**3.08 -TESTING**

A. Conduct field testing in the presence of the Engineer for specified mil thickness in accordance with SSPC-PA-2.

B. Test results shall meet requirements of SSPC-PA-2. Failure of test results shall require that surfaces be repainted until approved results of testing have been obtained for the specified mil thickness.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 10162**

**METAL TOILET PARTITIONS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Provide wall-hung metal toilet partitions, doors, urinal screens and accessories as indicated and specified.

B. Provide compartments for physically handicapped in toilet rooms as indicated.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit layout drawings for the work of this section in detailed plans and elevations. Show fabrication method, anchoring, jointing, reinforcing, metal thicknesses and core connection to partitions, doors, screens and shower compartments. List coatings, finishes, and colors.

2. Manufacturer's literature and specifications of partitions, shower and drying compartments, hardware and accessories.

3. Color charts from manufacturer's full range of standard colors matching colors indicated in finish schedule.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver material in manufacturer's original unopened and undamaged packages.

E. Clearly identify manufacturer, brand name, contents, color, stock number and order number on each package. Damaged packages that may affect conditions of contents are not acceptable.

F. Store in original packaging under protective cover and protect from damage. Stack containers in accordance with manufacturer's recommendations.

G. Handle materials in manner to prevent damage to products and finishes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide partitions, shower and drying compartments as the product of one manufacturer.

C. Do not fabricate work until approved shop drawings have been received.

D. Allow no exposed parts of finished installation to show any manufacturer's labels, names or emblems.

E. Gages specified are U.S. Standard.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Knickerbocker Partition Corporation.

B. The Mills Co.

C. Sanymetal Products Company, Inc.

**2.02 - WALL-HUNG PARTITIONS**

A. Location and sizes on drawings.

B. Trade Names:

1. Wall-Hung Flush by Knickerbocker
2. Wall Supported Series 700 by Mills
3. Wall Supported by Sanymetal

C. Materials and Fabrication:

1. Steel: cold-rolled galvanized and bonderized.
2. Panels: two face sheets of minimum 20 gage steel formed in a wedge, 6-in. at wall, 1-1/4-in. at pilaster, with structural internal reinforcing members cemented to a honeycomb core. Provide concealed panel-to-wall connections for leveling.
3. Doors: flush type 1-in. thick of two face sheets of minimum 22 gage steel with formed edges, cemented under pressure to a sound-deadening honeycomb core.
4. Pilasters: 1-1/2-in. thick of same construction as panels except make face sheets of minimum 18 gage steel. Provide structural reinforcing for pilaster-panel fasteners.
5. Weld edges of panels, pilasters and doors at intervals of not over 18-in. and seal with a continuous oval edge interlocking molding, mitered, welded and ground smooth at corners.

D. Hardware: Provide as specified herein.

E. Accessories: Provide Combination Coat Hook and Bumper and Doorstop and Keeper as specified hereinafter.

**2.03 - URINAL SCREENS (AND VISION SCREENS)**

A. Location and sizes on drawings.

B. Flush type, 1-1/4 in. thick by approximately 18-in. deep and 42 in. high of same construction as toilet partition panels and by same manufacturer.

C. Screens: Wall hung, straight.

D. Furnish screens with integral flanges for attachment to walls.

**2.04 - HARDWARE**

A. Hinges: Nonferrous alloy, chrome plated, gravity type controlled by opposing nylon cams under spring tension, mounted on a fixed pintle.

B. Latches: Stainless steel bolt and nonferrous chrome plated handle and escutcheon.

C. Stirrup Brackets: Polished and anodized, heat treated, extruded aluminum alloy for attaching panels and pilasters.

D. Provide hardware with vandalproof one way, chrome plated, screws.

**2.05 - ACCESSORIES MATERIALS**

A. Combination Coat Hook and Bumper: Cast nonferrous alloy, chrome plated.

B. Doorstop and Keeper: Nonferrous alloy, chrome plated with rubber bumper.

C. Provide accessories with vandalproof, one way, chrome plated screws.

**2.06 - FINISHES**

A. Provide baked-on synthetic enamel finish. Colors to be selected by Design Builder from manufacturer’s full range of colors.

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Check areas to receive toilet partitions, urinal screens for correct height and spacing of support structures and plumbing fixtures that may affect quality and execution of work.

**3.02 - INSTALLATION**

A. Install toilet partitions, doors, urinal screens, and accessories in accordance with manufacturer's printed recommendations.

B. Erect compartments and related items in a rigid substantial manner, straight and plumb.

C. Leave wall clearance of approximately 1-in. for panels and pilasters unless otherwise indicated.

D. Leave door clearance of approximately 3/16-in. along vertical edge, uniform from top to bottom, unless otherwise indicated. Do not install warped or otherwise damaged doors.

E. Conceal drilling and cutting in finish work.

**3.03 - ADJUSTING**

A. Adjust hardware and leave in perfect working condition.

B. Adjust door hinges to hold door open to approximately 30 degrees.

**3.04 - PATCHING**

A. Field touch-up minor scratches.

B. Replace defective materials and finishes having deep gouges and scratches with new material or entire new panel and at no additional cost to the Design Builder.

**3.05 - CLEANING**

A. Remove protective maskings and clean surfaces.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 10200**

**LOUVERS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide aluminum louvers as specified herein and/or as shown on the Contract Drawings.

B. The extent of louver work includes the following:

1. Fixed, extruded all welded aluminum louvers.
2. Acoustical louvers.
3. Blank-off panels for louvers.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop drawings of louver units and architectural screen accessories shall include plans, sections and details, showing profiles, angles, spacing of louver blades, unit dimensions related to wall openings and construction; free areas for each size indicated; profiles of frames at jambs, head and sills; and anchorage details and locations.

2. Submit three (3) original hard copy color charts for aluminum finish.

3. Product test reports indicating compliance for louvers with performance requirements specified for standard free area, wind driven rain, airborne sound transmission loss and structural performance.

4. Product certificates signed by louver manufacturer certifying that their products, which comply with project requirements, are licensed to bear the AMCA seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Brace and support units to prevent deformation during delivery.

E. Factory wrap units with approved materials to protect finish during delivery and storage.

F. Handle units with care to prevent bending or scratching.

G. Shop Assembly for Architectural Screen: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize filed adjustments, mechanical attachment and field assembly of units. Pre-assemble units in ship to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Structural Performance: Provide exterior metal louvers and aluminum architectural screen capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft. (1440 Pa), acting inward or outward.

2. Thermal Movements: Provide louvers that allow for the thermal movements resulting from change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects.

C. Air Performance and Water-Penetration Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer’s stock units 48-in. wide by 48-in. high. Test units according to AMCA 500.

D. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer’s stock unit according to ASTM E90.

**1.08 - REFERENCES**

A. American Architectural Manufacturers Association (AAMA) Specification.

1. AAMA 611-98: Voluntary Guide Specification for Anodized Architectural Aluminum.

B. AMCA: Air Movement and Control Association Publications.

1. Test Standard: AMCA 500-L-99, Laboratory Methods of Testing Louvers for Rating, Section 8.3.1-Water Penetration Test.

2. Test Standard: AMCA 500-L-99, Laboratory Methods of Testing Louvers for Rating, Section 8.3.2-Wind Driven Rain Water Penetration Test.

C. Sheet Metal and Air Conditioning Contractors Association (SMACNA).

D. Society for Protective Coatings – SSPC – Paint 12: Cold Applied Asphalt Mastic (Extra Thick Film).

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. The Airolite Co.

B. Construction Specialties, Inc.

C. Industrial Louvers, Inc.

D. Or acceptable equivalent product.

**2.02 – MATERIALS**

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or 6063-T52.

B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Type 304A series stainless steel.

D. Provide continuous aluminum perimeter angles (alloy 6063) and anchors or type, size, and material required for loading and installation indicated. Provide stainless steel anchors.

E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers.

**2.03 - GENERAL**

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. All Welded Assembly: Joint stationary blade and frames and frame members with fillet welds concealed from view. Louver blades shall be joined to each jamb frame with a minimum of two fillet welds produced with the Pulsed Gas Metal Arc Welded (GMAW/Mig) process. Each weld shall be a minimum of 1-inch (25.4 mm) in length with a minimum 3/16-inch (4.76 mm) leg. Frames shall be joined at each corner with a full-length GMAW fillet weld with a minimum 3/16-inch (4.76 mm) throat.

D. Fabricate frames, channel type to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials; tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturers, or 72-in. (1830 mm) o.c., whichever is less.

G. Provide sill extensions fabricated of continuous 0.125-in. thick aluminum where indicated and required for drainage to exterior and to prevent water penetrating to interior.

H. Provide 0.125-in. thick interior aluminum stools where indicated on drawings. Color and finish of sills to match louver.

**2.04 – FIXED ALUMINUM DRAINABLE LOUVERS**

A. Louver Construction: Provide fixed-blade, slight-proof, drainable type louvers with extruded- aluminum frames and blades complying with the following:

1. Louver Depth: 5 in. unless otherwise indicated.
2. Frame and Blade Thickness: 0.081-in. (2.06 mm).
3. Standard Free Area: Not less than 50% based on 48-in. x 48-in. tested unit to AMCA Standard.
4. Free Area Velocity at Beginning Point of Water Penetration – 0.01 oz H20/sq. ft. Free Area: 1,134 fpm (5.76 m/s).
5. Air Volume Flow Rate at Beginning Point of Water Penetration – 4 ft. x 4 ft. Unit: 10,331 cfm (4,896 m3/s).
6. Pressure Drop at Beginning Point of Water Penetration: 0.40 in. H20 (0.100 pKa).
7. Pressure Drop at Design Air Flow Indicated on HVAC Plans: 0.10 in. H20 maximum.

**2.05 – LOUVER SCREENS**

A. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: ½-in. mesh, 0.063-in. diameter aluminum bird screening, unless otherwise indicated.
3. Screening Type: 18x14 mesh, 0.0123-in. 5056 alloy aluminum insect screening where indicated.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6-in. (150 mm) from each corner and at 12-in. (300 mm) o.c.

C. Louver Screen Frames: Fabricate rewirable screen frames with mitered corners to louver sizes indicated and with the same kind and form of metal as indicated for louver to which screens are attached.

1. Finish: Same finish as louver frames to which louver screens are attached.

D. Provide louver guards fabricated to dimensions indicated, of 12 gage steel wire woven in a ¾-in. mesh, crimped into ½-in. x 1/8-in. steel channel frames hot dipped galvanized louver guards after fabrication and shop apply two coats epoxy paint finish to match color of louver.

**2.06 – BLANK-OFF PANELS**

A. If indicated provide laminated metal-faced panels where required to seal off louver area not connected to ductwork, consisting of insulating core surfaced on back and front with metal sheets.

1. Thickness: 2-in. (50 mm).
2. Metal Facing Sheets: Aluminum sheet, 0.032-in. (0.8 mm) thick.
3. Insulating Core: Extruded-polystyrene insulation board complying with ASTM C578, Type VII.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer’s standard extruded-aluminum-channel frames 0.081-in (2.06 mm) thick, with corners mitered and with same finish as panels.
5. Finish: Same as finish applied to louvers.
6. Attach blank-off panels to back of louver frames with stainless steel sheet-metal screws.

**2.07 – FINISHES**

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers and aluminum screen after assembly.

C. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finish. Finish: High Performance Coating.

**PART 3 - EXECUTION**

**3.01 - PREPARATION**

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction.

**3.02 - INSTALLATION**

A. Locate and place louver and architectural screen units level, plumb, and as indicated alignment with adjacent work.

B. Provide continuous angle supports mitered at corners with finish to match louver.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damages by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.

G. Mount bird screens of all louvers unless indicated otherwise on inside face with clips, machine screw into frames.

H. Verify size, location and placement of continuous louvers and individual louver units prior to fabrication. Coordinate field measurement and shop assembly to minimize field adjustment.

**3.03 - CLEANING**

A. Upon completion remove any and all protective coatings and clean off all parts of the work.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 10420**

**PLAQUE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes all labor, materials, tools and equipment required to furnish and install the plaque as shown on drawings, specified herein, or evidently required to complete the work.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit camera ready art work of plaque and samples of bronze finishes and available letter types to the Engineer for approval.
2. Materials list.
3. Dimensional drawings.
4. Mounting details.
5. Fastener hardware.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Plaque fabrication and delivery shall be approximately two months prior to the completion of the project. Preliminary information is specified herein. Final information will not be available until six months prior to the scheduled completion date of the project.

## PART 2 - PRODUCTS

### 2.01 - PLAQUE

A. Plaque shall be as follows:

| Precision Tooled Plaque with Etched Insert | | | |
|---|---|---|---|
| Material | Bronze | Border | Single Line Bevel |
| Size | 36” Wide by 24” High | Color | 2025 Black (Gloss) |
| Depth | 5/16” | Style | Arial |
| Shape | Rectangle | Clear Coat | Satin |
| Copy | Raised, Horizontal Stroke | Mount | 1/4-20 Machine Screws (4), Countersunk |
| Finish | Sand Background, Brushed Surface | Rosettes | R4, 1” Diameter |

| Etched Insert | | | |
|---|---|---|---|
| Finish | Smooth with Brushed Surface | Clear Coat | Satin |
| Color | 2025 Black Fill and Edge | Size | 7” Diameter |

Note 1: The Etched Insert is the Town Seal made of the same material as the overall plaque.

B. Provide blocking in wall to support and secure plaque to surface using Type 316 Stainless Steel hardware.

C. Information shall include, but not limited to, Project Title, Town Seal, Year, Selectmen, Board of Water and Sewer Commissioners, Owners Project Manager, Engineer and Contractor. Preliminary information is as follows:

| Board of Selectmen | Board of Water & Sewer Commissioners |
|---|---|
| Alan McClennen Jr., Chairman<br>Mefford Runyon<br>Kevin Galligan<br>Mark Mathison<br>David Currier | John Meyer, Chairman<br>Herbert Kinney<br>Robert Rich<br>Richard Hartmann<br>Kenneth Rowell<br>Leonard Short |

| Town Administrator | Project Representatives |
|---|---|
| John Kelly | Thomas Daley, P.E., Director<br>Ronald Collins, P.E., Facilities Manager<br>Todd Bunzick, Water Superintendent |

| Owners Project Manager | Engineer |
|---|---|
| Tighe & Bond<br>Ian Catlow, P.E. | AECOM Technical Services, Inc.<br>Thomas Parece, P.E. |

| Contractor | Year |
|---|---|
| TBD | 2022 |

D. Final text and composition will be furnished by the Engineer with an approved submittal package.

E. Final location of Plaque to be determined by Owner.

**PART 3 - EXECUTION**

## 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

### 3.02 - MOUNTING

A. Mounting shall be in accordance with the manufacturer's written instructions.

B. Location will be as provided during construction.

## 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

**END OF SECTION**

**SECTION 10440**

**SIGNS**

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1.01 SCOPE ..... 1
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1.03 DEFINITIONS ..... 1
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1.05 PRODUCT HANDLING ..... 2
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PART 2 - PRODUCTS ..... 2
2.01 DOOR SIGNS ..... 2
2.02 SAFETY SIGNS ..... 5
PART 3 - EXECUTION ..... 5
3.01 INSTALLATION ..... 5
3.02 - CONTRACT CLOSEOUT ..... 5

## PART 1 - GENERAL

### 1.01 SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide signage as specified and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Materials list, descriptions and brochures
2. Dimensional drawings
3. Mounting details and fastener hardware.

**1.05 PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Attention is directed to SECTION 01640, SPECIAL MECHANICAL AND ELECTRICAL EQUIPMENT REQUIREMENTS wherein certain Special Mechanical and Electrical Equipment Requirements are specified. These requirements are a part of this section and relate to:

1. Substitution of Equipment.

**PART 2 - PRODUCTS**

**2.01 DOOR SIGNS**

A. The following door signs shall be furnished and installed:

| Building | Door Number | Room Name / Sign Name | Type |
|---|---|---|---|
| 10 | 101A | Wastewater Treatment Facility<br>Septage Receiving and Sludge Thickening Room | |
| 10 | 101B | Wastewater Treatment Facility<br>Septage Receiving and Sludge Thickening Room | |
| 10 | 101C | Wastewater Treatment Facility<br>Septage Receiving and Sludge Thickening Room | |

| Building | Door Number | Room Name / Sign Name | Type |
|---|---|---|---|
| 10 | 101D | Wastewater Treatment Facility<br>Septage Receiving and Sludge Thickening Room | |
| 10 | 101F | Wastewater Treatment Facility<br>Septage Receiving and Sludge Thickening Room | |
| 10 | 102B | Wastewater Treatment Facility<br>Vehicle Storage | |
| 10 | 103A | Break Room | |
| 10 | 104A | Wastewater Treatment Facility<br>Sodium Hypochlorite / PAC Room | |
| 10 | 104B | Wastewater Treatment Facility<br>Sodium Hypochlorite / PAC Room | |
| 10 | 105A | Conference Room | |
| 10 | 106A | Superintendent’s Office | |
| 10 | 107A | Copier Room | |
| 10 | 108A | Electrical Room | A |
| 10 | 108B | Wastewater Treatment Facility<br>Electrical Room | A |
| 10 | 109A | Mechanical Room | A |
| 10 | 109B | Wastewater Treatment Facility<br>Mechanical Room | |
| 10 | 110A | Storage | |
| 10 | 111A | Men’s Room | |
| 10 | 111B | Men’s Shower | |
| 10 | 113A | Women’s Room | |
| 10 | 113B | Women’s Shower | |
| 10 | 115A | Laboratory | |
| 10 | 116A | Control Room | |
| 10 | 117A | Wastewater Treatment Facility<br>Polymer Room | |
| 10 | 118A | Wastewater Treatment Facility<br>Headworks | |
| 10 | 119A | Wastewater Treatment Facility<br>Disk Filter Room | |
| 10 | 119B | Wastewater Treatment Facility<br>Dick Filter Room | |
| 10 | 120A | Utility Closet | |
| 10 | 120B | Laundry Closet | |
| 10 | 130A | Closet | |

| Building | Door Number | Room Name / Sign Name | Type |
|---|---|---|---|
| 10 | 135A | Wastewater Treatment Facility<br>Soda Ash Room | |
| 10 | V-1A | Wastewater Treatment Facility<br>Vestibule | A |
| 10 | V-1B | Vestibule and Exit | |
| 10 | CR-A | Wastewater Treatment Facility<br>Corridor | |
| 10 | S1-A | Wastewater Treatment Facility<br>Stair 1 | |
| 10 | S1-B | Stair 1<br>Exit and Pump Room | |
| 10 | S1-C | Stairwell 1<br>First floor | A |
| 10 | S2-A | Wastewater Treatment Facility<br>Stair 2 | |
| 10 | S1-B | Stair 2<br>Exit and Pump Room | |
| 10 | S2-C | Stairwell 2<br>First Floor | A |
| 20 | 002 | Equipment Storage Facility<br>Vehicle Storage | A |
| 20 | 010 | Equipment Storage Facility<br>Vehicle Storage and Work Room | A |
| 20 | 111 | Work Room | A |

1. Sign Type A shall be 6-inch by 8-inch injection molded plastic signs with pictogram and copy as indicated above. Signs shall have raised edges and squared corners. Copy shall be Helvetica Regular and color shall be selected from manufacturer's standard range. Signage shall include a Braille Cell Slug with matching copy. Type A signs shall be *Braille-Tec, 'Chemcast* Border' signs or approved equal.
2. Sign Type B shall be 4-inch by 8-inch injection molded plastic signs with squared corners and raised edges and one line of copy. Copy shall be Helvetica Regular and color shall be chosen from manufacturer's standard range. Signage shall include a Braille Cell Slug with matching copy. Type B signs shall be *Braille-Tec, 'Chemcast Border'* signs or approved equal.
3. Sign Type C shall be 4-inch by 12-inch injection molded plastic signs with squared corners and raised edges and two lines of copy. Copy shall be Helvetica Regular and color shall be chosen from manufacturer's standard range. Signage shall include a Braille Cell Slug with matching copy. Type B signs shall be *Braille-Tec, 'Chemcast Border'* signs or approved equal.

B. Room identification signs shall be ADA compliant, non-flammable, colored MP plastic with radiused corners HC300 ADA System as manufactured by Best Sign Systems or equal. Letters shall be raised 1/32-inch and shall be accompanied with Grade 2 Braille. Letter style and color shall be chosen by the Engineer from the manufacturer's standard colors. Mounting on drywall shall be with adhesive vinyl foam tape. Mounting on masonry / concrete shall be with stainless steel fasteners and expansion shields. A total of 38 interior signs are required. Final locations for the signs shall be given to the Contractor during construction.

1. Signs with one line of copy shall be 12-inch by 3-inch by 1/8-inch.
2. Signs with two lines of copy shall be 102, 12-inch by 5-inch by 1/8-inch.
3. Signs for restrooms shall be Type C and include symbols indicating gender and handicapped accessibility. Five signs required.

**2.02 SAFETY SIGNS**

A. OSHA signs shall be fiberglass 1/8-inch thick with standard OSHA headers and colors.

B. Signs shall be 10-inch by 14-inch. Sign shall be mounted using vandal resistant Type 316 stainless steel fasteners and expansion shields, where required.

C. Refer to SECTION 10600, IDENTIFICATION SYSTEMS for additional information.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. Mount signs Type A and Type B in locations as directed with construction type mastic.

B. Mounted all other signs where directed by the Engineer. Signs shall be mounted by using a minimum of four (4) Type 316 stainless steel screws.

## 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 10475**

**EMERGENCY AND MISCELLANEOUS EQUIPMENT**

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1.05 PRODUCT HANDLING ..... 2
1.06 DESIGN CRITERIA ..... 2
PART 2 - PRODUCTS ..... 2
2.01 GENERAL ..... 2
2.02 PROTECTIVE EQUIPMENT ..... 3
2.03 MISCELLANEOUS EQUIPMENT – GRAINGER INDUSTRIAL SUPPLY CATALOG ..... 4
2.04 MISCELLANEOUS EQUIPMENT – OTHER INDUSTRIAL SUPPLY CATALOGS ..... 6
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2.06 MARKER BOARD ..... 9
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PART 3 - EXECUTION ..... 10
3.01 INSTALLATION ..... 10
3.02 CONTRACT CLOSEOUT ..... 10

## PART 1 - GENERAL

### 1.01 SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide emergency and miscellaneous equipment as specified and/or as shown on the drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The work of this section shall be provided under the PART II - WWTF AND EFFLUENT DISPOSAL RELATED WORK, Bid Item 2A.

### 1.03 DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A complete list of all items including the manufacturers’ description and include samples of metal, plastics, laminated plastics, and fabrics showing the full range of colors and finish selection available.
2. Brochures and/or Catalogue Cuts including materials of construction, dimensions, minimum submergence requirements, etc.
3. Color and finish selection shall be by Engineer.

**1.05 PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

**PART 2 - PRODUCTS**

**2.01 GENERAL**

A. The following list of Protective Equipment and Miscellaneous Equipment are identified by various manufacturers’ catalogue numbers and descriptions. Equal products of other manufacturer will be given consideration.

B. All products of the same type shall be the same manufacturer.

## 2.02 PROTECTIVE EQUIPMENT

| Item Number | Description | Manufacturer and Grainger Industrial Supply Catalog No. | Quantity |
|---|---|---|---|
| 1 | Ultra-spec 2000 Anti-Fog Safety Glasses, Clear Lens Color<br>Mfr. Model # S0250X | Honeywell UVEX<br>4T513 | 10 |
| 2 | Ultra-spec® OTG (Over-the-Glass) 2001 Scratch-Resistant Safety Glasses, Clear Lens Color<br>Mfr. Model # S0112 | Honeywell UVEX<br>6T359 | 5 |
| 3 | ProLok Faceshield Assembly, Visor Material: Polycarbonate, Headgear Material: Plastic<br>Mfr. Model # 11340145 | Sperian<br>4RF25 | 3 |
| 4 | Replacement Polycarbonate Visor – Clear<br>Mfr. Model # 11390061 | Sperian<br>4RF27 | 3 |
| 5 | Chemical Resistant Gloves, Size 9, 15"L, Green<br>Mfr. Model # 37-165 | Ansell<br>3AP19 | 12 |
| 6 | Chemical Resistant Gloves, Size 11, 15"L, Green<br>Mfr. Model # 37-165 | Ansell<br>5AG52 | 12 |
| 7 | Cowhide Leather Work Gloves, Safety Cuff, Blue/Tan, Size: M, Left and Right Hand<br>Mfr. Model # 4AJ82 | Condor<br>4AJ82 | 12 |
| 8 | Cowhide Leather Work Gloves, Safety Cuff, Blue/Tan, Size: L, Left and Right Hand<br>Mfr. Model # 3AT60 | Condor<br>3AT60 | 12 |
| 9 | Black Exterior/Red Interior Electrical Gloves, Natural Rubber, 1 Class, Size 10<br>Mfr. Model # E114RB/10 | Salisbury<br>5T946 | 3 |
| 10 | Electrical Glove Protectors, White/Orange, Import Cowhide, 14” Length<br>Mfr. Model # ILP5S/12 | Salisbury<br>30L167 | 2 |
| 11 | 29dB Over-the-Head Ear Muffs, Gray<br>Mfr. Model # QM29 | Honeywell Howard Leight<br>5FV26 | 6 |
| 12 | 12"H Men's Boots, Plain Toe Type, Neoprene Upper Material, Brown, Size 10<br>Mfr. Model # 22172G/10 | Talcon Trax<br>6PPL4 | 3 |
| 13 | 12"H Men's Boots, Plain Toe Type, Neoprene Upper Material, Brown, Size 12<br>Mfr. Model # 22172G/12 | Xtratuf<br>6PPL6 | 3 |
| 14 | Barrier Post, 41 In. H, PK6 | Brady | 2 |

| Item Number | Description | Manufacturer and Grainger Industrial Supply Catalog No. | Quantity |
|---|---|---|---|
| | Mfr. Model # 92123 | 4T632 | |
| 15 | Plastic Chain, 240", Yellow<br>Mfr. Model # 2LEB3 | Tough Guy<br>2LEB3 | 2 |
| 16 | Chain Link, 2 In., Yellow, Polyethylene, PK36<br>Mfr. Model # 78246 | Brady<br>4T631 | 1 |
| 17 | Centrifugal Explosion Proof Confined Space Blower, 3/4 HP, 115VAC Voltage<br>Mfr. Model # SVB-E8EXP | Air Systems International<br>5FXZ8 | 1 |

**2.03 MISCELLANEOUS EQUIPMENT – GRAINGER INDUSTRIAL SUPPLY CATALOG**

| Item Number | Description | Manufacturer and Grainger Industrial Supply Catalog No. | Quantity |
|---|---|---|---|
| 1 | 12 ft. 375 lb. Load Capacity Fiberglass Stepladder<br>Mfr. Model # 7412 | Werner<br>4XN75 | 1 |
| 2 | 3-Step Rolling Ladder, Serrated Step Tread, 60" Overall Height, 350 lb. Load Capacity<br>Mfr. Model # A3R2630A3B3C50P6 | Cotterman<br>4XM71 | 1 |
| 3 | Bolted Workbench, Shop Top, 36" Depth, 30-1/2" to 34-1/2" Height, 72" Width, 4000 lb. Load Capacity,<br>Mfr. Model # 1005W | Edsal<br>7D189 | 6 |
| 4 | Freestanding Boltless Shelving with Steel Decking, 5 Shelves, 36"W x 18"D x 84"H<br>Mfr. Model # HCU-361884 | Edsal<br>1PWT2 | 12 |
| 5 | Electric Pallet Jack, 3000 lb. Load Capacity, Fork Size: 5-29/32"<br>Mfr. Model # EME 112 | Jungheirich<br>5NP25 | 1 |
| 6 | First Aid Kit, Kit, Steel Case Material, General Purpose<br>Mfr. Model # 019720-0009L | Honeywell North<br>4A421 | 2 |
| 7 | Lockout Station, Filled, 18" x 14"<br>Mfr. Model # 134036 | Brady<br>489K65 | 3 |
| 8 | Portable Lockout Kit, Filled, Electrical Lockout, Pouch, Red<br>Mfr. Model # 105967 | Brady<br>1TAC5 | 1 |
| 9 | 45 gal. Flammable Cabinet, 65" x 43" x 18", Manual Door Type | Eagle | 1 |

| Item Number | Description | Manufacturer and Grainger Industrial Supply Catalog No. | Quantity |
|---|---|---|---|
| | Mfr. Model # 1947 | 3W209 | |
| 9 | 55 gal. Hazardous Waste and Drum Storage Cabinet, 65" x 31-1/4" x 31-1/4", Manual Door Type,<br>Mfr. Model # 1926 | Eagle<br>3W372 | 1 |
| 10 | Yellow Polypropylene Mop Bucket and Wringer, 8-3/4 gal.<br>Mfr. Model # FG758088YEL | Rubbermaid<br>5NY79 | 4 |
| 11 | Telescopic Handle, Clamp, 54" to 66"L<br>Mfr. Model # FGH224000000 | Rubbermaid<br>1RF46 | 4 |
| 12 | Side Gate Synthetic String Wet Mop Head, Blue<br>Mfr. Model # FGA25306BL00 | Rubbermaid<br>3U680 | 8 |
| 13 | 36"W Curved Nonmarking Rubber Floor Squeegee Without Handle, Gray<br>Mfr. Model # 1ZBZ7 | Tough Guy<br>1ZB27 | 6 |
| 14 | 36"W Straight Nonmarking Rubber Replacement Squeegee Blade, Gray<br>Mfr. Model # 1ETZ9 | Tough Guy<br>1ETZ9 | 6 |
| 15 | Dust Mop Frame, Slide On, 36"W<br>Mfr. Model # 1TZG4 | Tough Guy<br>1TZG4 | 2 |
| 16 | Cotton Dust Mop, Length 36", Width 5"<br>Mfr. Model # FGJ15503YL00 | Rubbermaid<br>3U896 | 6 |
| 17 | Natural Threaded Wood Handle, Length 60"<br>Mfr. Model # 3H384 | Tough Guy<br>3H384 | 2 |
| 18 | Synthetic Push Broom, 24" Sweep Face<br>Mfr. Model # 1A847 | Tough Guy<br>1A847 | 4 |
| 19 | Manhole Cover Hook<br>Mfr. Model # 015 438 | Cherne<br>3TCR5 | 2 |
| 20 | Magnetic-Lid-Lifter<br>Mfr. Model # 9401-26A | Allegro<br>5PTN0 | 1 |
| 21 | Parking Curb, HDPE, 6 ft. x 4" x 8", Yellow, 2465 psi<br>Mfr. Model # 1790Y | Grainger<br>2GTG3 | 8 |
| 22 | Concrete Installation Kit, For Use With Parking Stop<br>Mfr. Model # CS-33-KIT-3 | Grainger<br>4UP82 | 16 |
| 23 | Key Control Cabinet, 120 Units<br>Mfr. Model # 2NET5 | Grainger<br>2NET5 | 1 |

| Item Number | Description | Manufacturer and Grainger Industrial Supply Catalog No. | Quantity |
|---|---|---|---|
| 24 | Emergency Information Center, Wall Mounted<br>Mfr. Model # IC326E | Brady<br>5RE38 | 2 |
| 25 | Right-To-Know SDS, Kit, 18’ x 24” Wall Mounted<br>Mfr. Model # ZRS347 | Accuform<br>38W964 | 2 |

**2.04 MISCELLANEOUS EQUIPMENT – OTHER INDUSTRIAL SUPPLY CATALOGS**

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 1 | 74P Tandem 4-Wheel Drum Truck Polyolefin Casters 1000 Lb. with Hand Brake | Modern Equipment MECO<br>WG988517- | 1 |
| 2 | 1 Ton Aluminum Gantry with 2 Foot Extension | Spanco<br>1ALU1210B | 1 |
| 3 | 2-Way 60' Cable & 8' Tripod Confined Space Winch Kit | Northern Safety & Industrial<br>163916 | 1 |
| 4 | Full Body Construction Harness | Guardian<br>493160 | 1 |
| 5 | Full Body Construction Harness | Guardian<br>493161 | 2 |
| 6 | Full Body Construction Harness | Guardian<br>493162 | 1 |
| 7 | GasAlert MicroClip XL Multi-Gas Monitor | Honeywell<br>MCXL-XWHM-Y-NA | 2 |
| 8 | Diesel Engine Driven Priming Assisted Centrifugal Pump w/Autostart with: (a) 2 sets of suction and discharge stainless steel quick disconnect fittings; (b) 4 sections of ridged suction hose (40-feet length); (c) 4 sections of flexible discharge hose (40-feet length); and (d) 8 sets of stainless hose connections. | Gorman-Rupp Co.<br>PA8E60-4045H FT4 mounted on MassDOT approved trailer with emergency lighting system | 1 |
| 9 | 2000 Series 52-inch W x 37.5 H 10-Drawer Steel Rolling Tool Cabinet (Red) | Craftsman<br>CMST25210RB | 1 |
| 10 | 2000 Series 52-inch W x 24.5 H 8-Drawer Ball-Bearing Steel Rolling Tool Chest (Red) | Craftsman<br>CMST25180RB | 1 |
| 11 | 298-Piece Standard (SAE) and Metric Polished Chrome Mechanic’s Tool Set | Craftsman<br>CMMT12039 | 1 |

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 12 | 25-Piece Screwdriver Set | Craftsman CMHT65046 | 1 |
| 13 | 2-Piece 10-in Steel Adjustable Wrench Set | Craftsman CMMT12002 | 1 |
| 14 | 24-in Steel Adjustable Wrench | Craftsman CMMT81627 | |
| 15 | 48-Piece ½-in Drive Shallow Deep 6-Point Standard and Metrix Combination Impact Socket Set | Craftsman CMMT16548 | 1 |
| 16 | 20-Key Standard (SAE) and Metric Hex Key Set | Craftsman CMHT26000 | 1 |
| 17 | 5-Piece 6-Point Standard (SAE) Flare Nut Open Wrench Set | Craftsman CMMT99334 | 1 |
| 18 | 5-Piece 6-Point Metric Flare Nut Open Wrench Set | Craftsman CMMT99333 | 1 |
| 19 | 2-Piece Grove Joint Plier Set | Craftsman CMHT82547 | 1 |
| 20 | 16-oz Smooth Face Steel Head Fiberglass Claw Hammer | Craftsman CMHT51398 | 1 |
| 21 | ½-in Break Bar | Craftsman CMMT44201 | 1 |
| 22 | 2-Pack Locking Plier Set | Craftsman CMHT81727 | 1 |
| 23 | 42-Piece Torx Bit Standard (SAE) and Metric Combination Drive Socket Set | Craftsman CMMT34912 | 1 |
| 24 | 12-in Extra Fine Cut Hack Saw | Craftsman CMHT20138 | 1 |
| 25 | 18-in Steel Pry Bar Set | Craftsman CMMT14107 | 1 |
| 26 | 7-Piece Standard (SAE) and Metric Splice Nut Drive Set | Craftsman CMHT65081 | 1 |
| 27 | 14-Piece Standard (SAE) and Metrix Hex Key Set | Craftsman CMHT26001 | 1 |
| 28 | 8-in Electrical Linesman Pliers with Wire Cutter | Craftsman CMHT81717 | 1 |
| 29 | 8-in Electrical Long Nose Pliers with Wire Cutter | Craftsman CMHT81645 | 1 |
| 30 | 8-in Cutting Pliers | Craftsman CMHT81648 | 1 |
| 31 | 6-in Needle Nose Pliers | Craftsman CMHT82299 | 1 |

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 32 | 8-in Electrical Long Nose Pliers with Wire Cutter | Craftsman CMHT81645 | 1 |
| 33 | Not Used | | |
| 34 | Automatic Portable Sampler for Indoor and Outdoor Use with: (a) composite sampling bottle configurations; (b) sequential sampling bottle configurations; (c) ProPak disposable sample bags; and (d) suction lines and strainers | Teledyne ISCO 6712 | 1 |
| 35 | Thermo Electron Corporation BOD Incubator, Floor Model | NPL IP-815 | 1 |
| 36 | Thermo Scientific Revco General Purpose 14.5 cu.ft. Refrigerator Model No. RLR1611A | Fisher Scientific 13-990-327 | 1 |
| 37 | Accumet XL600 Dual ph/ISE, Conductivity and Dissolved Oxygen Benchtop Meter Deluxe Kit | Fisher Scientific 13-636-XL600D0 | 1 |
| 38 | Orion Star A323 Dissolved Oxygen Portable Meter | Fisher Scientific STARA3235 | 1 |
| 39 | Accumet Excel XL60 pH/mV/Temperature/DO/ISE and Conductivity Meter | Fisher Scientific 13-636-XL600C | 1 |
| 40 | Ohaus Voyager Pro Series Analytical Balance Model No. VP214CN | Fisher Scientific 02-114-20 | 1 |
| 41 | Blue Recycling Tilt Truck 1/2 Cubic Yard and 750 Lb. Capacity | Global Industrial T9F240924 | 3 |
| 42 | Trash Can - 32 Gallon, Gray | Rubbermaid H-1045GR | 6 |
| 43 | 13-5/8 Qt. Plastic Wastebasket - Black | Global Industrial T9F261747BK | 12 |
| 44 | Toter Residential Heavy Duty 2-Wheeled Trash Can with Attached Lid, 96-Gallon, Greenstone | Toter 025596-R1GRS | 1 |
| 45 | Bin Cabinet Deep Door with 132 Yellow Bins, 16-Gauge Assembled Cabinet 38"W x 24"D x 72"H, Gray | Global Industrial T9F662147YL | 2 |
| 46 | 5-Drawer Steel Flat File for 36" x 48" Documents, Black | Safco 4998 | 1 |
| 47 | Closed Base for 5-Drawer Steel Flat File | Safco 4999 | 1 |
| 48 | 5-Drawer Letter-Size File Cabinet | Uline H-3705 | 4 |

| Item Number | Description | Manufacturer and Catalog No. | Quantity |
|---|---|---|---|
| 49 | 5-Shelf Bookcase | Uline H-3611 | 3 |
| 50 | Laboratory VIS Spectrophotometer with RFID* Technology | HACH DR3900 | 1 |

## 2.05 PROJECTION SCREEN AND PROJECTOR

A. Recessed projection screen shall be 84-inch by 84-inch ceiling mounted unit. Viewing surface to be fiberglass matt white. Screen shall be electrically operated with 120V motor mounted inside screen roller, controlled by 3 position switch to stop or reverse screen at any point. Furnish case with cover plate. Unit to be suspended from structure above. Match to Series E by Draper, Inc. Provide projection screen as manufactured by any of the following: Da-Lite Screen Co., Inc., Draper Shade & Screen Co., Inc., or Stewart Filmscreen Corp.

B. Ceiling Mounted Short Throw Projector with 3000 lumens and 18,000:1 contrast ratio, ceiling mount components, spare projection bulb, and remote control. Ceiling Mounted Short Throw Projector as manufactured by Optoma, Model No. W303St or equal.

C. Projection Screen and Projector to be located in Room 105 of the WWTF.

## 2.06 MARKER BOARD

A. High-pressure laminated, porcelain enamel marker board of 3-ply construction consisting of face sheet, core material, and backing. Face sheet shall consist of 0.024-inch enameling grade steel especially processed for temperatures used in coating porcelain on steel.

B. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face wit a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 12000 degrees Fahrenheit. Proprietary face sheet construction "Vitracite" by Claridge may be provided.

C. Match to Series 5, with clear, anodized aluminum, perimeter trim, maprail and marker holders by Claridge Product and Equipment, Inc. Panel shall be LCS marker board. Color shall be No. 32 LCS white.

D. Provide as follows:

| Item Number | Building Name / Room Name | Room ID | Outside Dimensions L by W (inches) | Quantity |
|---|---|---|---|---|
| 1 | Administration / Break Room | 103 | 60 x 36 | 1 |
| 2 | Administration / Conference | 105 | 60 x 36 | 1 |
| 3 | Administration / Supr. Office | 106 | 60 x 36 | 1 |
| 4 | Administration / Control Room | 116 | 36 x 36 | 1 |
| 5 | Equipment Storage Facility / Garage | 201 | 60 x 36 | 1 |
| 6 | Equipment Storage Facility / Work Room | 202 | 60 x 36 | 1 |

E. Marker Boards to be located in the field by the Engineer.

## 2.07 BULLETIN BOARD

A. Clear anodized aluminum perimeter trim by Claridge Product and Equipment, Inc. Series 5. Tack panel shall be ¼-inch cork on ¼-inch hardboard underlay. Color shall be 1109 Buff.

B. Manufacturer: Provide marker board and bulletin boards by any of the following: Best-Rite Chalkboard Co.; Carolina Chalkboard Co.; Claridge Products and Equipment, Inc.; Ghent Manufacturing, Inc.; Greensteel, Inc.; Lemco, Inc.; March Chalkboard Company; or Nelson Adams Company.

C. Provide as follows:

| Item Number | Building Name / Room Name | Room ID | Outside Dimensions L by W (inches) | Quantity |
|---|---|---|---|---|
| 1 | Administration / Break Room | 103 | 60 x 36 | 1 |
| 2 | Administration / Conference | 105 | 60 x 36 | 1 |
| 3 | Administration / Super. Office | 106 | 60 x 36 | 1 |
| 4 | Administration / Copy Room | 107 | 36 x 36 | 1 |
| 5 | Administration / Control Room | 116 | 48 x 36 | 1 |
| | Equipment Storage Facility / Garage | 201 | 60 x 36 | 2 |
| 6 | Equipment Storage Facility / Work Room | 201 | 60 x 36 | 2 |

D. Bulletin Boards to be located in the field by the Engineer.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner. The Contractor shall unpack all items and dispose of all unwanted packing materials.

B. The Contractor shall provide a typed and witnessed inventory of all items specified herein. The inventory shall be taken by the Contractor in the presence of the Engineer and a representative of the Owner.

C. Copies of all parts list, packing slips, warranty data, etc., shall be given to the Owner by the Contractor.

E. Wall brackets for the first aid kits, shall be installed where directed by the Engineer.

F. Provide Type 316 stainless steel mounting clips at top and angle clips at bottom, all 2’-0” on center for marker and bulletin boards.

G. Provide Type 316 stainless steel mounting hardware for shelving.

### 3.02 CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700 – CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 10506**

**METAL LOCKERS**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 3
1.07 - QUALITY ASSURANCE ..... 3
PART 2 - PRODUCTS ..... 3
2.01 - LOCKER MANUFACTURERS ..... 3
2.02 - LOCKER DATA ..... 3
2.03 - LOCKER MATERIALS AND CONSTRUCTION ..... 3
2.04 - LOCKER HARDWARE ..... 4
2.05 - LOCKER ACCESSORIES ..... 4
2.06 - LOCKER FINISH ..... 4
2.07 - BENCHES AND SUPPORTS ..... 4
PART 3 - EXECUTION ..... 4
3.01 - INSTALLATION ..... 4
3.02 - PATCHING ..... 4
3.03 - CLEANING ..... 4
3.04 - CONTRACT CLOSEOUT ..... 4

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Metal Lockers, Benches, and Appurtenances as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's product data, specifications and printed installation instructions.

2. Locker room layout and details of installation.

3. Color chips from manufacturer's complete standard range of colors.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver and store materials in manufacturer's original, unopened, undamaged containers. Keep containers and materials dry.

E. Handle materials in manner to prevent damage to products or finishes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide products of one manufacturer.

**PART 2 - PRODUCTS**

**2.01 - LOCKER MANUFACTURERS**

A. Lyon Metal Products, Inc., Aurora, IL.

B. Penco Products Inc., Oaks, PA.

C. Republic Steel Industrial Products Division, Canton, OH.

**2.02 - LOCKER DATA**

A. Locations, sizes and quantities as follows.

1. Location and Quantities: As shown on the drawings.

2. Size and Type: Men’s and Women’s Room are 15” W x 15” D x 6’ H single tier lockers.

B. Single and double tier lockers with louvers on top and bottom; sloping top; 6-in. high legs with closed base.

1. Provide hardware for each locker as specified in paragraph 2.04.

2. Provide the following accessories for each locker:

a. Coat Hooks: One ceiling hook with two prongs; three wall hooks with one prong each. Locate wall hooks on back and each side wall.

b. Number Plates: One on each locker door.

**2.03 - LOCKER MATERIALS AND CONSTRUCTION**

A. Materials:

1. Lockers: Mild annealed, cold-rolled sheet steel free from surface imperfections and suitable for receiving a high grade baked enamel finish.

2. Bolts and Nuts: Cadmium plated steel.

B. Construction:

1. Body (sides, backs, tops and bottoms): 24 gage steel. Make exposed sides 16 gage. Flange sides to give double thickness of metal at back vertical corners and with edges suitably formed to provide a rigid assembly when bolted together.

2. Door Frames: 16 gage steel formed to a channel shape, electrically welded. Add an additional flange to vertical members to form door strike. Reinforce door to prevent twisting.

3. Doors: 16 gage one piece steel adequately flanged with channel shape formations or vertical edges and right angle formations at top and bottom.

4. Louvers: Six, for each location on door.

5. Legs: A continuation of the vertical frame members with rear legs adjustable.

6. Hat Shelf: 24 gage steel, perforated, rolled front and flanged side and back. Locate approximately 9 in. below top of single tier locker.

7. Other Trim and Closure Pieces: 16 gage sheet steel formed for attachment to lockers. Include filler pieces, end panels, clips and splice plates as necessary. Factory finish to match lockers.

**2.04 - LOCKER HARDWARE**

A. Hinges: Provide at least 2-in. wide, full loop, tight pin, five-knuckle hinges welded to locker frame and securely fastened to door. Provide three hinges for each door 42-in. high or over. (Provide two hinges for each door less than 42-in. high.)

B. Locking Device: A positive, automatic type whereby locker door may be locked while open, then closed without unlocking and without damaging locking mechanism. Locking device shall engage door frame at three points. Provide lock bar of channel formation and tamperproof, operating within channel formation of door. Provide rubber silencers on latching hook, top and bottom of lifting trigger, and top and bottom of locking bar.

C. Keying: Provide lockers with built-in masterkeyed flat or grooved key locks. Supply two keys for each lock and a total of two master keys.

D. Door handles: Die-cast zinc alloy, chrome plated, either lifting or pull-out type of tamper proof design.

**2.05 - LOCKER ACCESSORIES**

A. Coat Hooks: Cadmium plated steel. Place ball points on each prong. Attach with two bolts or rivets.

B. Number Plates: Polished aluminum with black numerals not less than 1/2 in. high. Number consecutively beginning with "1" in each room. Attach plates with split rivets.

**2.06 - LOCKER FINISH**

A. Shop Finish: Heavy coat of baked on enamel applied to bonderized and phosphated steel. Apply finish to exterior and interior surfaces of fronts, ends, backs, sides and tops of lockers and exposed to view and panels.

B. Color to be selected by Design Builder from manufacturer's color charts.

**2.07 - BENCHES AND SUPPORTS**

A. Provide clear hardwood seats 9-1/2-in. wide by 1-1/4-in. thick by lengths as shown on drawings, finished with three coats of plastic sealer.

B. Pedestal Supports: 1-1/4-in. O.D. enameled steel tubing with 10 gage flanges welded to each end. Color to match lockers. Overall height: 16-3/4-in. including flanges

C. Wall Supports: Steel standards painted to match lockers.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. General: Install lockers in strict accordance with manufacturer's recommendations and in layout indicated. Install trim and closure pieces neatly, scribing to walls where required. Adjust doors and latches for proper operation and leave lockers level, plumb, neat, rigid and free from imperfections.

B. On Metal Legs: Set and align lockers carefully in position and adjust legs as necessary for level installation. Attach closed base.

**3.02 - PATCHING**

A. Field touch-up minor scratches.

**3.03 - CLEANING**

A. Remove protective maskings and clean surfaces.

**3.04 - CONTRACT CLOSEOUT**

B. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 10525**

**FIRST AID AND FIRE FIGHTING EQUIPMENT**

PART 1 - GENERAL ..... 1
1.01 - SCOPE ..... 1
1.02 - MEASUREMENT AND PAYMENT ..... 1
1.03 - DEFINITIONS ..... 1
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 2
1.07 - QUALITY ASSURANCE ..... 2
1.08 - REFERENCES ..... 3
PART 2 - PRODUCTS ..... 3
2.01 - EQUIPMENT ..... 3
PART 3 - EXECUTION ..... 5
3.01 - INSTALLATION ..... 5
3.02 - CONTRACT CLOSEOUT ..... 5

## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide First Aid and Fire Fighting Equipment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's product data, catalogs and brochures for all items specified.
2. Submit manufacturer's installation instructions.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver equipment in manufacturer's original unopened and undamaged packages.

E. Clearly identify manufacturer, brand name, contents, stock number and order number on each package. Damaged packages that may affect conditions of contents are not acceptable.

F. Store in original packaging under protective cover and protect from damage. Stack containers in accordance with manufacturer's recommendations.

G. Handle equipment in manner to prevent damage to products and finishes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. S3.1: Permissible Ambient Noise During Audiometric Testing, Criteria for.

B. U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (NIOSH).

C. U.S. Department of Labor, Mine Safety and Health Administration (MSHA).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - EQUIPMENT**

A. First-Aid Equipment:

1. Manufacturers:

a. Mine Safety Appliances Co., Pittsburgh, PA.

b. North Health Care Inc., Rockford, IL.

c. Otis Clapp & Son, Inc., Boston, MA.

2. Pack first-aid material in sturdy steel cabinet designed for industrial plant use containing wide variety of American Medical Association approved material for virtually any first-aid need capable of serving up to 50 people. Arrange materials for ready access-ibility, clearly marked for each group of dressings, arranged to be located instantly and removed easily. Include first-aid manual and contents sheet.

3. Include brackets or clips for wall mounting permitting easy movability, and stop hinges for cabinet lid permitting lid to be used as a shelf when open.

4. Locate first-aid cabinets in each of the following buildings and rooms, location determined by Engineer.

| Location | Room Number | Quantity |
|---|---|---|
| WWTF - Break Room | 103 | 1 |
| WWTF - Control Room | 116 | 1 |
| WWTF - Basement Pump Room | 126 | 1 |
| Equipment Storage Facility | 201 | 1 |
| Equipment Storage Facility – Work Room | 202 | 1 |

B. Fire Extinguishers:

1. Manufacturers:

a. Larsen’s Manufacturing Company, Minneapolis, MN.

b. Sierra Fire Equip. Co., Los Angeles, CA.

c. General Fire Extinguisher Corp., Northbrook, IL.

2. Provide the following types of fire extinguishers consisting of 10 pound, minimum stored- pressure, extinguishers with trigger-type valves, hand grips, and with a short hose and diffuser horn.

a. Types:

(1) Type 1 Dry Chemical (Class B and C) at electrical room.

(2) Type 2 Multi-Purpose (Class A, B and C)

(3) Type 3 Carbon Dioxide (Class B and C)

(4) Type 4 Clean Streaming Agent

3. Locate fire extinguishers in each of the following buildings and rooms at locations determined by Engineer.

| Type | Building | Room Number | Quantity |
|---|---|---|---|
| Type 1 Dry Chemical (Class B and C) | WWTF | 101 | 3 |
| | WWTF | 104 | 1 |
| | WWTF | 108 | 2 |
| | WWTF | 117 | 1 |
| | WWTF | 118 | 1 |
| | WWTF | 119 | 1 |
| | WWTF | 135 | 1 |
| Type 2 Multi-Purpose (Class A, B and C) | WWTF | 102 | 1 |
| | WWTF | 109 | 1 |
| | WWTF | 115 | 1 |
| | WWTF | 126 | 2 |
| | Equipment Storage Facility | 201 | 3 |
| | Equipment Storage Facility | 202 | 1 |
| Type 3 Carbon Dioxide (Class B and C) | --- | --- | --- |
| Type 4 Clean Streaming Agent | --- | --- | --- |

4. Fire Extinguishers are noted on the DRAWING 00 A-001, ARCHITECTURAL SYMBOLS, NOTES AND ABBREVIATIONS as “FE”. Each FE location is identified above and on the Drawings. All FE are to be surface mounted. No recessed cabinets.

C. Fire-Protection Cabinet:

1. Cabinet Type: Suitable for fire extinguisher and hose valve.
2. Cabinet Construction: Provide to suit wall construction indicated, including fire rating.
3. Cabinet Material: Enameled-steel sheet.
4. Semirecessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Basis of design: Larsen 2409-R7.
   a. Square-Edge Trim: 1-1/4- to 1-1/2-inch [32- to 38-mm] backbend depth.
   b. Provide with fire rated option at fire rated partitions.
5. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall; with no trim. Basis of design: Larsen 2409-SM.
   a. Door and Cabinet Trim Material: Steel sheet.
   b. Door Style: Vertical glazing.
   c. Door Glazing: Clear acrylic.
   d. Door Hardware: Manufacturer’s standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

(1) Provide projecting lever handle with cam-action latch.

(2) Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

e. Accessories:

(1) Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

(2) Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

(3) Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

(a) Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER". Letter color red.

f. Finish:

(1) Manufacturer's standard baked-enamel paint for the following:

(a) Exterior and interior of cabinet door, and trim.

(b) Color: White.

g. Provide fire rated option at fire rated partitions.

6. Mounting Brackets:

a. Mounting Brackets: Basis of design Larsen 862.

b. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

(1) Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

(a) Orientation: Vertical.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install wall mounting brackets and clips at heights as recommended by manufacturer. Attach cabinets and equipment in accordance with manufacturer's printed recommendations.

B. Correct defects and defective equipment promptly at no additional compensation to the Owner.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 10600**

**IDENTIFICATION SYSTEMS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Identification Systems as specified herein and/or as shown on the Contract Drawings.

B. Furnish and install interior and exterior signage as specified and indicated, complete with installation components.

C. Furnish and install identification tags as specified and indicated, with nomenclature labels engraved on the tags.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop drawings including elevations, dimensions, details, shape and thickness of materials, and construction and mounting details, for each type of sign.

2. Submit sign schedule, sign layout including color charts for letters, backgrounds and symbols.

3. Tagging schedule including equipment tagged and nomenclature label tags as required.

4. Manufacturer's literature indicating dimensions, materials, and installation instructions for tags, machine bolts and screws, concrete screws, nylon fasteners, and adhesives.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Provide tags installed on equipment before equipment installation wrapped with individual protective transparent covers.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide signs and tags that reference the exact equipment and structures upon which they will be attached, coordinated with PART 4.

C. Provide tags with readable nomenclature; bent, warped, or scratched tags are not acceptable.

D. Provide chemical and cleaning solvent resistant tags and signs as recommended by manufacturer, and UL listed, for service in corrosive environments.

E. Products used must have a service record with a minimum of five (5) years of service under similar service conditions.

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. ANSI A31.1: Scheme for the Identification of Piping Systems, Designation.

B. American Society for Testing and Materials (ASTM):

1. ASTM D702: Cast Methacrylate Plastic Sheets, Rods, Tubes, and Shapes

C. Military Specifications (MS):

1. MS MIL-M-43719: Marking Materials and Markers, Adhesive, Elastomeric, Pigmented; General Specification for

D. Underwriters' Laboratories (UL)

**PART 2 - PRODUCTS**

**2.01 - SIGNS**

A. General:

1. Provide signs as specified and indicated and of the types and characteristics specified in PART 4 - Sign Schedule.

2. For wall and fence-mounted signs, provide power-driven fasteners for concrete, toggle bolts and through-bolts for masonry, stainless steel machine carriage bolts for steel, lag bolts and screws for wood and gypsum wallboard, and 316 stainless steel wire for chain-link fence.

B. Provide materials in accordance with the following:

1. Provide signs that are shop assembled, and ready for installation upon delivery. Predrill or punch holes for screws or bolts.

2. Galvanizing shall be by hot-dip process after fabrication, and in accordance with ASTM A 123.

3. Aluminum Alloy: Provide aluminum alloy products fabricated in accordance with ASTM B 209. Aluminum sheet shall be at least 16 gauge, 0.09 inch thick.

4. Steel: Provide steel products fabricated in accordance with ASTM A 36.

5. Provide pressure sensitive vinyl for graphics in compliance with MS MIL-M-43719, minimum 0.005 in. film thickness. Film shall include a precoated pressure sensitive adhesive backing.

6. Acrylic Sheet: Provide acrylic sheet fabricated in accordance with ASTM D 702, Type III.

C. Aluminum Signs:

1. Provide aluminum signs and components from a single manufacturer.

2. Sign Posts: Provide 2-7/8-in. outside diameter steel pipe with 0.2-in. wall thickness and with provisions for fastening sign panels with concealed fasteners. Provide caps for each post.

a. Provide posts with one coat of zinc-chromate primer, in accordance with SECTION 09941, FIELD PAINTING. Do not coat portion of post to be embedded in concrete.

3. Sign Panels: Provide aluminum panels and interlocking components able to interlock with posts with concealed fasteners. Provide panels fabricated with a minimum of 0.090 inch aluminum.

4. Finishes: Provide reflective traffic signs finished with either semi-gloss baked enamel or two-component acrylic polyurethane approved by the Design Builder.

5. For aluminum signs mounted on posts, provide 4000 psi concrete footings, in accordance with SECTION 03300, CAST-IN-PLACE CONCRETE.

6. Provide signs with pressure sensitive precision cut vinyl letters.

7. Provide aluminum signs for regulating traffic and parking of the characteristics specified in PART 4 - Sign Schedule.

8. Provide anchors and fastener materials compatible with material to which applied and matching in color and finish.

D. Fiberglass Signs:

1. Provide fiberglass signs and mounting components from a single manufacturer.

2. Provide signs fabricated of 0.125-in. acrylic sodified polyester resin reinforced with chopped strands of fiberglass, and with photographic silkscreen graphics printed on the substrate and embedded into the fiberglass sheets.

3. Provide fiberglass signs for identifying or giving direction to buildings, facilities, rooms, galleries, and process areas, and for identifying hazardous areas, as specified and indicated.

4. Provide fiberglass signs of the characteristics specified in PART 4 - Sign Schedule.

E. Provide vinyl NFPA four-color hazard labels with adhesive backing for all chemical containers identifying hazard levels of contents.

**2.02 - INTERIOR SIGNAGE**

A. Refer to SECTION 10440 - SIGNS

**2.03 - TAGS**

A. For all equipment and items specified in DIVISION 11, EQUIPMENT, DIVISION 13, SPECIAL CONSTRUCTION, DIVISION 14, CONVEYING SYSTEMS, DIVISION 15, MECHANICAL and DIVISION 16, ELECTRICAL provide tags with the applicable and corresponding nomenclature label.

1. Include and provide tags as indicated on the drawings.

B. For equipment, provide corrosion-resistant, 0.125-in. thick plastic tags with equipment nomenclature, in white 1/2-in. lettering, engraved in black enamel background, with a minimum of 1/8-in. border around the engraved print, and with extra length to provide for fastening device. For wire and cable, provide black adhesive backed mylar tape with white nomenclature pre-printed on the tape in a letter size no greater than one outside diameter of the cable.

C. Provide materials specified below for attaching tags to equipment in accordance with paragraph 2.03D - Tagging Schedule:

1. Provide 1/8-in. by 3/8-in., Type 316 stainless steel machine screws.
2. Provide one-piece self-locking nylon tag fasteners.
   a. Provide nylon fasteners to attach tags only on non-moving parts of stationary equipment.
   b. Fasteners longer than 8-in. are not acceptable.
   c. Provide no more than one fastener per tag.
3. Provide 5-mil solvent-activated permanent adhesive.
4. For valve operator chains provide 2" heavy duty rust proof key rings, mounted through the hole in tag and around the chain such that the chain moves freely through the ring during operation.

D. Tagging Schedule:

**TAGGING SCHEDULE**

| | Equipment | Method of Attaching Tags |
|---|---|---|
| 1. | Moving equipment including but not limited to; cranes, hoists, elevators and longitudinal and cross collectors | Drill surface and use machine screws |
| 2. | Stationary equipment and structural/architectural items concrete screws for concrete; or use nylon tag fasteners or adhesives | Drill and use machine screws for steel and |
| 3. | Wiring and Cable | Adhesive-backed mylar tape |

Note: If the equipment does not fall in the above three categories consult Design Builder for tag location

**2.04 - BURIED UTILITY WARNING AND IDENTIFICATION TAPE**

A. Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument.

B. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification to read CAUTION BURIED (APPROPRIATE NAME) PIPING BELOW. Provide permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. General:

1. Provide all material, equipment, and labor to install identification systems as specified and indicated.
2. Notify Design Builder in writing of sign installation at least twenty-one (21) days in advance. Design Builder will assign exact location for each sign.
3. Prepare and clean surfaces on which signs and tags will be mounted prior to installation.

B. Signs:

1. General:
   a. Install signs plumb and true at locations as specified and as directed by Design Builder. Do not install signs on any surfaces until finishes on such surfaces have been completed.
   b. Protect work against damage during construction.
2. Post Footings:
   a. Provide vertical sides to minimize up-lift. Provide excavation and dispose of excavated material in accordance with SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.
   b. Pour concrete and set sign posts. Rod and compact concrete around posts. Slope top of footings above level of adjacent grade, and trowel finish.
   c. Set sign posts 36-in. into concrete; total depth of concrete 42-in; total width of concrete 6-in. minimum diameter, plus outside diameter of post.
   d. Hold embedded items in place during placement and curing of concrete.
3. Install fiberglass signs with hardware compatible with surface material on which sign is to be mounted, as specified in paragraph 2.01B.
4. Install NFPA labels on chemical containers.

C. Tags:

1. Attach tags to be accessible and readable without disassembly, removal, or disruption of operation of any equipment.
2. Do not install tags in path of operation of moving or moveable equipment.
3. Affix tags in accordance with paragraph 2.03D - Tagging Schedule.
   a. Tighten nylon tag fasteners such that tags do not hang more than 1-in. from equipment in accordance with manufacturer's printed instructions.
4. Drilling for Machine Screws:
   a. For fluid handling equipment including pipes, valves and pumps, and electric motors do not drill directly into wall containing the fluid or machinery; drill into flanges or support elements for attaching tags.
5. Buried Utility Warning and Identification Tape - Bury tape with the printed side up at a depth of 18-inches below final grade, except for utilities under paving, install tape 36" below final grade.

### 3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

See Attached Sign Schedule

## SIGN SCHEDULE

| LOCATION AND QUANTITY OF SIGNS | SIGN TYPE | OVERALL SIZE (in.) | LETTERING TEXT | LETTER SIZE (in.) | COLOR OF WORDING | COLOR OF BACKING | ADDITIONAL GRAPHICS |
|---|---|---|---|---|---|---|---|
| 1. At switchgear | Fiberglass | 18 x 4 | DANGER<br>HIGH VOLTAGE | 4<br>4 | White<br>Black | Red<br>White | |
| 2. At emergency shower and eyewash stations, one sign per station | Fiberglass | 7 x 10 | EMERGENCY SHOWER<br>AND<br>EYEWASH STATION | 3/4<br>1/2<br>3/4 | Red<br>Black<br>Red | White<br>White<br>White | MSDS sheets to be provided by Owner; Install two signs per tank in clearly visible locations. |
| 3. At service water hose gates, one sign per hose gate | Fiberglass | 7 x 10 | DANGER<br>SERVICE WATER (W2)<br>NOT FOR DRINKING | 1<br>1/2<br>1/2 | White<br>Black<br>Black | Red<br>White<br>White | |
| 4. Not Used | --- | --- | --- | --- | --- | --- | --- |
| 5. At service faucets, one sign per | Fiberglass | 7 x 10 | PROHIBITED<br>POTABLE WATER<br>DO NOT ATTACH HOSE<br>TO FAUCET | 1<br>1/2<br>1/2<br>1/2 | Red<br>Black<br>Black<br>Black | White<br>White<br>White<br>White | |
| 6. NFPA 704 hazard diamond symbols with signs. Mount two on each chemical storage tank and one on each door leading to chemical storage area and at Fill Stations | Vinyl<br>See Note 4 | 18 x 18 | Per NFPA | 4 | Per NFPA | Per NFPA | MSDS sheets to be provided by Owner |
| 7. Chemical (Liquid/Gas) Storage and feed rooms. Provide separate sign for each chemical indicated on the drawing for storage and feed rooms. | Fiberglass | 7 x 10 | DANGER<br>(with chemical name(s) indicated) | 1-1/2 | Red<br>Black | White<br>White | |
| 8. At Analyzer, provide signs for each chemical indicated on the drawings | Fiberglass | 4 x 10 | (with chemical name(s) indicated) | 1/2 | Black | White | |

| LOCATION AND QUANTITY OF SIGNS | SIGN TYPE | OVERALL SIZE (in.) | LETTERING TEXT | LETTER SIZE (in.) | COLOR OF WORDING | COLOR OF BACKING | ADDITIONAL GRAPHICS |
|---|---|---|---|---|---|---|---|
| | | | ANALYZER | 1/2 | Black | White | |
| 9. Sample Sink | Fiberglass | 4 x 10 | TO BE DETERMINED | 1/2 | Black | White | |
| 10. Area/room identification signs, on each side of door indicating area/room to be entered | Refer to SECTION 10440 - SIGNS | | | | | | |
| 11. Evacuation plans located as directed by the Owner. Provide a minimum of five (5) evacuation plans | Fiberglass | 17 x 11 | EVACUATION PLAN | 1/2 | Red | White | Plans to be provided by Design Builder |
| 12. Fire alarm signs, one per pull station | Fiberglass/ Plastic | 12 x 18 | FIRE ALARM (WITH ARROW) | 2 | White | Red | |
| 13. Fire extinguisher, one per extinguisher | Note 3 | Note 3 | FIRE EXTINGUISHER (WITH ARROW) | 2 | White | Red | |
| 14. No exit signs, quantity = 5, at locations per Design Builder | Fiberglass/ Plastic | 10 x 14 | NO EXIT | 2 | White | Red | |
| 15. Exit signs, quantity = 14, at locations per Design Builder | Fiberglass/ Plastic | 10 x 14 | EXIT (WITH ARROW) | 2 | White | Red | |

Notes:

1. For lettering Text specified in brackets ({ }), provide signs with contents of brackets replaced with actual unit, facility, roadway, or building name indicated.
2. For signs without overall size listed, provide signs to fit lettering with 1-1/2-inch margin.
3. Fire extinguisher signs shall be self-adhesive arrows pointing to the fire extinguisher.
4. Symbols and signs shall be self-adhesive vinyl, screen printed with UV resistant inks. No mechanical fasteners will be allowed. Provide signs identifying the
5. chemicals contained in the storage tanks and with letters 6-in. high. Color of letters and backgrounds to be selected by the Design Builder.

**SECTION 10801**

**TOILET AND BATH ACCESSORIES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Toilet and Bath Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's data and specifications and other product data required to demonstrate compliance with the specified requirements.
2. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use room designations indicated on Drawings.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE:**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Materials, devices, equipment and apparatus of a patented or of a special nature of manufacture shall be prepared, applied, or installed in strict accordance with the manufacturer's directions.

C. Work of this Section shall be executed in strict accordance with Drawings, and approved Shop Drawings.

D. Provide all holes, connections, and fastenings for and to work of other trades abutting, adjoining or intersecting work of this Section.

**1.08 - WARRANTY**

A. Provide manufacturer's standard warranty.

**1.09 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. C 1036: Flat Glass.

2. F 446: Grab Bars and Accessories Installed in the Bathing Area.

**1.10 - COORDINATION**

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

D. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

G. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of three keys to Owner's representative.

**2.02 - TOILET AND BATH ACCESSORIES**

A. Toilet Tissue Dispenser:

1. Basis-of-Design Product: Model B-4288; Bobrick Washroom Equipment, Inc.

2. Type: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.

3. Mounting: Surface mounted with concealed anchorage.

4. Material: Stainless steel.

5. Operation: Noncontrol delivery with standard spindle.

6. Capacity: Designed for two, 4-1/2- or 5-inch- diameter-core tissue rolls.

B. Combination Towel Dispenser/Waste Receptacle:

1. Basis-of-Design Product: Model B-3699; Bobrick Washroom Equipment, Inc.

2. Type: Surface mounted.

3. Towel-Dispenser Capacity: 350 C-fold or 475 multifold paper towels.

4. Waste-Receptacle Capacity: 12 gal.

5. Accessories: Vinyl, reusable waste-receptacle liner, tumbler locksets, and removable front panel at waste receptacle for cleaning ease.

C. Liquid-Soap Dispenser:

1. Basis-of-Design Product: Model B-8226; Bobrick Washroom Equipment, Inc.
2. Mounting: Lavatory mounted.
3. Capacity: 34 fl. oz.
4. Materials: Chrome-plated, high-impact resistant ABS escutcheon with bright polished finish and concealed locking mechanism; high-impact-resistant plastic body and shank; antibacterial-soap-resistant plastic cylinder valve with stainless steel spring and u-packing seal and duckbills; and shatter-resistant polyethylene container.
5. Stainless-Steel Soap Valve: Designed for dispensing soap in liquid form.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

D. Grab Bar:

1. Basis-of-Design Product: B-6806 Series, straight models; Bobrick Washroom Equipment, Inc.
2. Material: Stainless steel, 0.05 inch thick.
3. Mounting: Concealed.
4. Gripping Surfaces: Slip-resistant texture.
5. Outside Diameter: 1-1/2 inches for heavy-duty applications.

E. Sanitary Napkin Disposal Unit:

1. Basis-of-Design Product: Model B-270; Bobrick Washroom Equipment, Inc.
2. Mounting: Surface.
3. Material: Stainless steel.
4. Door or Cover: Self-closing.
5. Receptacle: Removable and reusable.

F. Mirror Unit:

1. Basis-of-Design Product: Model B-165 Series; Bobrick Washroom Equipment, Inc.
2. Frame: Stainless-steel channel.
3. Size: As indicated on Drawings.

G. Shower Curtain:

1. Basis-of-Design Product: Models B-204-2 and B-204-1; Bobrick Washroom Equipment, Inc.
2. Material: 0.008-inch- thick vinyl, with integral antibacterial agent.
3. Grommets: Corrosion-resistant at minimum 6 inches o.c. through top hem.
4. Size: Minimum 6 inches wider than opening by 72 inches high.
5. Color: White.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

**2.03 - FABRICATION**

A. General: Materials shall be free from defects impairing strength, durability or appearance.

B. Sections and shapes shall be rolled, formed, drawn or extruded as required for respective functions.

C. Molded work shall have sharply defined profile and shall be clean and straight. Plain work shall be leveled, straight and surfaces true and smooth. Edges, angles, and corners shall be square, clean and sharp, unless otherwise detailed.

D. Fastenings, exposed metal fastenings, and accessories, unless Underwriters prohibit for safety, shall be of same materials, texture, color and finish as the base metal to which applied.

E. Molds, trim, frames and other metalwork shall be proper dimensions to receive masonry block and tile, plaster, ceramic tile, or other scheduled finishes.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Provide concealed wood blocking (3/4" plywood covering 32" x 32" area) in stud walls for attachment of accessories.

2. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446. Grab bars shall be screwed to solid 2x blocking in stud partitions.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

C. Toilet Accessories:

1. Provide 1 mirror over each lavatory, in accordance with manufacturer's instructions.

2. Provide grab bars, screwed to solid blocking in stud partitions.

3. Provide one toilet paper holder for each water closet.

4. Provide one sanitary napkin disposal at each woman’s water closet.

5. Provide one combination towel dispenser/waste receptacle for each toilet room.

6. Install one soap dispenser for each lavatory.

7. Provide one shower curtain at each shower and each shower drying compartment.

**3.02 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 10999**

**BUILDING SPECIALTIES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Building Specialties as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit product data and specifications for all items specified.

2. Submit for review completely detailed drawings of items specified, included printed installation instructions for each manufacturer.

3. Indicate on shop drawings, coatings or other corrosion protection applied at the shop or in the field.

C. Show alloys, tempers and finishes, if any, on shop drawings for aluminum work.

D. Submit color charts and finishes specified.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. A123: Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products.

2. A153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. Aluminum Association Standards for Anodic Finishes.

**1.08 - RELATED WORK**

A. Section 10600: Identification Systems for interior and exterior signage

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Galvanize items indicated or specified in accordance with ASTM A123 or ASTM A153, as appropriate.

**2.02 - LETTERS FOR BUILDING SIGN**

A. Provide letters for the building signage of cast aluminum, aluminum alloy F-214, and of style indicated and height indicated. Provide stainless steel studs threaded into the letters for setting into drilled holes with adhesive cement. Anodized aluminum finish

**2.03 - SURFACE ENTRANCE MATS**

A. Manufacturers:

1. Notrax.

2. American Floor Products Co.

3. Mats, Inc.

B. Mats:

1. Basis of Design: Notrax – 118 Arrow Trax – High performance

2. Polypropylene w/ vinyl backing - Entrance Mat..

3. Sizes and colors to be selected from full selection of manufacturer’s standard.

**2.04 - HORIZONTAL BLINDS**

A. Manufacturers:

1. SWF Contract, Middleton, WI

2. Levolor, Atlanta GA.

3. Or acceptable equivalent product.

B. Horizontal Blinds:

1. Provide horizontal blinds with 25 mm/1 inch slats.
2. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising.
3. Blinds shall be inside mount.
4. Provide tapes for 50 mm/2 inch slats with longitudinal reinforced vinyl plastic in 1-piece turn ladder construction. Tapes for 25 mm/1 inch slats shall be braided polyester or nylon.
5. Color as indicated on finish schedule.
6. Horizontal blinds shall be located on all exterior windows.

C. Head Channel and Slats:

1. Provide head channel made of aluminum with corrosion-resistant finish nominal 0.61 mm/0.024 inch for 25 mm/1 inch slats.
2. Provide slats of aluminum, not less than 0.152 mm/0.006 inch thick, and of sufficient strength to prevent sag or bow in the finished blind.
3. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap.
4. Enclose all hardware in the headrail.

D. Controls:

1. The slats shall be tilted by a transparent tilting wand, hung vertically by its own weight, and shall swivel for easy operation.
2. Provide a tilter control of enclosed construction.
3. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life.
4. The tilter shall tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats.
5. Include a mechanism to prevent over tightening.
6. Provide a wand of sufficient length to reach to within 1500 mm/5 feet of the floor.

E. Intermediate Brackets:

1. Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over 1200mm/48 inch wide.

F. Bottom Rail:

1. Provide bottom rail made of corrosion-resistant steel with factory applied finish.
2. Provide closed oval shaped bottom rail with double-lock seam for maximum strength.
3. Bottom rail and end caps to match slats in color.

G. Braided Ladders:

1. Provide braided ladders of 100 percent polyester yarn, color to match the slat color.
2. Space ladders 15.2 slats per 300 mm/foot of drop in order to provide a uniform overlap of the slats in a closed position.

H. Hold-Down Brackets:

1. Provide universal type hold-down brackets for sill or jamb mount where indicated on placement list.

**2.05 - FALL PROTECTION DEVICES – Not Used**

**2.06 - ALUMINUM FLOOR HATCHES AND FRAMES – Not Used**

**2.07 - SPLASH BLOCKS**

A. Provide precast concrete splash blocks 18 in. x 24 in. by 4 in. thick with sloping, displayed drainage recess cast in top surface, and reinforced with 4 in. by 4 in. 10/10 welded wire mesh.

**2.08 - FIRE DEPARTMENT LOCK BOX**

A. Lock box shall be constructed of 14 G. steel of strength and thickness to deter forced entry. The box shall be of size sufficient to contain all keys, swipe cards, and other required items as may be deemed necessary by the Fire Marshal. The door for the box shall be hinged and secured by an approved mortise cylinder lock.

B. Boxes shall be powder coated painted a bright “RED” color so as to be readily noticeable, and have the words “FIRE DEPARTMENT” painted in at least 1-inch “WHITE” letters on the door of the box.

C. Lock boxes shall be installed on the exterior of a structure or building, as near as practical to the main entrance door. Boxes shall be located within 40 to 60 inches above the ground level and securely affixed to a wall so as not to be loose or movable. Boxes shall be positioned so as to be readily apparent upon approach to the door.

D. Fire department approval is required to install and maintain lock boxes.

**2.09 - SELF-CLOSING SAFETY GATES**

A. Manufacturers:

1. Self-Closing Safety Gate by FabEnCo, Inc.
2. Self-Closing Ladder Safety Gate by PS Corporation.
3. Self-Closing Safety Gate by FS Industries.

B. Description:

1. Provide self-closing safety gates as indicated.
2. Material: ASTM A36 galvanized steel.
3. Finish: Safety yellow powder coat.
4. Size: To suit the clear openings indicated. Field measure and verify prior to fabrication.
5. Provide mounting hardware and accessories for mounting to failing and to concrete wall. Provide gates with stainless steel springs.
6. Installation shall be in accordance with the manufacturer’s printed instructions and approved shop drawings.

C. Locations

1. DRAWING 10 A-406 – ENLARGED STAIR 1 PLANS, at the Top of Stair 1 at Grade Level.
2. DRAWING 10 A-407 – ENLARGED STAIR 2 PLANS, at the Top of Stair 2 at Grade Level.

**PART 3 - EXECUTION**

**3.01 - PREPARATION**

A. Protect aluminum surfaces which after installation would otherwise be in contact with concrete or brick masonry, or with mortar.

1. Remove dirt, grease, oil, and other foreign substance from the surface to be coated; clean with acceptable solvent; rinse with water; and dry thoroughly.
2. Apply a coat of:

a. Bitumastic Super Service Black by Koppers Co., Inc., Pittsburgh, PA.

b. Tarmastic 100 by Porter Coatings Div., Porter Paint Co., Louisville, KY.

c. 450 Heavy Tnemecol by Tnemec Co., North Kansas City, MO.

d. Or acceptable equivalent product.

3. Clean and repaint as directed areas where the protective paint has been damaged.

**3.02 - INSTALLATION**

A. Install each building specialty item in accordance with that applicable manufacturer's printed instructions and approved shop drawings and as specified herein.

B. Attach aluminum items to concrete or brick masonry with stainless steel fasteners.

C. Set anchor and expansion bolts accurately.

D. Hold embedded items accurately in place during placement of concrete.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11140**

**COMPRESSED AIR SYSTEMS**

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## PART 1 - GENERAL

### 1.01 SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide compressed air system for non-medical air piping materials, including compressors, electric motors and starters, receiver, all necessary piping, fittings, valves, gages, switches and all necessary accessories, connections and equipment as specified and/or as shown on the drawings. The Compressed Air System shall be provided as part of the Equipment Storage Facility. The location of the air compressor, hose reels and the like will be determined in the field. All piping shall be surfaced mounted within the Equipment Storage Facility.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide the following:

1. One packaged air compressor and receiver.
2. Piping, Fittings and Valves, etc.
   a) Header Piping – 1-1/2-inch x 500-feet.
   b) Drop Piping – Six at ¾-inch x 15-feet.
   c) Drop Piping Components – Each with Ball Valve, Check Valve, Pressure Reducing Value, Pressure Gauge and Hose Connections.
3. Hose Reels
   a) Three which holds 3/8-inch x 100-foot hose.
   b) Three which holds 1/2-inch x 100-foot hose.
4. Hoses and Couplings
   a) Four at 3/8-inch x 50-feet.
   b) Two at 3/8-inch x 100-feet.
   c) Four at 1/2-inch x 50-feet.
   d) Two at 1/2-inch x 100-feet.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. An allowance is specified in SECTION 01020, ALLOWANCES which is required to be utilized by the Contractor during the preparation of their bid for PART IV – ALTERNATIVES, Item A-1B. - Addition of the Equipment Storage Facility. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Compressed Air System. Paid invoices from the equipment suppliers and detailed labor, materials and supplies worksheets shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
    a. Piping and Supporting Elements
    b. Valves (Isolation Valves, Air Pressure Reducing and Regulating Valves, Automatic Drain Valves)
    c. Pressure Gages
    d. Filter capacity and operating characteristics
    e. Vibration Isolation
    f. Quick couplings
    g. Hose Assemblies
    h. Air Compressor System:
        1) Characteristic performance curves
        2) Efficiency
        3) Compressor; manufacturer and model
        4) Compressor operating speed
        5) Capacity; (free air delivered at indicated pressure)
        6) Type of bearing in compressor
        7) Type of lubrication
        8) Capacity of receiver
        9) Unloader; manufacturer, type, and model
        10) Type and adjustment of drive
        11) Electrical motor; manufacturer, frame and model
        12) Speed of motor
        13) Current characteristics and HP of motor
        14) Air muffler filter; manufacture, type, and model

15) After cooler; manufacturer, type, and model

i. Pneumatic compressed air system and hydrostatic drainage piping test reports.

j. Brazing and welding certificates.

2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

a. Complete list indicating all components of the systems.

b. Complete diagrams of the internal wiring for each item of equipment.

c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

**1.05 PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

**1.07 WARRANTY**

A. The manufacturer shall guarantee all materials and equipment to be free from all defects due to faulty materials or workmanship for a period of three years from the date of manufacturer's letter verifying proper installation and service of equipment.

**1.08 REFERENCED STANDARDS**

A. American Society of Mechanical Engineers (ASME)

1. A13.1-2007 - Scheme for the Identification of Piping Systems
2. B16.21-2011 - Nonmetallic Flat Gaskets for Pipe Flanges
3. Bl6.22-2013 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
4. B16.24-2011 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
5. B18.2.1-2012 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
6. ASME Boiler and Pressure Vessel Code - BPVC Section VIII-1-2013 - Rules for Construction of Pressure Vessels, Division 1

B. American Society for Testing and Materials (ASTM)

1. ASTM-A126-2004 (R2009) - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
2. ASTM-B32-2008 - Standard Specification for Solder Metal
3. ASTM-B61-2008 (R2013) - Standard Specification for Steam or Valve Bronze Castings
4. ASTM-B62-2009 - Standard Specification for Composition Bronze or Ounce Metal Castings

5. ASTM-B88-2009 - Standard Specification for Seamless Copper Water Tube
6. ASTM-B584-2013 - Standard Specification for Copper Alloy Sand Castings for General Applications
7. ASTM-B813-2010 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

C. American Welding Society (AWS)
1. A5.8/A5.8M AMD1-2011 - Specification for Filler Metals for Brazing and Braze Welding

D. International Code Council (ICC)
1. IPC-2012 - International Plumbing Code

E. Manufacturer Standardization of the Valve and Fittings Industry, Inc (MSS)
1. SP-70-2011 - Gray Iron Gate Valves, Flanged and Threaded Ends
2. SP-71-2011 - Gray Iron Swing Check Valves, Flanged and Threaded Ends
3. SP-72-2010a - Ball Valves With Flanged or Butt-Welding Ends For General Service
4. SP-80-2013 - Bronze Gate, Globe, Angle, and Check Valves
5. SP-110-2010 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
6. SP-123-2013 - Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

F. National Electrical Manufacturers Association (NEMA)
1. 250-2008 - Enclosures for Electrical Equipment (1000 Volts Maximum)

G. National Fire Protection Association (NFPA)
1. 70-2011 - National Electrical Code (NEC)

H. Underwriters' Laboratories, Inc. (UL)
1. 508-1999 (R2013) - Standard for Industrial Control Equipment

## PART 2 - PRODUCTS

### 2.01 PIPES, TUBES AND FITTINGS

A. Pipes shall be drawn temper, Type "K" or "L" seamless copper tube, conforming to ASTM B88 with wrought copper solder joint fittings conforming to ASME B16.22.

B. Copper unions shall conform to ASME B16.22 or MSS SP-123.

C. Cast copper alloy flanges shall be Class 300 conforming to ASME B16.24.
1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 3.2 mm (1/8-inch) maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

D. Solder filler metal shall consist of lead free alloys conforming to ASTM B32 with water flushable flux conforming to ASTM B813.

E. Silver Brazing Filler metals shall be BCuP series, copper phosphorus alloys for general duty brazing conforming to AWS A5.8/A5.8M.

F. Pipe identification shall comply with ASME A13.1. Pipe identification labels shall be located as follows:

1. At intervals of not more than 20 feet.
2. At least visible once in or above every room.
3. On both sides of walls or partitions penetrated by the piping.
4. At least once in every story height traversed by risers.

**2.02 VALVES**

A. Ball

1. Ball valves 3-inches and smaller shall be soldered, full port, two or three piece ball valve conforming to MSS SP-110. The ball valve shall have a Steam Working Pressure rating of 150 psig and a Cold Working Pressure rating of 600 psig. The body material shall be Bronze ASTM B584, Alloy C844.
2. Ball valves 4-inches and larger shall be flanged, Class 150, full port steel ball valve conforming to MSS SP-72. The body shall be split design. The Cold Working Pressure rating shall be 285 psig. The seals shall be PTFE or TFE. Ball and stem shall be stainless steel.

B. Check

1. Check valves smaller than 4-inches shall be Class 125, bronze swing check valves with non-metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a Cold Working Pressure rating of 200 psig. The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.
2. Check valves 4-inches and larger shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a Cold Working Pressure rating of 200 psig. The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends and bronze trim.

**2.03 DIELECTRIC FITTINGS**

A. Fittings joining copper alloy and ferrous materials shall be isolated.

B. Dielectric unions shall be factory fabricated union assemblies, rated at 250 psig minimum working pressure at 180 degrees F suitable for compressed air service.

C. Dielectric flanges shall be factory fabricated companion flange assemblies, rated at 300 psig minimum working pressure at 180 degrees F suitable for compressed air service.

**2.04 FLEXIBLE PIPE CONNECTORS**

A. Stainless steel hose flexible connectors shall be corrugated, stainless steel tubing with stainless steel wire braid covering and ends welded to inner tubing. The stainless steel hose connectors shall be rated at 200 psig minimum. The end connections for NPS 2-inches and smaller shall be threaded steel pipe nipple. The end connections for NPS 2-1/2-inches and larger shall be flanged steel nipple.

B. Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing. The corrugated-bronze tubing shall be rated at 250 psig minimum.

## 2.05 SPECIALTIES

A. Pressure gages permanently installed in the system shall be listed for compressed air service and shall include a snubber or pulsation dampener and an isolation valve for maintenance access.

1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 4-1/2-inches, for compressed air, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be labeled for appropriate service and marked "USE NO OIL".

2. For all services downstream of main shutoff valve: Manufactured for compressed air use and marked "USE NO OIL", 1-1/2-inch diameter gage with dial range 1 to 200 psig for air service.

B. Air Pressure Regulating Valves:

1. Air pressure regulating valves under NPS 3-inches shall be pilot or diaphragm operated, bronze body and trim, direct acting, spring loaded manual pressure setting adjustment and rated for 200 psig inlet pressure. Delivered pressure shall not vary more than 0.15 psig for each 1.5 psig variation in inlet pressure.

2. Air pressure regulators 3-inches and larger shall be pilot operated, bronze body, direct acting, spring loaded manual pressure setting adjustment and rated for 250 psig inlet pressure. Delivered pressure shall not vary more than 0.15 psig for each 1.5 psig variation in inlet pressure.

C. Safety valves shall be constructed according to the ASME BPVC Section VIII and be National Board Certified, labeled, and factory sealed. The safety valve shall be constructed of bronze body with poppet type safety valve for compressed air service.

## 2.06 HOSES AND REELS

A. Hoses and couplings shall be suitable for compressed air service of 3/8-inch through 3/4-inch diameter and rated for 250 psig minimum working pressure and a minimum 1,000 psig burst pressure.

B. Hoses shall be rubber, spiral synthetic yarn reinforced with a resistant (weather, oil, solvents) outer coating.

C. Quick Connect Couplings shall be two-piece straight through, threaded brass for connecting two sections of hose. Quick connect coupling assemblies shall have a locking mechanism constructed to permit one-handed feature for quick connection and disconnection of compressed air hose and equipment

D. Hose Reels shall be spring-retractable, all-steel construction and baked-on powder-coat finish with dual pedestal base and guide arm, containerized spring assembly, field adjustable guide arm designed for wall or ceiling mounting positions.

## 2.07 AIR COMPRESSORS

A. The packaged air compressor and receiver shall be factory assembled, wired, piped, and tested.

B. Air Compressors shall be Fully Packaged Model 2475N5 FP as manufactured by Ingersoll Rand or equal.

1. Two stage reciprocating design, air cooled, vertical configuration, and tank mounted rated for continuous duty.

2. Motor shall be 5 HP, 240 V, ODP, NEMA 1 and designed to operate in 120 degrees F ambient temperature with a mounted motor starter.

3. 80 gallon ASME Coded Air Receiver.

4. Delivers 16.8 CFM at an operating pressure of 175 psig with an air treatment system that delivers dry, clean air.

5. Oil Sight Glass and Low Oil Level Switch.

C. Accessories

1. Startup Kit. Startup Kit shall include all parts needed to correctly start up and maintain the system for the first year of operation including 5-year extended warranty, All Season Select® lubricant, replacement air filter elements, Product sheet and proof-of-warranty decal. Startup Kit shall be Item No. 32305880 by Ingersoll Rand or equal.
2. Inlet Pressure and System Pressure Controller through a single device. Controller shall be Model PacE™ as manufactured by Ingersoll Rand or equal.
3. Inline Filter to remove soils particles, liquid water, oil and aerosols as manufactured by Ingersoll Rand or equal.
4. Electronic Drain. Valve shall be Model EDV-2000 Electric Condensate Drain as manufactured by Ingersoll Rand or equal.
5. Air Cooled Aftercooler as manufactured by Ingersoll Rand or equal.

**PART 3 - EXECUTION**

**3.01 VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 INSTALLATION**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Installation of the equipment shall be in accordance with written instructions provided by the manufacturer and as approved.

C. Piping shall be installed exposed in mechanical rooms and service areas.

D. All pipes shall be installed at right angles or parallel to building walls. Diagonal runs are prohibited unless indicated.

E. Piping installed adjacent to equipment shall be located to allow for the required service clearances.

F. Air and drain piping shall be installed with a 1 percent slope downward in direction of flow.

G. Nipples, flanges, unions, transitions, and special fittings, and valves shall be installed with pressure ratings same as or higher than system pressure rating.

H. Cast copper alloy companion flange with gasket and soldered joints shall be used to connect equipment and specialties with flanged connections.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Only eccentric reducers shall be installed where compressed air piping is reduced in direction of flow, with bottoms of both pipes and reducers fitting flush.

K. Branch connections shall be installed from the top of the main compressed air line. Drain legs and drain trap shall be installed at the end of each main and branch and at all low points in the system.

L. Thermometers and pressure gages shall be installed on discharge piping from each air compressor and on each receiver.

M. Valves shall be installed to permit servicing to all equipment.

N. Pipes shall be installed free of all sags and bends.

O. Piping shall be cut square and accurately with a tube cutter (sawing is not permitted) to measurements determined at place of installation and worked into place without springing or forcing the pipe. Tube must bottom in each solder

socket so there are no gaps between tube and fitting where solder can enter the inside of line. The tube shall be reamed to remove burrs, being careful not to expand tube and that no chips of copper remain in the line. Care shall be exercised in handling equipment and tools used in cutting or reaming of pipe to prevent oil or grease being introduced into piping.

P. Particular care shall be exercised, when flux is applied to avoid leaving any excess inside the completed joints. Thoroughly wash the outside of each joint with clean hot water after assembly to remove oxide coating.

Q. Hanger spacing shall be based upon NFPA 99.

R. The Filtered Muffler shall be mounted to the air compressor outdoor intake line without the use of foundations or support frames. Silencer tubes shall be located between the filter and the housing.

S. Rigidly support valves and other equipment to prevent strain on tube or joints.

T. Compressor assembly shall have an equipment identification nameplate.

U. Suitably brace piping against sway and vibration. Bracing shall consist of Type 316 stainless steel brackets, anchor chairs, rods, and structural steel for vibration isolation.

**3.03 PAINTING**

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09900, PAINTING.

**3.04 CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment including piping and valves and concrete surfaces.

**3.05 MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided for installation, startup and testing for the system – One working day.

**3.06 MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided for training on the system – One working day.

B. Training shall be performed at the project site.

**3.07 LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 SPARE PARTS – Not Used**

**3.09 FIELD TESTING**

A. Preliminary Testing

1. Preliminary tests shall be performed by the contractor prior to testing witnessed by the Engineer. Tests shall be pneumatic and shall use dry, oil-free compressed air.

2. Testing shall include preliminary testing by swabbing joints under test with standard soap solution and observing for bubbles at internal pressures not in excess of 5 psi.

3. When testing reveals system leakage, isolate and repair the leaks, replace defective materials where necessary, and retest the system until there is no loss of pressure. Remake leaking gaskets with new gaskets and new flange bolting, and discard used bolting and gaskets.

4. Drainage piping shall be hydrostatically tested to a pressure of 5 psi to ensure the piping does not leak. Repair all observed leaks and retest until all leaks have been corrected.

B. Start-up and Testing

1. As recommended by manufacturer and listed standards and under actual or simulated operating conditions,

pneumatic tests shall be conducted to prove piping system integrity and full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system. Tests shall be pneumatic and shall use dry, oil-free compressed air.

2. Tests shall include initial piping purge test, initial pneumatic test for positive–pressure gas systems, initial cross-connection test, and initial standing positive-pressure gas piping tests, system capacity, control function, and alarm functions.

3. Pneumatic tests shall be performed utilizing a test pressure of 50 psi higher than the maximum allowable working pressure, minimum of 150 psi. Test pressure shall be maintained for a minimum period of four hours to ensure the temperature in the piping system stabilizes, then the pressure is refreshed and held for two hours with no loss of pressure. Pneumatic testing performance shall be in accordance with industry safety standards with the pressure gradually increased in increments of 25 percent of the maximum allowable working pressure until the required test pressure is reached. At each interval, the system pressure shall be held long enough for piping strains to stabilize. If leaks are observed, the leaks shall be identified, the system de-pressurized and repairs made before proceeding.

4. Other than standard piping flanges, plugs, caps and valves, only use commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. Published safe test pressure rating of any plug used shall be not less than three times the actual test pressure being applied. During pneumatic testing evacuate personnel from areas where plugs are used.

5. Remove components that could be damaged by test pressure from piping systems to be tested.

6. Perform valve-operating tests and drainage tests to insure valves do not leak when operating under pressure and are correctly labeled.

7. Check piping system components, such as valves, for proper operation under system test pressure.

8. No test media shall be added to a system during a test for a period specified or determined by the Engineer.

9. Prepare and maintain test records of all piping systems tests. Records shall show the Engineer and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates.

10. System verification and final testing shall be conducted comprising of a system verifier standing pressure test, verifier cross-connection test, verifier piping purge test, verifier final tie-in test, verifier operational pressure test, verifier piping particulate test, verifier piping purity test, labeling, and source equipment verification test.

11. When any defects are detected, correct defects and repeat test at no cost to the Owner. When testing reveals system leakage, isolate and repair the leaks, replace defective materials where necessary, and retest the system until there is no loss of pressure. Remake leaking gaskets with new gaskets and new flange bolting, and discard used bolting and gaskets.

12. The Engineer will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Engineer. Provide a minimum of 7 days written notice.

## 3.10 CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700 – CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11306**

**PREFABRICATED LOW-PRESSURE SEWAGE PUMP SYSTEMS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The work of this section includes furnishing all equipment necessary to manufacture, store and deliver a Type C exterior Prefabricated Low-Pressure Sewage Pump Systems (Systems) and appurtenances as specified here and which is to be used for the In-Plant Pump Station.

B. The systems shall be complete factory-built and tested Systems of the wet well-dry well type. The wet well shall consist of a grinder pump suitably mounted in a high-density polyethylene (HDPE) basin. The basin shall include 100-year flood zone protection components and anti-buoyancy devices, as applicable. The unit shall have a separate dry well containing a National Electrical Manufacturers Association (NEMA) 4X electrical quick disconnect; pump removal system, stainless-steel shut-off valve assembled within the dry well basin. The anti-siphon valve and check valve shall e assembled within the wet well basin as part of the pump core assembly. The unit shall also be supplied with an electrical alarm/disconnect panel, and all necessary internal wiring and controls. The pump shall be a semi-positive displacement type grinder unit. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required with the section, but are not limited to the following:

1. Shop Drawings, including all equipment and components. The sheets shall list all pertinent product data such as name, catalog number, model number, nameplate data, dimensions etc. The submitted data shall be organized into separate loose-leaf three-ring binders according to the type of site such as tanks, and booster pump station, etc.

2. In order to assist with the evaluation of the submittal, Appendix A shall be filled out and submitted as part of the shop drawing review process. It shall be signed by an officer of the corporation of the Manufacturer and properly witnessed.
3. Manufacturer's brochures and/or catalogue cuts for all materials and equipment and shall include at least the following: (a) software; (b) DC power supplies; (c) terminal blocks; (d) conductors; (e) surge protection; (f) enclosures; (g) drawings; and (h) wiring diagrams.
4. Manufacturer's certification of a minimum of 1,000 operating systems and Manufacturer's certification of a minimum of 10-years' operating experience or, in lieu of this experience, an irrevocable letter of credit or dual obligee performance bond.
5. Manufacturer's authorized service center's evidence of an established 24-hours/7 days per week service program including maintaining spare parts and service manuals located within 2-hours of the project site.
6. Manufacturer's authorized service center's proof of an established service program including complete spare parts and service manuals.
7. Performance curves.
8. Motor Data in accordance with Specification SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.
9. Control Panels:
    A. Bill of Materials including manufacturer, model number and quantities.
    B. Annotated product cut sheets for enclosures and control panel components. System Operation and Maintenance Manual including equipment, components and spare parts list.
    C. Front elevations of control panels showing dimensions, location of panel interior and exterior mounted components. Provide control panel elevation drawings with and without doors.
    D. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    E. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, electrical and instrumentation drawings.
10. Certification of Equipment Manufacturer's Experience as specified herein.
11. Warranty and Service Agreement as specified herein.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance. The equipment shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture. If stored for more than 2-weeks, the equipment shall receive all maintenance considerations required by the Manufacturer for proper storage of the equipment.

B. All Systems shall be delivered to the job site, 100-percent assembled including pump(s) and level controls, except where partial disassembly is required by transportation regulations or for protection of components. Panels are to be delivered separately but 100-percent assembled. The Systems shall have been factory tested and shall be ready for installation.

C. The manufacturer shall be responsible for providing a factory authorized service technician on site for any final assembly required including the installation and wiring any components in the basin, such as the pumps and level controls, at no additional cost to the OWNER or the Contractor.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment covered by this specification are intended to be standard materials and equipment of proven ability as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the Manufacturer's recommendations and as specified herein. The specifications call attention to certain features but do not purport to cover all details entering into the manufacture of the equipment. All work shall conform to the requirements of SECTION 01640, SPECIAL MECHANICAL AND ELECTRICAL EQUIPMENT REQUIREMENTS.

B. The equipment specified hereunder is based on a prefabricated low-pressure semi positive displacement sewage pump system. All pumps and appurtenances must be supplied by a single Manufacturer. The lack of a "named supplier" does not relieve the Manufacturer from providing equipment for exterior installations that meet all mechanical, performance, warranty and service agreement requirements as specified herein. The System has been designed for Semi-Positive Displacement Pumps (designed to operate at a near constant flow rate over its performance curve) and therefore centrifugal pumps are not acceptable.

C. The System specified shall be the product of a company experienced in the design and manufacture of Semi-Positive Displacement Pumps specifically intended for use in low-pressure sewage systems.

   a. Manufacturers proposing equipment for this project shall have at least 10-years' experience in the design and manufacture of Semi-Positive Displacement Pumps of identical size and mechanically similar to the specified units which have been in successful operation at no less than 1,000 low pressure sewage pump system installations and having not less than 10-years of experience in supplying the specified product in a minimum of 10 municipal facilities of the type stated herein within the Northeastern United States region (New England and the Middle Atlantic (NY, NJ, PA, DE, MD, VA, WV) states) with preference given to facilities located in the New England states. An installation is defined as multiple pumps (greater than 25) discharging into a common low-pressure sewer system. The proposal shall include the names, addresses and telephone numbers of the Contact person for each of at least 5 of the listed references. Acceptable references shall be the owner/operator of the referenced facilities.

   b. Manufacturers shall submit detailed installation and user instructions for its product and provide evidence of an established 24-hours / 7 days per week service support program including maintaining spare parts and service manuals located within 4-hours of the project site.

D. In lieu of this experience, the Manufacturer may submit a letter of credit or dual oblige bond for 100 percent of the cost of each System to be supplied. Submittals which do not include the required Certified Letter will be summarily rejected and returned to the Manufacturer without further review and consideration. The irrevocable letter of credit or dual oblige bond shall be retained by the OWNER until the installed equipment has passed the specified performance testing, the equipment has been accepted by the OWNER, and has successfully operated for a period of 2-years.

E. Supervisory Control and Data Acquisition Qualifications – Not Used

**1.07 - WARRANTY AND SERVICE AGREEMENT**

A. The Manufacturer shall provide the OWNER with a warranty and service agreement with a factory authorized service center for each of the System manufactured and delivered. The warranty and service agreement shall be provided by and maintained by the Manufacturer. Third party agreements are not acceptable. The warranty and service agreement shall be between the OWNER and the Manufacturer and shall start upon acceptance of the System by the OWNER.

B. The System and associated appurtenances shall require no periodic maintenance. If periodic maintenance is required, it shall be performed by the Manufacturer at no cost to the OWNER and/or Contractor during the warranty period and/or service agreement period. The following are considered to be maintenance issues covered by warranty and/or service agreement period:

1. Clogging or jamming of the grinder assembly due to accumulation of components found in normal sewage systems. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of sewage solids such as paper, sanitary napkins, disposable diapers, wood, plastic, glass, rubber, and the like to finely divided particles which will pass freely through the passages of the pump and the small diameter discharge piping. Abusive amounts of debris such as cloth towels, excessive amounts of wipes and trashy debris shall not be deemed as normal domestic sewage.
2. Repair and/or maintenance of level controls for any reason.
3. Any periodic oil changes as required by the Manufacturer's standard operation and maintenance/service manual.
4. Repair and or maintenance of the cutting mechanism for any reason.
5. A authorized factory technician(s) and/or representative(s) first response to a high-water alarm for any reason exclusive of power failures.

C. Warranty

1. The OWNER will report any defects and or alarms found during the warranty period to the Manufacturer’s authorized service center. The Warranty shall be a 100 percent on-site warranty (labor, equipment, parts, travel expenses, etc.). Warranty repairs will be made free of charge. Non-warranty repairs such as those resulting from misuse or installation related issues will be charged at $100.00 per hour as adjusted in accordance with Paragraph 1.07.D.(d). Repair will be made free of charge and be made on-site by an authorized service center. Service Center shall respond within 24-hours of notice given to the Manufacturer’s authorized service center by the OWNER. The Manufacturer’s authorized service center shall provide pump equipment loaners at no charge in the event that repairs cannot be completed on site in a timely manner.
2. The Manufacturer shall provide a warranty covering all Manufacturer defects on the complete System and accessories, for a period of 2-years after notice of OWNER’s acceptance.
3. The warranty shall cover all costs including but not limited to labor, materials, and expenses of the Manufacturer.

D. Service Agreement

1. Manufacturer’s authorized service center shall provide a service agreement on parts and labor on the complete System and accessories for a period of 10-years after notice of OWNER and Contractors acceptance. The service agreement shall cover all necessary repairs to the units.
   (a) Site visits and repairs for warranty issues during the warranty period shall be performed by the Manufacturer’s authorized factory technician(s) and/or representative(s) at no charge.
   (b) Site visits and repairs required because of normal wear and tear (non-warranty issues) during the second 5-years shall be performed by the Manufacturer’s authorized factory technician(s) and/or representative(s) at the Manufacturer’s service rate of $90 per hour plus parts.
   (c) Site visits and repairs required because of misuse and/or abuse during the 10-year period shall be performed by the Manufacturer’s authorized factory technician(s) and/or representative(s) at the Manufacturer’s service rate of $100 per hour plus parts.
   (d) Every 2-years, the hourly rate shall be adjusted according to a U.S. Department of Labor and Industries Index that is mutually agreeable between the OWNER and the Manufacturer’s authorized service center.

2 The terms “misuse and abuse” refers to any clogs, jamming or complications of the grinder pumps not due to normal domestic sewage, including a reasonable amount of sewage solids such as paper, sanitary napkins, disposable diapers, wood, plastic, glass, rubber, and the like to finely divided particles which will pass freely through the passages of the pump and the small diameter discharge piping.

3 The OWNER will report any defects/alarms found during the service agreement period to the Manufacturer’s authorized service center. Repairs will be made on-site by an authorized service center. Service Center shall respond within 24-hours of notice given to the Manufacturer’s authorized service center by the OWNER. Manufacturer’s authorized service center shall provide pump equipment loaners at no charge, in the event that repairs cannot be completed on site in a timely manner.

4 The Manufacturer shall maintain an authorized service center within 4-hours of the OWNER for the duration of the service agreement period.

**1.08 - INSTALLER TRAINING**

A. The Manufacturer shall provide authorized factory technician(s) and/or representative(s), who have knowledge of the proper equipment operation and maintenance as specified for each type of equipment (instrument and control system considered one piece of equipment) to conduct an installer’s training seminar for the Contractor. The OWNER and/or their representatives may attend the training seminar. The Manufacturer shall issue a certification of the training to each participant. Failure to provide this training seminar will result in the Manufacturer being responsible for all repair costs caused by the improper installation.

B. The Manufacturer shall prepare and conduct an 8-hour comprehensive installer, service troubleshooting and start up training seminar in order to reinforce the Manufacturer’s installation and service manuals. The seminar shall take place at a location identified by the OWNER. The seminar shall include at least the following:

1. System basics (design, components, and operation and maintenance);
2. General electrical troubleshooting of alarm panel, Power supply to pump, investigation of house service supply to panel, pumping station observations;
3. Pump diagnostics to include complete pump disassembly and component by component inspection and replacement procedure;
4. Pump re-assembly, testing and placement back into service;
5. Pumping station installation process, inspection points and recommended procedures. Discussion of electrical supply, piping, plumbing, ballast requirements, and system performance issues;
6. Off season shut-down (Winterization); and
7. System inspection and startup procedures.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. The Manufacturer shall furnish complete factory-built and tested units, each consisting of a grinder pump suitably mounted in a high density polyethylene (HDPE) basin, NEMA 4X Alarm/Control Panel, NEMA 6P electrical quick disconnect, pump removal system, shut-off valve, anti-siphon valve, and check valve assembled within the basin, remote electrical alarm/disconnect panel (and all necessary internal wiring and controls). The pump(s) shall be a semi-positive displacement type grinder unit. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower.

B. The equipment shall be designed to receive and grind untreated sanitary sewage from a building connection and pump it into a low-pressure sewer system and/or gravity sewer system.

C. The equipment shall be designed and manufactured for installation with salt water contact and/or atmospheric conditions.

D. The equipment shall conform to requirements for materials, installation, and approvals of state, local, Underwriters Laboratories, Inc., NEC, NEMA, ASTM, NSF and other applicable codes.

E. The equipment shall be free from electrical and fire hazards as required in residential and/or non-residential environments. As evidence of compliance with this requirement, the completely assembled and wired equipment in its tank shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. The grinder pump shall meet state and local standards for plumbing equipment for use in and/or near residences and/or non-residential locations, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low-pressure sewer system applications. As evidence of compliance with this requirement, the pumps shall bear the National Sanitation Foundation seal.

**2.02 - DESIGN DATA**

A. Each pump shall be of a semi-positive displacement type such that the output capacity is essentially independent of the discharge pressure. The pump shall be designed to deliver 11 GPM at a total dynamic head of 92 feet (40 psig) and 7.8 GPM at 185 feet (80 psig) of total dynamic head on a continuous basis. At zero head the pump output shall not be more than 15 GPM. Each pump shall be capable of pumping at a negative head of 100 feet. The pumps shall be capable of intermittent operation (3-minute minimum) at any head.

B. Pumps shall be driven by a 1 horsepower maximum, 230 Volt, single-phase motor with a maximum pump speed of 1,725 RPM.

**2.03 - MATERIALS**

A. Iron castings, shapes and bars: ASTM A48 Class 30.

B. Other Materials: Applicable ASTM specifications unless otherwise specified.

C. Corrosion Protection: All materials exposed to wastewater shall have inherent corrosion resistance or protection (i.e. cast iron, HDPE, stainless-steel, PVC, etc.).

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**2.04 - EQUIPMENT TYPE AND DESIGN**

A. Include all equipment, control, accessories and appurtenances necessary to make complete systems.

B. The Systems, as noted herein, shall be complete, Factory Built, UL Listed, Package Station of the Wet well-Dry well type shall consist of:

1. The self-contained “core” unit which contains the semi-positive displacement pump, electrical quick disconnect, level sensors, and all controls necessary to operate the pump unit.

2. The tank with a wet well and separate integral dry well access way assuring that one will not be directly exposed to raw sewage (for exterior unit), discharge piping, pump removal system, electrical quick disconnect, shut-off ball valve, anti-siphon valve, check valve and other appurtenances. For safety reasons open wetwell designs will not be acceptable with exception to Type C Station.

3. Electrical wiring.

4. Alarm disconnect panel for all units.

**2.05 - CORE UNIT**

A. GENERAL

1. Each pump core unit shall consist of a cartridge-type easily removable module comprising a pump motor, grinder, liquid level controls, electrical quick disconnect for exterior unit, discharge check valve, anti-siphon valve, Type 316 stainless-steel discharge piping and necessary internal wiring.

2. The controls included in the core unit shall provide for fully automatic operation of the grinder pump assembly, and no external control panel shall be required for normal operation of the grinder pump unit.

3. The watertight integrity of the core unit shall be established by factory test at a minimum pressure of 5 psig.

4. Exterior core unit shall have two lifting eyes on the top housing to facilitate removal of the core unit from the tank when necessary. Core unit shall have latching mechanism to lock the core into place in the station. The latching device shall be able to be operated from above without entry into the System.

5. Type C Core shall be of same type, horsepower and maintain the same performance rating as Type A and Type B stations with exception of the Core latching mechanism to lock the core into place in the station. Type C station cores are the only exception to wet well dry well configurations permitted in this contract.

B. PUMP

1. The pump shall be an electric motor driven, vertical rotor, solids handling pump of the progressing cavity type provided with a mechanical seal. It shall be specifically designed for low-pressure sewer service.

2. To prevent motor head misalignment that would result in grinder striking and binding, the pump shall be housed in an ASTM cast iron housing. Carbon steel or "plastic type" housings will not be acceptable.

C. ROTOR

1. The pump rotor shall be through-hardened highly polished precipitation hardened stainless-steel.

D. STATOR

1. Stator material shall be an ethylene propylene synthetic elastomer compounded for use in domestic sewage service. Its properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and wear resistance.

2. The stator shall be designed and mounted in such a way as to accommodate rotor run-out and permit direct connection of the rotor to the motor shaft with no intermediate flexible coupling.

E. GRINDER

1. The grinder shall be positioned immediately below the pumping elements, and the grinder impeller shall be direct-driven through the pump rotor and securely fastened to the pump rotor shaft. The grinder shall be of the rotating type with a stationary hardened and ground chrome steel shredding ring spaced in accurate close annular alignment to the driven impeller assembly which shall carry two hardened Type 400 series stainless-steel cuter bars.

2. This assembly shall be balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be designed and constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. In order to accomplish the foregoing the grinder pumps shall comply with the following requirements:

   a. The grinder shall be positioned in such a way that solids are fed in an up-flow direction.

   b. In order to control inlet velocity to the grinder, the pump inlet opening shall have a diameter of no less than 5-inches.

   c. At maximum pump capacity the average inlet velocity shall not exceed 4 feet per second.

   d. The grinder rotational speed shall not exceed 1,800 RPM.

   e. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of sewage solids such as paper, sanitary napkins, disposable diapers, wood, plastic, glass, rubber, and the like to finely divided particles which will pass freely through the passages of the pump and the 1-1/4-inch diameter discharge piping.

F. ELECTRIC MOTOR

1. Provide motors in accordance with Specification SECTION 01171 – ELECTRIC MOTORS.

2. Provide motor rated for use for Class I, Division I environment.

3. Motors shall be air filled and require no periodic maintenance. Oil filled motors that require periodic oil changes will not be acceptable.

G. MECHANICAL SEAL

1. A mechanical seal shall be provided to prevent leakage between the pump and the motor cavity. The seal shall have a stationary ceramic seat and a carbon rotating sealing surface with faces precision lapped and held in position by a stainless-steel spring. The stationary face of the mechanical seal shall be mounted in a precision machined counter bore in a cast housing to assure long-term concentricity with the motor shaft.

2. The use of plastic components shall not be deemed acceptable given the potential for creep in the critical alignments that could promote seal failure.

H. INTEGRAL CHECK VALVE

1. Each System shall be equipped with a factory-installed, gravity operated flapper type check valve built into the discharge pipe assembly. This valve shall provide a full-port passageway when open and shall introduce a friction loss of less than 6-inches of water at maximum rated pump flow. Working parts shall be made of Type 304 stainless-steel or fabric reinforced synthetic elastomer to insure corrosion resistance, dimensional stability, and fatigue resistance.

2. A non-metallic hinge shall be an integral part of the flapper assembly providing maximum degree of freedom for assured seating even at very low back pressure. “Hinge pin” connections that promote debris accumulation are not acceptable.

3. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The working pressure of the valve shall be at least 235 psi.

4. Ball type check valves are unacceptable due to their limited sealing capacity in slurry applications.

I. ANTI-SIPHON VALVE

1. To ensure that the pump cannot lose prime even under negative pressure conditions in the discharge piping system, the System shall be equipped with an integral anti-siphon vacuum relief valve in the discharge piping just below the integral check valve.

2. The valve shall be designed to open to atmosphere whenever pressure in the discharge line is less that atmospheric and automatically close whenever the pump pressurizes the line. Moving parts will be made of Type 304 stainless-steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin.

3. Anti-siphon port diameter shall be no less than 60 percent of the inside diameter of the pump discharge piping.

4. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

J. DISCHARGE PIPING

1. Discharge piping shall be factory installed and shall be Type 304 stainless-steel for exterior unit.

2. A four-foot long flexible connector shall be supplied as part of the exterior grinder pump assembly. The connector shall be 1-1/4-inch, IPS, SDR 11 HDPE piping. The tank end shall have a Type 304 stainless-steel, multi-level mechanical transition piece hydraulically compressed onto the polyethylene pipe. The tank side shall be 1-1/4-inch male NPT threads and the street side shall be plain end pipe to connect to a 1-1/4-inch by 1-1/2-inch compression coupling suitable for either 1-1/2-inch SDR26 PVC or SDR 21 PVC or SDR 11 HDPE pipe.

3. The transition fittings shall be designed so that as the internal pressure within the pipe increases, the sealing surface area on the barb increases. Under zero internal pressure the compression strain and tensional strain created by the compression of the multi-level barbs is greater than the stresses created by the relaxation and/or thermo expansion and contraction. The entire assembly shall be rated for 160 psi working pressure.

K. LEVEL CONTROLS

1. All liquid level controls necessary for operation of the pump and alarm system shall be built into the pump core unit. The primary on/off and alarm functions are to run on independent circuits. Control components shall be located inside the top housing of the core unit. The top housing shall be attached with stainless-steel fasteners. Non-fouling wastewater level detection for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air-bell level sensor connected to a pressure switch. Other types of level detection devices prone to fouling and needing periodic maintenance such as ultrasonic or conductance probes are not acceptable.

2. The level detection device shall have no moving parts in direct contact with the wastewater. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

3. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. The high-level sensing pressure switch shall also be designed to operate as a redundant on/off switch in case of on/off pressure switch failure.

4. To assure reliable operation of the pressure sensitive switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment.

L. ELECTRICAL WIRING

1. The pump core unit shall be furnished with a 32-foot length of 6 conductor, 12-gauge, Type SJOW cable, pre-wired and watertight. The core unit shall be furnished with NEMA 6P electrical quick-disconnect to meet UL requirements. There shall be no junction box required in the station.

2. The grinder pump core unit shall include a single NEMA 6P electrical quick disconnect for all power and control functions warranted by the Manufacturer to be watertight. The quick disconnect shall also be capable of serving as a receptacle for a portable generator to control the pump. No separate control panel shall be required to control the pump.

M. SERVICEABILITY

1. The pump core unit (exterior unit) shall have two lifting eyes complete with polypropylene lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect accessibility for core unit removal and installation.

2. All maintenance tasks for the unit must be possible without entry into the unit (as required by OSHA 1910.146 Permit required confined spaces). Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.

N. MAINTENANCE

1. It is the intent of this specification that the System and associated appurtenances require no periodic maintenance. If periodic maintenance is required such as oil changes or washing grease from float switches, it shall be performed by the Manufacturer at no cost to the OWNER for the life of the unit.

**2.06 - TANK AND INTEGRAL ACCESSWAY**

A. EXTERIOR UNIT - TYPE A AND TYPE B – Not Used

B. EXTERIOR UNIT – TYPE C

1. General – Type C Stations shall have 2 pumps each rated to a peak flow of 33 gpm at 90-feet TDH and have a system capacity of 6,000 gallons per day and a wet well capacity of 500 gallons.

2. Basin - Basin shall be configured to operate with three grinder pump cores. Pumps shall be configured to run as two duty pumps and one backup pump and shall alternate lead lag status at the end of each pump rotation. Pumps shall be controlled by the control systems as specified herein.

3. Discharge Hose - Each pump shall be furnished with a discharge hose and fittings for easy removal and replacement of each pump core. The piping shall be constructed of polypropylene, EPDM or PVC. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal. The bulkhead penetration shall be factory installed and warranted by the Manufacturer to be watertight. The assembly shall include a redundant full union ball valve to be installed on the pump discharge connection prior to the discharge hose making it capable for the removal of the pump core at the pump connection or at the basin connection. Hose shall be of sufficient length to enable removal of the pump core from the pump connection without being excessively long.

4. Pumps

   a) The pumps shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier.

   b) All pump castings shall be cast iron, fully epoxy coated to 8 to 10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless-steel.

   c) The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

5. Grinder

   a) The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a 1-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 to 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.

   b) This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed to minimize clogging and jamming under all normal operating conditions including starting. Enough vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

      1) The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

      2) The maximum flow rate through the cutting mechanism must not exceed 4-feet per second. This is a critical design element to minimize jamming and as such must be adhered to.

3) The inlet shroud shall have a diameter of no less than 5-inches. Inlet shrouds that are less than 5-inches in diameter will not be accepted due to their inability to maintain the specified 4-feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.

4) The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

c) The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4-inch diameter stainless-steel discharge piping.

6. Electric Motor

a) As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, Single Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30-amperes and high starting torque of 8.4-foot pounds.

b) The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided using an automatic-reset, integral thermal overload protector incorporated into the motor.

c) This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application.

d) Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability.

e) The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

7. Mechanical Seal

a) The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless-steel spring.

8. Fiberglass Tank Construction

a) The tank shall be a wetwell design consisting of a single wall, laminated fiberglass construction. The resin used shall be of a commercial grade suitable for the environment. The reinforcing material shall be a commercial grade of glass fiber capable of bonding with the selected resin. The inner surface shall have a smooth finish and be free of cracks and crazing. The exterior tank surface shall be relatively smooth with no exposed fiber or sharp projections present. Tank bottom shall have filleted corners to prevent sewage solids accumulation.

b) Dimensions shall be 60-inches in diameter by 108-inches high unless otherwise stated.

c) The wet well cover shall be constructed of 0.250-inches thick mill finish aluminum diamond plate with a load rating of 300 pounds per square-foot and equipped with 300 series stainless-steel hardware. It shall include a hinged, aluminum access cover with internal fiberglass safety grate. The accessway shall be an extension of the wetwell assembly and shall include a lockable cover assembly. The cover shall be aluminum, with a load rating of 300 pounds per square-foot.

d) The tank shall be supplied with two lifting lugs molded to the tank and of sufficient strength to support the tank and hardware during installation.

e) The tank wall and bottom shall be of sufficient thickness and construction to withstand the imposed loading due to saturated soil at the specified burial depth for each available tank height. All station components must function normally when exposed to the external soil and hydrostatic pressures developed at the specified burial depth. The tank bottom shall be reinforced steel insert with a fiberglass plate extending beyond the tank walls to support concrete anchoring, as required, to prevent flotation.

f) Each pump shall be fitted with a discharge hose with a true union ball valve connection at the pump and a quick disconnect pump connection rated at 200 psi WOG at the manifold.

g) The tank shall have a stainless-steel discharge manifold capable of accepting up to 4 pump quick discharge connections. The manifold shall terminate outside the tank wall with a 1-1/2-inch female NPT pipe thread.

h) The power and control cable shall connect to the pump by means of the provided NEMA 6P Electrical Quick Disconnect (EQD) and shall enter the tank through a field installed watertight strain relief connector supplied by the Manufacturer. An electrical junction box shall not be permitted in the tank. Installation of the inlet grommet and cable strain relief shall require field penetration of the tank wall by the Contractor. The tank shall also be vented to prevent sewage gases from accumulating inside the tank by means of a factory-provided, field-installed mushroom vent. The station cover or station wall shall be factory drilled to accept the mushroom vent or lateral vent pipe connection. The tank and stainless-steel discharge bulkhead shall be factory-tested to be watertight.

9. Electrical Quick Disconnect

a) Each grinder pump core shall include a factory-installed NEMA 6P electrical quick disconnect for all power and control functions. The Electrical Quick Disconnect will be supplied with 32-feet, 25-feet of useable, electrical supply cable to connect to the alarm panel. The Electrical Quick Disconnect shall require no tools for assembly, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque.

b) Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. Junction boxes are not acceptable due to the large number of potential leak points. The Electrical Quick Disconnect shall be so designed to be conducive to field wiring as required.

10. External Disconnect Junction Box

a) All cables from the Pump chamber shall connect to the alarm panel through a four pump disconnect junction box with sealed upper compartment in a NEMA 4X enclosure. The enclosure shall have a lower, vented compartment to allow the power and float cables to enter through underground conduit and then be sealed to prevent gasses from entering the upper disconnect switch enclosure. The enclosure is to be lockable dead front suitable for wall or pedestal mounting.

b) Internal wet well junction boxes are expressly forbidden.

11. Air Vacuum Release Valve

a) The Sewage Combination Air Valves shall combine an Air and Vacuum large orifice and an automatic small orifice in a single body. The valve shall be specially designed to operate with liquids carrying solid particles such as wastewater and effluent. The combination air valve shall discharge air (gases) during the filling or charging of the system, admit air to the system while draining and at water column separation and discharge accumulated air (gases) from the system while operating under pressure. The valve's design shall guarantee separation of the liquid from the sealing mechanism and provides optimum work conditions. The valve shall discharge air at high flow rates, without premature closing.

b) The Sewage Combination Air valve shall be capable of operating at working pressure range of 3 to 150 psi. The valve shall be certified to a test pressure of 250 psi at a working temperature of 140 Degree F. The valve shall be rated for a maximum working temperature for short time period: 194 Degree F.

c) Valve body shall be either Stainless-steel SAE 316 or Reinforced Nylon and shall not contain any corrosive materials in the body and mechanism. All internal metal parts shall be SAE 316 stainless-steel. Internal floats shall be made of composite materials. The valve design shall prevent any contact between wastewater and the sealing mechanism by creating an air gap at the top of the valve. This air gap shall be guaranteed even under extreme conditions.

d) The valve body shall be a conical body shape designed to assure a large initial air/gas pocket, to maintain the maximum distance between the liquid and the Sealing Mechanism; while allowing minimum body height. A spring supported joint between the stem and the upper float shall be provided to assure that vibrations of the lower float will not unseal the air release orifice of the air valve.

e) Release of air will occur only after enough air accumulates. A Rolling Seal Mechanism in the valve design shall be utilized as it is less sensitive to pressure changes than a direct float seal. The rolling seal mechanism is required as it allows a comparably large orifice for a wide pressure range (up to 150 psi).

f) The lower body shall be funnel-shaped to ensure that residue wastewater matter will drain to the pipe and be to be carried away by the flow and will not remain in the valve. The upper body shall have a 1-½-inch threaded discharge outlet which shall enable removal of excess fluids.

g) The valves shall be furnished with flanged ends to meet ASA 150 standard. Smaller valves (less than 3-inches) may be supplied with NPT male threads.

12. Controls

a) Provide a pump control panel for the (2) sanitary pumps SAN.P-1 and SAN.P-2 including all equipment, installation, services and appurtenance to achieve a complete and fully functioning system.

b) Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

c) The enclosure shall include a hinged lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel.

d) Provide through-the-door main disconnecting circuit breaker rated 20A, 10kAIC (minimum) at 240V, single-phase. The panel shall be provided with integral step-down transformers as required.

e) Provide 120VAC or 24VDC device power from the control panel for all system devices including instruments, valves, switches, etc.

f) Each pump shall be provided with a dedicated main circuit breaker.

g) The panel shall contain a Hand/Off/Auto (HOA) feature, an internal run indicator for each pump, and a complete alarm circuit.

h) All indicating lights shall be LED type.

i) The pump control panels hall include:

- Corrosion-proof enclosure;
- NEMA 4X rated enclosure;
- Lockable latch with padlock;
- Circuit breakers;
- Terminal blocks and ground lugs;
- Alarm Dry Contacts;
- Lead/Lag indicator lights;
- Alarm indicator lights;
- Run indicator lights;

- Hand/Off / Auto Switch mounted on the inner door for each pump;
- IEC Rated Motor starters w/adjustable overloads;
- Alarm Horn w/ silence circuitry;
- Aux. dry contacts for (High Level, Backup Active, Low Level;
- Unitronics V570 Programmable logic controller (PLC) for primary level controls;
- Backup float level control circuit;
- Required analog I/O Modules;
- Required digital I/O Modules;
- 24DC power supply to (PLC);
- 4-20 Ma Level transducer with built in surge protection; and
- UL 508A Listing.

j) The audible alarm shall be externally mounted on the enclosure. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is in a weather proof push-to-silence button.

k) The entire alarm panel, as manufactured, shall be listed by Underwriters Laboratories, Inc.

l) Each pump shall cycle and alternate sequentially at the end of its cycle to equalize run times.

m) Operating levels can be adjusted individually utilizing the Unitronics V570 touch pad. Example: 1st On/Off, 2nd On/Off, 3rd On/off 4th On/Off, High Level Alarm and Low-Level Alarm settings.

n) The wet well shall be monitored by the 4-20 ma level transducer and displayed in feet on the color display mounted on the inner door. Level transducer shall be protected from direct contact with sewage by means of stilling well-constructed of non-corrosive materials.

o) A 2-float backup circuit shall be provided which will be activated if the preset high-level float is reached. This circuit will require a manual reset to reactivate the Level transducer.

p) Station Monitoring - The system specified herein shall be manufactured by High Tide Technologies, LLC, or equal.

**2.07 - ENGINEERED STAINLESS-STEEL SERVICE LATERAL COMPONENTS**

i. The Contractor shall furnish prefabricated service lateral fitting kits (exclusive of piping, specified under SECTION 02629, POLYVINYL CHLORIDE PRESSURE SEWER PIPE) suitable for installation on PVC or HDPE piping. Each consisting of three (3) polypropylene compression male adapter fittings, one (1) combination curb-stop/check valve assembly and one (1) curb box. The curb stop/check valve assembly shall be 316-stainless-steel and have a two-piece cast 316-stainless-steel housing.

ii. The pre-fabricated service lateral assemblies are to be 100 percent hydrostatically tested to 150 psi in the factory.

iii. All plastic valve and fitting components are to be tested for compliance with ASTM D1599 (Categories 7.1.1, 7.2.2, and 7.2.3). Components shall be tested against the requirements of ASTM D2513 (Categories 6.10.1 and 6.10.2).

iv. All plastic fittings to conform to IPS dimension standards in compliance with ASTM-F714, ASTM-D3035 and ASTM-D-1599-99.

v. All plastic compression fittings are to be molded from polypropylene and shall be tested for resistance to aging, pressure rating, tensile strength, and flexural strength. All components shall incorporate compression fitting connections for easy, reliable installation of piping. All fittings and valves shall be rated for 150 psi service. Fittings shall be made for use with SDR 11 HDPE or for SCHEDULE 40 PVC only when additional stainless-steel gripper ring is incorporated into the grip ring assembly.

vi. All pipe connections shall be made using compression fitting connections including a Buna-N O-ring for sealing to the outside diameter of the pipe. A split collar locking device shall be integrated into all pipe connection fittings to securely restrain the pipe from hydraulic pressure and external loading caused by shifting and settling.

vii. Stainless-steel Curb Stop/Check Valve Assembly shall be pressure-tight in both directions. The ball valve actuator shall include position stop features at the fully opened and closed positions. The curb stop/check valve assembly shall be designed to withstand a working pressure of 235 psi.

viii. The stainless-steel check valve shall be integral with the curb stop valve. The check valve will provide a full-ported 1-1/4-inch passageway and shall introduce minimal friction loss at maximum rated flow. The flapper hinge design shall provide a maximum degree of freedom and ensure seating at low back pressure. Flapper and hinge assembly shall be fully serviceable in the field.

ix. Curb boxes shall be constructed of ABS, conforming to ASTM-D 1788. Lid top casting shall be cast iron, conforming to ASTM A-48 Class 25, providing magnetic detectability, and be painted black. The lid shall have the word “SEWER” cast into it. All components shall be inherently corrosion-resistant to ensure durability in the ground. Curb boxes shall provide height adjustment downward (shorter) from their nominal height.

**2.08 - ALARM DISCONNECT PANEL**

A. Each exterior unit shall include a NEMA 4X, UL listed alarm/disconnect panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged pad lockable cover, secured dead front and component knockouts. The enclosure shall not exceed 14-inches wide by 16-inches high by 3.75-inches deep. Contractor shall locate panel on exterior of home at the location where utilities enter the home and in view of the grinder station.

B. The primary on/off and alarm functions are to run on separate circuits. For each core, the panel shall contain a 15-amp, double pole circuit breaker for the power circuit and a 15-amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, push to run feature and a complete alarm circuit. The Alarm/Disconnect Panel shall include the following features: audio and visual alarm, push-to-run switch, and high level (redundant) pump starting control. The alarm sequence is to be as follows:

1. When liquid level in the sewage wet-well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.
2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
3. Visual alarm remains illuminated until the sewage level in the wetwell drops below the “off” setting of the alarm pressure switch.

C. The visual alarm lamp shall be inside a red fluted lens at least 2-5/8-inch in diameter and 1-11/16-inch in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. For duplex units, in addition to the above, two high-level indicator lights shall be mounted behind the access cover. During a high-level alarm condition, the appropriate light will illuminate to indicate which pump core requires servicing.

D. The audio alarm shall be a printed circuit board in conjunction with an 86-dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The audio alarm shall be capable of being deactivated by depressing a push-type switch, which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.

E. The entire Alarm Disconnect Panel as manufactured shall be listed by Underwriters Laboratories, Inc.

**2.10 - INTERIOR ALARM – Not Used**

**2.11 - GRINDER PUMP MONITORING SYSTEM – Not Used**

**2.12 - ANTI-BUOYANCY DEVICE – Not Used**

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the work of this Section, the Contractor shall:

1. Verify that each project site is ready for this work.
2. Verify that field measurements are as shown on approved shop drawings and/or Manufacturer's instructions.
3. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

B. The Contractor shall notify all subcontractors involved or affected by this work and coordinate the work with them.

**3.02 - INSTALLATION**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as per all federal, state and/or local codes, rules and regulations.

C. Installation of the equipment shall be in accordance with written instructions provided by the Manufacturer and as approved by the local regulatory agency.

**3.03 - PAINTING – Not Used**

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, the Contractor shall remove all foreign matter from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces by the Contractor.

**3.05 - FACTORY TESTS**

A. The Manufacturer shall give each system an operational test of all equipment at the factory to check for excessive vibration, for leaks in all piping and seals, and for correct operation of the automatic control system and all auxiliary equipment. Each system shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge line, level sensors, each unit’s dedicated controls. All factory tests shall incorporate each of the above listed items.

B. Actual appurtenances and controls, which will be installed in the field, shall be particular to the tested pump only.

C. A common set of appurtenances and controls for all pumps will not be acceptable.

D. Certified test results shall be supplied showing the operation of each pump at 2 different points on its curve, with the maximum pressure no less than 60 psi. Certified copies of all test procedures and results shall be provided to the OWNER.

E. The OWNER reserves the right to inspect such testing procedures at the Manufacturer’s facility. All completed units shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets, etc.).

**3.06 - MANUFACTURER'S FIELD SERVICES**

A. The Manufacturer shall provide an authorized factory technician(s) and/or representative(s), who has knowledge of the proper equipment operation and maintenance as specified for each type of equipment (instrument and control system considered one piece of equipment) to conduct an installer's training seminar for Contractors as specified herein.

B. Upon completion of the installation, the authorized factory technician(s) and/or representative(s) will perform the following test on each system:

1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
2. Turn ON the alarm power circuit.
3. Fill the wet well with water to a depth sufficient to verify the high-level alarm is operating. Shut off water.
4. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should immediately turn ON. Within 1-minute alarm light will turn OFF. Within 3-minutes the pump will turn OFF.
5. Install Pump Monitoring module and perform setup and system initialization.
6. Pump Monitoring Collector and Monitoring system shall be fully tested to demonstrate communications, system alarm and power failure. Each addressed shall be assigned with a Pump Monitoring Serial Number to be recorded in the Start Up records. The Manufacturer shall provide the OWNER a hard copy and electronic copy of the records.

C. The Manufacturer shall provide complete Startup reports for each system installation. Reports shall be maintained in electronic format and shall be forwarded to the Contractor and to the OWNER. Reports shall state any deficiencies that require attention prior to commencement of warranty coverage. The Contractor shall be responsible to schedule the Start Up inspection by notifying the Manufacturer a minimum of 24-hours prior to the requested start up inspection visit. Start-up reports shall include:

1. Complete names and addresses of OWNER;
2. Name of authorized factory technician(s) and/or representative(s) performing the startup inspection;
3. Station size and configuration, station and pump serial number(s) and panel serial number;
4. Verification that all valves are open and the station is able to function as part of the system;
5. Motor voltage and motor-amperage during operation;
6. Site pictures of finished grade, pump accessway, alarm panel and any noted deficiencies requiring attention;
7. Notations of the station cleanliness and reediness to accept wastewater; and
8. Verification of the Pump Monitoring System to include testing results of all reporting functions for alarm, power loss and ability to track pump starts and run times.

D. Performance Verification Test

1. Conduct performance verification tests to demonstrate that control system maintains set-points, and that system is programmed for the correct sequence of operation. Conduct performance verification test one day after work is installed of continuous RTU systems operation and before final acceptance of work.
2. Performance verification test shall demonstrate the following:
   a) Field Testing: Calibrate field equipment and verify equipment and system operation before placing the system on-line. Field-testing shall include the following tests.
   b) Calibration Accuracy and Operation of Inputs Test: Check for proper calibration and operation of each input instrument. Document each reading for the test report.

c) RTU Startup and Memory Test: Demonstrate that programming is not lost after a power failure and RTU controllers automatically resume proper control after a power failure.

d) Surge Protection: Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

E. Field Test

1. Demonstrate compliance of the control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that tests are performed by competent employees regularly employed in the testing and calibration of instrumentation systems.
2. Notify the OWNER of any defective products and workmanship disclosed by the tests.
3. Testing will include the field and the performance verification tests. Field tests shall demonstrate proper calibration of input devices, and the operation of specific equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.
4. Test each device such that each item will function not less than 5-times.
5. Tests are subject to oversight and approval by each OWNER and Contractor.

**3.08 - SPARE PARTS – Not Used**

## 3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

SEE APPENDIX A

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**APPENDIX A**

IN ORDER TO ASSIST THE OWNER AND ENGINEER WITH THE EVALUATION OF SUBMITTALS THE FOLLOWING SHALL BE FILLED OUT AND SUBMITTED AS PART OF THE SHOP DRAWING REVIEW PROCESS. IT SHALL BE SIGNED BY AN OFFICER OF THE MANUFACTURER AND PROPERLY WITNESSED.

IF THERE ARE NO NON-CONFORMING ASPECTS OF THE SPECIFICATION SECTION, THE MANUFACTURER SHALL WRITE IN THE WORD "NONE".

1. QUALITY ASSURANCE

   A. General

      Describe all non-conforming aspects to the specification:

      _____
      _____
      _____

   B. Safety

      Describe all non-conforming aspects to the specification:

      _____
      _____
      _____

   C. Factory Test

      Describe all non-conforming aspects to the specification:

      _____
      _____
      _____

   D. Manufacturer's Installer Training

      Describe all non-conforming aspects to the specification:

      _____
      _____
      _____

   E. Manufacturer's Field Services

      Describe all non-conforming aspects to the specification:

      _____
      _____
      _____

   F. Experience

      List five (5) low-pressure sewer system installations that have been in operation for a period of no less than five (5)-years each with at least twenty (20) pumps pumping into a "common" low-pressure sewer system.

      1. Installation Owner and Location: _____

         Contact Person: _____

         Telephone Number: _____

         Number of Units: _____

         Type of Units: _____

         Date Installed: _____

2. Installation Owner and Location: _____
Contact Person: _____
Telephone Number: _____
Number of Units: _____
Type of Units: _____
Date Installed: _____

3. Installation Owner and Location: _____
Contact Person: _____
Telephone Number: _____
Number of Units: _____
Type of Units: _____
Date Installed: _____

4. Installation Owner and Location: _____
Contact Person: _____
Telephone Number: _____
Number of Units: _____
Type of Units: _____
Date Installed: _____

5. Installation Owner and Location: _____
Contact Person: _____
Telephone Number: _____
Number of Units: _____
Type of Units: _____
Date Installed: _____

2. WARRANTY

Fully state any deviations to the Manufacturer's warranty/ service agreement:

_____
_____
_____

3. PRODUCTS

Describe all non-conforming aspects to the specification:

_____
_____
_____
_____
_____
_____
_____

I attest that all questions are answered truthfully and all non-conforming aspects to the specifications have been described where requested.

Name of Manufacturer: _____

Certified By:

_____

Name of Corporate Officer

_____

Signature

_____

Date

Witnessed By

_____

Name

_____

Signature

_____

Date

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**SECTION 11308**

**RECESSED IMPELLER PUMPS AND APPURTENANCES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide and test recessed impeller pumps, motors, variable frequency motor controllers, and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 0700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENTS AND PAYMENT.

**1.03 - DEFINITONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Data regarding pump and motor characteristics and performance:

a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSHr.

(1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).

c. Results of shop performance tests as specified.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSH3 curve for each speed.

3. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.

4. Wiring diagrams for motors.

5. Motor FLA data.
6. Shop drawing data for accessory items.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.
9. Operating and maintenance instructions and parts lists.
10. Listing of reference installations as specified with contact names and telephone numbers.
11. Certified results of hydrostatic testing.
12. Certified results of dynamic balancing.
13. Bearing temperature operating range for the service conditions specified.
14. List of recommended spare parts other than those specified.
15. Shop and field inspection reports.
16. Bearing Life: Certified by the pump manufacturer. Include design data.
17. Pump shop test results.
18. Motor shop test results.
19. Qualifications of field service engineer.
20. Recommendations for short and long-term storage.
21. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.
22. Special tools.
23. Number of service person-days provided and per diem field service rate.
24. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.
25. Recommended location of suction and discharge pressure gauges.
26. Manufacturer’s product data, specifications and color charts for shop painting.
27. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
28. The latest ISO 9001 series certification.
29. Certified statement of pump, motor and shafting alignment within manufacturer tolerances.
30. Provide a scaled drawing for each pump service showing the pumps, motors, hoists including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.
31. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIEVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

D. Seismic Design Requirements

1. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

2. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

3. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

4. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Pumps shall be the product of one manufacturer.

C. Pumps shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

b. Variable frequency motor controllers shall be supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

c. Provide certificate of co-ordination signed by pump, motor and variable frequency motor controller manufacturer.

d. Provide motors in accordance with SECTION 01171 – ELECTRIC MOTORS.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 1 person-days.

4. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1 person-days.

5. Field Performance Testing: Field performance test equipment specified.

a. 1 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-days.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

8. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

**1.08 - REFERENCES**

A. American Bearing Manufacturers Association (ABMA):

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

C. American Society of Mechanical Engineers (ASME):

1. Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

D. ASTM International (ASTM):

1. A36/A36M: Standard Specification for Carbon Structural Steel.

2. A48/A48M: Standard Specification for Gray Iron Castings.

3. A322: Standard Specification for Steel Bars, Alloy, Standard Grades.

4. A532: Standard Specification for Abrasion-Resistant Cast Iron.

5. A743/A743M: Standard Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, Corrosion Resistant, for General Application.

E. Hydraulic Institute (HI):

1. Current Standards.

2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

F. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. SBR Transfer Pumps (SBR.TP-1 through 3): Pump raw municipal wastewater that has been through a screen with 6 mm openings and pump from the aerated pre-equalization tanks.

C. Sludge Transfer Pumps (SL.TP-1 and 2): Pump waste sludge and septage from the aerated waste sludge storage tanks to the rotary drum thickeners, with solids concentration up to 1.0 percent.

D. Coordinate pump dimensions and weights with hoists as specified in Sections 14300.

E. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

F. Provide equipment rated in accordance with the Environmental Classification Schedule on Contract drawing 00 E-601.

**2.02 - MANUFACTURERS**

A. Recessed Impeller Pumps

1. Egger Series
2. Fairbanks Nijhuis
3. KSB

**2.03 - PUMP CONSTRUCTION**

A. Pumps: Recessed impeller, vortex type, single-stage, centrifugal pumps. Driven as indicated in the Process Pump Schedule.

B. Pump Configuration: As indicated in the Process Pump Schedule.

C. Design and proportion all parts of pump specially adapted for the service specified and indicated.

D. Pump Mounting: Provide type as indicated and specified.

1. Horizontal Pumps:
    a. Mount each pump and drive on a common base.
        (1) Material: ASTM A36 fabricated structural steel.
        (2) Provide structural steel shape bases, bent form bases are not acceptable.
        (3) Provide bases with provisions for grouting and for anchor bolts.
        (4) Design baseplates to support pump and driver.
        (5) Provide planed surfaces of bearing pads for pumps and drives.

E. Pump Casing, Fronthead and Wear Plate:

1. Provide materials for the pump services as follows:
    a. Pump Services: SBR Transfer Pumps and Sludge Transfer Pumps.
        (1) Cast Iron ASTM A48 Class 35B
        (2) Ni-Hard, ASTM A532 Class I, HC 600 or ASTM A532 Class IIIA
        (3) Minimum 650 BHN.
2. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.
    a. For pumps with cup type impellers provide a two (2) piece radially split casing with separate suction piece.
    b. For pumps with radial vane impellers provide a one (1) piece casing. Pumps requiring a replaceable wear element completely surrounding the impeller are not acceptable.
3. Provide lifting devices on pump casings for handling.
4. Provide ribs or reinforcing required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.

5. Provide flanged slotted suction and discharge connections or face and drill flanges of suction and discharge connections, in accordance with ANSI/ASME B16.1 Class 125-lb. ANSI Standard.
6. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment
7. without registered fits is not acceptable.
8. Provide high point of casing with an air vent or provide a self-venting casing and low point with a drain.

F. Main Frame:

1. Cast iron ASTM A48/A48M Class 40.
2. Fit to casing with machined registered joints.
3. Provide main frame designed to resist without distortion, all stresses due to impeller thrust and bearing loads.
4. Provide main frame designed to support shaft and impeller and to contain stuffing box and bearings.

G. Bearings:

1. Outboard bearing to be combination thrust and radial type; inboard bearing radial type.
2. Provide bearings in a dust and moisture proof enclosures.
3. Provide bearings with minimum LB-10 life rating of 100,000 hours at specified operating conditions and 40,000 hours minimum at 25 percent of the BEP at highest speed, based on latest ABMA and ANSI Standards.
4. Grease lubricated anti-friction type.
    a. Provide means in bearing housing, such as removable plug diametrically opposite grease fitting, to prevent over greasing of bearing.
    b. Grease fittings: Alemite.

H. Pump Shaft:

1. ASTM A322-C4140 heat treated steel or stainless steel type 420 or 430, machined.
2. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.
3. Sleeves:
    a. Extend sleeves through stuffing box.
    b. Pumps of hard metal construction: Type GGK-FP with Eut. 12496 coating, 55 to 62 HRC.

I. Impeller:

1. Type: Recessed radial curved vane or cupped type solids handling single suction.
    a. Straight vane impellers are not acceptable
2. Pump capable of passing a sphere size as indicated in the Process Pump Schedule.

J. Material:

1. Ni-Hard, ASTM A532 Class I, HC 600, or ASTM A532 Class IIIA minimum 650 BHN, or hardened duplex stainless steel CD4MCu for pumps specified with Ni-Hard or High Chrome Iron Casing.
2. Key-seat or taper and hold impeller to shaft by a streamlined bolt or locknut capable of holding in event of motor reversal under full torque. Impeller fasteners: Type 416 stainless steel.
3. Statically and dynamically balance each impeller.

K. Handhole Cleanouts:

1. Locate handholes in suction nozzle or separate suction piece for horizontal pumps to provide access to impeller and interior parts.
2. Equip handholes with covers designed for easy removal.
3. Shape interior surface of cover to maintain contour of interior of casing to which it is attached to maintain efficiency and to prevent lodging of solids.
4. Gaskets: Neoprene or Buna-N.
5. Hardware: Type 316 Stainless Steel.

L. Seals:

1. Split Mechanical Seal:
   a. Manufacturer: Chesterton Style 442
   b. Materials:
      (1) Gland: Type 316 stainless steel.
      (2) Rotary Holder: Type 316 stainless steel.
      (3) Hardware: Type 316 stainless steel.
      (4) Springs: Hastelloy C or Elgiloy
      (5) Rotating Faces: Silicon Carbide.
      (6) Stationary Faces: Silicon Carbide
      (7) Elastomers: Viton
      (8) Restriction Bushing: Split type, ESC Carbon Graphite PTFE or Type 316 SST.
   c. For pumps specified and indicated not requiring seal water, provide Enviroseal Spiraltrac bushing version D, type A
   d. Seals will be installed in the pumps at the jobsite by the seal manufacturer's field service technician. Seals installed at the pump manufacturer's facility are not acceptable.

M. Couplings: Horizontal Pumps:

1. Non lubricated, polyurethane flex material type.
2. Split design.
3. Spacer type.
4. Manufacturer: Rexnord Omega or acceptable equivalent product.
5. Provide guards for protection for personnel, conforming to OSHA requirements.
   a. Guards and Hardware: Type 316 stainless steel.

**2.04 - MOTORS**

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Process Pump Schedule.

D. Provide motors for horizontal pumps with mounts for bolting to baseplate.

E. In addition to the requirements for bearings specified in SECTION 01171, ELECTRIC MOTORS, provide pump motors with ball or roller bearings. Provide bearing with a minimum LB-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI/ASA S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Provide motor service factor of 1.0 in accordance with NEMA MG-1 requirements for VFD driven motors.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Provide VFD driven motors with normally-closed winding thermistors for motor over-temperature protection.

L. Provide motors as inverter duty rated for use with VFD's per NEMA MG1.

M. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

N. Site Altitude: Less than 3300 feet above sea level.

O. Provide Inpro/Seal bearing isolators.

**2.05 - DRAIN AND VENT PIPING**

A. Drain and vent piping: Schedule 5 Type 316L stainless steel with Pressfit connections or Schedule 40 Type 316L stainless steel with socket welded connections. Provide a sufficient number of unions to permit removal of each valve and in-line device.

B. Provide pipe and fittings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

C. Valves: Provide size and type as indicated and in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

**2.06 - GAUGES**

A. Provide gauges assemblies for suction and discharge of each pump in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Suction Gauges: compound type.

1. Scale: inches Hg to psi

C. Discharge gauges: Provide standard range with top limit above pump shutoff head at maximum pump speed.

1. Scale: psi

**2.07 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.08 - SHOP TESTING**

A. Provide motor shop testing in accordance with SECTION 01171, ELECTRIC MOTORS.

B. Pump Tests:

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

2. Provide certified performance tests as specified herein for all pumps and spare rotating assemblies.

3. Certified performance testing.
    a. Run pump at full speed rating point for 60 minutes prior to start of any testing.
    b. Full speed tests:
        (1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.
        (2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.
        (3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.
    c. Variable speed tests:
        (1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.
        (2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
        (3) Run a second test at a speed approximately midway between full and minimum speed.
        (4) Run additional tests for each reduced speed operating condition specified and indicated.
    d. Factory tests on pumps:
        (1) Use factory calibrated test drives.
    e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.
    f. Do not test pumps with job split seals.
4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.
5. Testing Acceptance Grade and Tolerances:
    a. ANSI/HI 14.6 Acceptance Grade: 1U.
    b. Efficiency Tolerance: -0 percent.
    c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.
6. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.
7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.
8. Repeat tests until specified results are obtained.
9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

B. Install pumping units on a concrete pad and align thereon.

1. Install as indicated.

2. Coupling halves must be disconnected and only reconnected after alignment.

3. Set base on plastic or stainless steel shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support. The use of leveling nuts is not acceptable

C. Horizontal pumps: Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.

D. Final Coupling Alignment:

1. Perform only after base is installed and piping is connected and pump nozzle connections tested as specified herein.

2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.

E. After alignment is correct, grout using high grade non-shrink grout.

1. For horizontal pumps fill entire base and leave no gaps or voids.

F. Split Mechanical Seals: Install seals with installation by the seal manufacturer's field service technician.

**3.02 - FIELD TOUCH-UP PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein

**3.05 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. One complete set of gaskets and O-rings.

b. One mechanical seal repair kit and restriction brushing for each pump provided with mechanical seals.

c. One shaft sleeve.

2. For each set of pumps of the same size and performance.

a. One set of all special tools required.

**3.08 - FIELD TESTING**

A. Test piping connections to prove the pump nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.

a. Provide vibration signature test data for each pump and drive assembly.

(1) Limit: 50 percent of ANSI/HI allowable limits.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all water, labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove and replace defective equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

**END OF SECTION**

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**SECTION 11309**

**CHOPPER PUMPS AND APPURTENANCES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.:

B. Provide and test chopper pumps, motors, variable frequency motor controllers and appurtenances as indicated and in compliance with Contract Documents.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300 SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Data regarding pump and motor characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSHr.
        (1) For units of same size and type, provide curves for a single unit only.
    b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).
    c. Results of shop performance tests as specified.
    d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSHr curve for each speed.
3. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.
4. Wiring diagrams for motors.
5. Motor FLA data.
6. Shop drawing data for accessory items.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.
9. Operating and maintenance instructions and parts lists.
10. Listing of reference installations as specified with contact names and telephone numbers.
11. Certified results of hydrostatic testing.
12. Certified results of dynamic balancing.
13. Bearing temperature operating range for the service conditions specified.
14. List of recommended spare parts other than those specified.
15. Shop and field inspection reports.
16. Bearing Life: Certified by the pump manufacturer. Include design data.
17. Pump shop test results.
18. Motor shop test results.
19. Qualifications of field service engineer.
20. Recommendations for short and long-term storage.
21. Resonant frequency analysis.
22. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.
23. Special tools.
24. Number of service person-days provided and per diem field service rate.
25. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.
26. Recommended location of suction and discharge pressure gauges.
27. Manufacturer’s product data, specifications and color charts for shop painting.
28. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
29. The latest ISO 9001 series certification.
30. Certified statement of pump and motor alignment is within manufacturer’s tolerances.
31. Provide a scaled drawing for each pump service showing the pumps, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

32. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All equipment shall be provided by the same manufacturer.

C. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Pumps shall be the product of one manufacturer.

C. Pumps shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. Variable frequency motor controllers shall be supplied under Div. 16. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

b. Provide electric motors in accordance with SECTION 01171, ELECTRIC MOTORS.

c. Variable frequency motor controllers shall be supplied under Div. 16 in accordance with Section 16260.

(1) Constant torque variable frequency motor controllers shall be supplied for Chopper Pumps.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 1 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1 person-days.

4. Field Performance Testing: Field performance test equipment specified.

a. 1 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. For variable speed pump systems, the pump manufacturer must perform an analysis of the combined motor and pump assembly for resonant frequency or their harmonics independent of a structure.

1. Submit a copy of these calculations for the record.

2. Should calculations indicate the probability of encountering such frequencies within the speed range required, provide all additional supporting devices necessary to affect the unit mass, and raise or lower resonant point.

3. Provide and install such additional devices at no additional cost to the Owner.

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

B. ASTM International (ASTM):

1. A36/A36M: Standard Specification for Carbon Structural Steel.

2. A322: Standard Specification for Steel Bars, Alloy, Standard Grades.

3. A536: Standard Specification for Ductile Iron Castings.

C. Hydraulic Institute (HI):

1. Current Standards.

2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

D. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. Thickened Sludge Pumps (TSL.P-1 and 2): Pump waste sludge thickened by rotary drum thickeners up to 5 percent solids. Pumps will be used to pump thickened sludge to a truck fill station.

C. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**2.02 - MANUFACTURERS**

A. Vaughan Co., Inc

B. THIS IS A PROPRIETARY SPECIFICATION; NO OTHER MANUFACTURERS OR MODEL NUMBERS ARE ACCEPTABLE.

**2.02 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.03 - PUMP CONSTRUCTION**

A. Pumps: Chopper type single-stage, centrifugal pumps. Driven as indicated in the Process Pump Schedule.

1. Provide pumps specifically designed to pump waste solids at heavy concentrations and consistencies without plugging or dewatering of solids.
2. Provide pumps to chop, macerate and condition solids as an integral part of the pumping action.
3. Provide pumps capable of chopping through and pumping high concentrations of solids such as plastics, heavy rags, grease, hair balls, wood, paper products and stringy materials without plugging.

B. Pump configuration as indicated in the Process Pump Schedule.

C. Design and proportion all parts of pump specially adapted for the service specified and indicated.

D. Provide room for inspection, repair and adjustment.

E. Horizontal Pumps:

1. Mount each pump and drive on a common base.
    a. Material: ASTM A36 fabricated structural steel.
    b. Provide structural steel shape bases, bent form bases are not acceptable.
    c. Provide with provisions for grouting and for anchor bolts.
    d. Design baseplate to support pump and driver.
    e. Provide planed surfaces of bearing pads for pumps and drives.

F. Pump Casing:

1. Casing: Ductile Iron Grade 80-55-06, resistant to abrasive action of solids or foreign matter contained in liquid.
2. Centerline discharge.
3. Fabricated steel casings are not acceptable.
4. Provide casings designed for removal of rotating parts without disconnecting suction and/or discharge piping.
5. Provide lifting devices on casings for handling.
6. Provide ribs or reinforcing if required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.
7. Face and drill flanges of suction and discharge connections in accordance with 125-lb. (PN10) ANSI Standard.
8. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment without registered fits is not acceptable.
9. Provide high point of casing with an air vent and low point with a drain.
10. Drill and tap pump suction and discharge nozzles for installation of 1/2-inch NPT piping and pressure gauges. Provide taps in accordance with Hydraulic Institute Standards.

G. Main Frame:

1. Ductile iron ASTM A536.
2. Fit to casing with machined registered joints.
3. Provide main frame designed to resist without distortion, all stresses due to impeller thrust and bearing loads.
4. Provide main frame designed to support shaft and impeller and to contain stuffing box and bearings.
5. Provide external adjustment of impeller and cutter bar clearance for pumps 6-inch and smaller.

H. Bearings:

1. Outboard bearing: Two (2) back to back mounted single row angular contact bearings.
2. Inboard bearing: Two (2) back to back mounted single row radial bearings.
3. Provide bearings in a dust and moisture proof enclosures.
4. Provide bearings with minimum B-10 life rating of 100,000 hours at specified operating conditions and 40,000 hours minimum at 25 percent of the BEP at highest speed, based on latest ABMA and ANSI Standards.
5. Provide Inpro/Seal bearing isolators.
6. Oil bath lubricated anti-friction type.
    a. Oil: ISO grade 100 turbine oil.
    b. Provide side mounted site glass.
    c. Provide viton double lip seals riding on Type 316L stainless steel shaft sleeves.
    d. Pressure venting device.
    e. Oil Fill.
    f. Drain Taps.

I. Pump Shaft:

1. ASTM A322-C4140 heat treated steel, machined.
2. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.
3. Sleeves:
    a. Extend sleeves through stuffing box.
    b. Material.
        (1) For pumps equipped with packing: Type 316 stainless steel with nickel chrome-boron coating.
        (2) For pumps equipped with mechanical seals: Type 316 stainless steel.

J. Impeller:

1. Semi-open, solids handling chopper, single-suction, statically and dynamically balanced.
2. Provide waterways with smooth contours and well-rounded entrances.
3. Provide pump out vanes to reduce seal area pressure, and to draw lubricant down from the reservoir should seal leakage occur.
4. Provide chopping/maceration of materials accomplished by the action of the cupped and sharpened leading edges at the bottom of the impeller blades as they move across the cutter bar at all points across the suction opening. Pumps 6-inch and Smaller: Provide clearance between the impeller and cutter bar of 0.010 inch to 0.015 inch.
5. 8620 Alloy Steel and heat treated to a minimum 60 Rockwell C and dynamically balanced.
6. Hold impeller in place with a key for pumps 6-inch and smaller.
7. Secure impeller to the shaft with a hardened cutter nut designed to cut stringy materials and prevent binding. 8620 Alloy Steel and heat treated to a minimum 60 Rockwell C.
8. Fabricated steel impellers are not acceptable.

K. Cutter Bar:

1. Single cast component recessed into the pump bowl, with a funnel shaped inlet opening.

2. Provide segment bars as a part of the casting, extending across the intake opening to within 0.010 inch to 0.015 inch of the rotating external cutter tooth.

3. Because of the tendency of rags and debris to hang up on protruding components and cause binding, cutting devices and tools extending outside the inlet opening, including impellers, are not acceptable.

4. Material: 8620 Alloy plate steel heat treated to a minimum 60 Rockwell C.

L. Upper Cutter Assembly:

1. Provide an assembly consisting of a specially modified impeller working against a stationary cutting ring mounted into the back side of the casing, design system to eliminate any buildup of rags, hair, or other stringy material.

2. Material: Cast 8620 Alloy steel heat treated to 60 Rockwell C.

M. Cutter Nut:

1. Provide a hex nut with an integrally cast anvil for shearing against the adjacent surface of the segment bars on the cutter bar.

2. Cast steel heat treated to a minimum 60 Rockwell C.

N. Flush-less Mechanical Seal:

1. Cartridge type with

a. Faces: Silicon Carbibe

b. O-Rings: Viton

c. Gland: Ductile iron

d. Springs: Provide seal sleeve of 17-4PH heat treated to shield all springs from the pumped liquid

e. Lubrication and Cooling: Separate Oil chamber

O. Handhole Cleanouts:

1. Locate handholes in discharge nozzle of volute to provide access to impeller and interior parts.

2. Equip handholes with covers designed for easy removal.

3. Shape interior surface of cover to maintain contour of interior of casing to which it is attached to maintain efficiency and to prevent lodging of solids.

4. Gaskets: Neoprene or Buna-N.

5. Hardware: Type 316 Stainless Steel.

P. Couplings: Horizontal Pumps:

1. Non lubricated, polyurethane flex material type.

2. Split design.

3. Spacer type.

4. Manufacturer: Rexnord Omega.

5. Provide guards for protection for personnel, conforming to OSHA requirements. Guards and Hardware: Type 316 stainless steel.

**2.04 - MOTORS**

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Process Pump Schedule.

D. Provide motors for horizontal pumps with mounts for bolting to baseplate.

E. In addition to the requirements for bearings specified under Electric Motors in SECTION 01171, ELECTRIC MOTORS, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Provide motor service factor of 1.0 in accordance with NEMA MG-1 requirements for VFD driven motors.

I. Provide VFD driven motors with normally-closed winding thermistors for motor over-temperature protection.

J. Provide motors as inverter duty rated suited for use with VFD's per NEMA MG1.

K. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

L. Rating: 460V, 3-phase, 60 Hertz.

M. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

N. Site Altitude: Less than 3,300 feet above sea level.

O. Provide Inpro/Seal bearing isolators.

**2.05 - DRAIN AND VENT PIPING:**

A. Provide drains from casing vent and drain piping and valves to discharge into gutters or sumps as indicated and as recommended by the Engineer.

B. Drain and vent piping: Schedule 5 Type 316L stainless steel with Pressfit connections or Schedule 40 Type 316L stainless steel with socket welded connections. Provide a sufficient number of unions to permit removal of each valve and in-line device.

C. Provide pipe and fittings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

D. Valves: Provide size and type as indicated and in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

**2.06 - GAUGES**

A. Provide gauges assemblies for suction and discharge of each pump in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Suction Gauges: compound type.

1. Scale: inches Hg to psi

C. Discharge gauges: Provide standard range with top limit above pump shutoff head at maximum pump speed.

1. Scale: psi

**2.07 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

1. Color: As specified for piping system of same service or as selected by the Engineer.

2. Nozzle Assemblies: SSPC-SP5 commercial sandblasted and finished with 3M™ Scotchkote™ 134 Fusion Bonded Epoxy Coating.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.08 - SHOP TESTING**

A. Provide motor shop testing in accordance with SECTION 01171, ELECTRIC MOTORS.

B. Pump Tests:

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

2. Provide certified performance tests as specified herein for all pumps and spare rotating assemblies.

3. Certified performance and witness testing.

a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

b. Full speed tests:

(1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

(2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.

c. Variable speed tests:

(1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

(2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

(3) Run a second test at a speed approximately midway between full and minimum speed.

(4) Run additional tests for each reduced speed operating condition specified and indicated.

d. Factory tests on pumps:

(1) Use tested job motors that are shipped to the pump testing facility for use in these pump tests.

(2) Use factory calibrated test drives.

e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

5. Testing Acceptance Grade and Tolerances:
   a. ANSI/HI 14.6 Acceptance Grade: 1U.
   b. Efficiency Tolerance: -0 percent.
   c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.
6. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.
7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.
8. Repeat tests until specified results are obtained.
9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**PART 3 - EXECUTION**

**3.02 - INSTALLATION**

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

B. Install pumping units on a concrete pad and align thereon.
   1. Coupling halves must be disconnected and only reconnected after alignment.
   2. Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.

C. Horizontal pumps: Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.

D. Final Coupling Alignment:
   1. Perform only after base is installed and piping is connected and pump nozzle connections tested as specified herein.
   2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.

E. After alignment is correct, grout using high grade non-shrink grout.
   1. For horizontal pumps fill entire base and leave no gaps or voids.
   2. Do not imbed leveling nuts in grout.

**3.03 - PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. One complete set of gaskets.

b. One mechanical seal repair kit.

2. For each set of pumps of the same size and performance.

a. One set of all special tools required.

**3.09 - FIELD TESTING**

A. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.

a. Provide vibration signature test data for each pump and drive assembly.

(1) Limit: 50 percent of ANSI/HI allowable limits.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all water labor, piping, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11316**

**PROCESS PUMPS AND APPURTENANCES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary provide and test process pumps and appurtenances as specificied and/or as shown on the drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections withing DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL ONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data regarding pump and motor characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSHr.
        (1) For units of same size and type, provide curves for a single unit only.
    b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).

c. Results of shop performance tests as specified.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide $NPSH_r$ curve for each speed.

3. Shop drawing data for accessory items.

4. Control Panels:

a. Bill of Materials including manufacturer, model number and quantities.

b. Annotated product cut sheets for enclosures and control panel components.

c. Front elevations of control panels showing dimensions, location of panel internal and panel exterior mounted components. Provide elevations with and without doors.

d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.

e. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, electrical and instrumentation drawings.

f. Provide a copy of the submittal to the project Control System Integrator for review and comments.

g. Submit 2 copies of the final PLC program on USB 3.0 flash drives, to be turned over to the Owner.

h. Submit VFD cut sheets and data in accordance with SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT, Paragraph 1.04 – Submittals.

5. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.

6. Motor wiring diagrams.

7. Motor FLA data.

8. Certified setting plans, with tolerances, for anchor bolts.

9. Manufacturer's literature as needed to supplement certified data.

10. Operating and maintenance instructions and parts lists.

11. Listing of reference installations as specified with contact names and telephone numbers.

12. Certified results of hydrostatic testing.

13. Certified results of dynamic balancing.

14. Bearing temperature operating range for the service conditions specified.

15. List of recommended spare parts other than those specified.

16. Shop and field inspection reports.

17. Bearing Life: Certified by the pump manufacturer. Include design data.

18. Pump shop test results.

19. Motor shop test results.

20. Qualifications of field service engineer.

21. Recommendations for short and long-term storage.

22. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.

23. Special tools.

24. Number of service person-days provided and per diem field service rate.

25. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

26. Recommended location of suction and discharge pressure gauges.

27. Manufacturer's product data, specifications and color charts for shop painting.

28. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

29. The latest ISO 9001 series certification.

30. Material Certification:

    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. All material and equipment shall be shipped., stored, handled and installed according to manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do no purport to cover all details entering into the construction of the equipment.

C. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Pumps of the same type shall be the product of one manufacturer.

C. Pumps shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

b. Provide plant water system pumps (W3.P-1 thru 3) variable frequency drvies (VFDs) integral to the plant water control panel. Provide plant water VFDs as specified herein and in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

c. Variable frequency motor controllers for Effluent pumps (EFF.P-1 and 2) and Foam Spray Water Pump (FS.P-1) shall be supplied under Division 16 in accordance with SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 1 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1 person-days.

4. Performance Testing: Field performance test equipment specified.

a. 1 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

B. ASTM International (ASTM):

1. A36/A36M: Standard Specification for Carbon Structural Steel.
2. A48/A48M: Standard Specification for Gray Iron Castings.
3. A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
4. B584: Standard Specification for Copper Alloy Sand Castings for General Applications

C. Hydraulic Institute (HI):

1. Current Standards.
2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

D. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

C. Plant Water Pumps (W3.P-1 thru 3): Pump plant water from the Plant Water Storage Tank to hose stations and washwater connections of various process equipment throughout the facility.

D. Effluent Pumps (EFF.P-1 thru 3): Pump disk-filtered plant effluent from the Post Equalization tank through the closed vessel UV system which discharges to the wick wells.

E. Foam Spray Water Pumps (FS.P-1): Pump foam spray water from the Plant Water Storage Tank to the foam spray headers and nozzles located at each SBR.

F. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**2.02 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.03 - PUMP CONSTRUCTION – GENERAL**

A. Pumps: Provide type, arrangement and drive as indicated in the Process Pump Schedule.

B. Design and proportion all parts of pump specially adapted for the service specified and indicated.

C. Pump Mounting:

1. Horizontal Pumps:

a. Mount each pump and drive on a common base.

(1) Material: ASTM A36/A36M fabricated structural steel or 316 fabricated structural stainless steel.

(2) Provide structural steel shape bases for pumps 4-inch and larger and bent form bases for pumps smaller than 4-inch unless otherwise specified.

(3) Provide bases with provisions for grouting and for anchor bolts.

(4) Design baseplates to support pump and driver.

(5) Provide planed surfaces of bearing pads for pumps and drives.

D. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.

E. Provide lifting devices on pump casings for handling.

F. Provide ribs or reinforcing required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.

G. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment without registered fits is not acceptable.

H. Seals:

1. Provide split mechanical seals for all direct coupled pumps unless otherwise specified

2. Split mechanical seal:

a. Manufacturer: Chesterton Style 442.

b. Materials:

(1) Gland: Type 316 stainless steel.

(2) Rotary Holder: Type 316 stainless steel.

(3) Hardware: Type 316 stainless steel.

(4) Springs: Hastelloy C or Elgiloy.

(5) Rotating Faces: Silicon Carbide.

(6) Stationary Faces: Silicon Carbide.

(7) Elastomers: Viton.

(8) Restriction Bushing: Split type, glass filled teflon.

c. For pumps specified and indicated not requiring seal water, provide Enviroseal Spiraltrac bushing version D, type A.

I. Couplings:

1. Non lubricated, polyurethane flex material type.
2. Split design.
3. Spacer type.
4. Manufacturer: Rexnord Omega or acceptable equivalent product.
5. Provide guards for protection for personnel, conforming to OSHA requirements.
   a. Guards and Hardware: Type 316 stainless steel.

**2.04 - END SUCTION CENTRIFUGAL PUMPS**

A. Manufacturers:

1. KSB
2. Goulds
3. Flowserve

B. Type: Non-overloading, single stage volute centrifugal pumps. Direct coupled to motor.

1. Vertically split end suction or inline as indicated in the Process Pump Schedule.
2. Key seated, provide Type 316 stainless steel lock nuts.

C. Casing, Bearing Frame and Seal Plate: ASTM A48/A48M Class 30 cast iron.

D. Impeller: Type 316 stainless steel.

1. Enclosed, dynamically balanced.

E. Shaft: Steel ASTM A108-C1141 or Stainless Steel ASTM 420 or 430.

F. Sleeves: Type 316 stainless steel.

G. Bearing: Grease lubricated ball bearings.

H. Mechanical Seals:

1. Provide as specified herein.

I. Motors: Provide as specified herein and in accordance with SECTION 01171 – ELECTRIC MOTORS

J. Couplings: Provide as specified herein.

K. Baseplates: Provide as specified herein.

**2.05 - VERTICAL MULTI-STAGE CENTRIFUGAL PUMPS (PLANT WATER PUMPS)**

A. Manufacturers:

1. Grundfos
2. Syncroflo
3. Flowtronex.

B. Type: vertical, inline, multistage centrifugal pumps. Direct coupled to motor.

C. Suction/discharge base, pump head: ASTM A48 Class 30 Cast Iiron.

D. Impeller: Type 304 stainless steel.

1. Enclosed.

E. Shaft: Type 431 stainless steel.

F. Shaft Couplings/Flange Rings: Ductile Iron (ASTM A48-30B).

G. Bearing Rings: Silicon carbide.

H. Mechanical Seals:

1. Provide as specified herein.

I. Motors: Provide as specified herein.

J. O-Rings: EPDM.

K. Baseplates: Provide as specified herein.

L. Pump Skid Construction:

1. Pump skid package shall include pumps, motors, VFD's ASME diaphragm tank, suction and discharge manifolds, valves and control panel.

2. Suction and discharge manifolds shall be Type 304 stainless steel, Schedule 10.

3. Provide full lug style butterfly isolation valve on suction and discharge of each pump.

a. Disk: Stainless steel.

b. Seat: EPDM

c. Body: Cast Iron

d. Coatings: Internally and externally with fusion bonded epoxy.

4. Provide a non-slam type check valve on discharge of each pump.

a. Maximum headloss: 5 psi @ pump design capacity

b. Body: Stainless steel or fusion bonded epoxy coated iron

c. Seat: EPDM

d. Springs: Stainless Steel

e. Disk: Stainless Steel.

5. Pressure Transducers: Installed on suction and discharge manifolds.

a. Material: Stainless Steel

b. Accuracy: + 1.0%

6. Pressure Gauges: Bourdon tube type on suction and discharge manifolds, liquid filled, stainless steel case and copper alloy parts.

a. Accuracy: 2.5%

7. Base Frame: Type 304 corrosion resistant stainless steel. Provide rubber vibration dampeners between each pump and base frame. Base shall be a structural steel base, bent form bases are not acceptable.

M. DIAPHRAGM TANK:

1. Provide an ASME diaphragm tank appropriately sized to meet low flow demands.

2. Materials

a. Shell: High strength steel

b. Diaphragm: Heavy duty Butyl

c. System connection: stainless steel

3. Configuartion and Size

a. Vertical configuration not to exceed 90 gallon tank volume.

**2.06 - MOTORS**

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS, and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Process Pump Schedule.

D. Provide motors for horizontal pumps with mounts for bolting to baseplate.

E. In addition to the requirements for bearings specified under Electric Motors in SECTION 01171, ELECTRIC MOTORS, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Provide motor service factor of 1.0 in accordance with NEMA MG-1 requirements for VFD driven motors.

I. Provide VFD driven motors with normally-closed winding thermistors for motor over-temperature protection.

J. Motors shall be inverter duty rated for use with VFD's per NEMA MG1

K. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

L. Rating: 460V, 3-phase, 60 Hertz.

M. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

N. Site Altitude: Less than 3,300 feet above sea level.

O. Provide Inpro/Seal bearing isolators.

**2.07 - CONTROL PANEL (PLANT WATER PUMPS)**

A. Automatic controls for operation of the Plant Water Pumps and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel.

1. Provide a NEMA 4X 316 Stainless Steel enclosure.

2. Panel shall be labeled UL 508A.

3. Provide VFDs internal to the control panel enclosure including dedicated VFD circuit breakers and drive over-temp protection. Provide VFDs in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

4. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.

5. Provide the control panel with an integral surge protection device (SPD):

a. 120VAC, 10kAIC rated.

b. Visual indication of plug status.

c. UL listed.

6. Provide the control panel enclosure with the following:
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC at 480VAC
    b. Provide an emergency stop (ESTOP) maintained pushbutton on the face of the panel to shut down the system.
    c. Provide LED type indicating lights.
    d. Switches, buttons and lights shall be 35 mm. Provide push-to-test LED lights.
7. Provide pushbuttons and selector switches as indicated on Contract P&ID drawings.
8. Heaters or AC units required for control panels shall be powered from the control panel.
9. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide equipment rated in accordance with the Area Classification Schedule on the Contract Electrical drawing 00 E-601

B. Programmable Logic Controller (PLC): Provide control and monitoring of the system as shown on the contract drawings.
1. Provide PLC of the latest model available at the time of bid. Allen Bradley CompactLogix preferred. If Allen Bradley CompactLogix is not available, Plant Water System Vendor shall provide all hardware, software, and programming required to communicate with the plant SCADA system. Coordinate with the System Integrator as required.
2. Provide control and monitoring of the system as shown on the contract drawings.
3. Provide Ethernet connection to plant SCADA system to allow communication, control, and data transfer. Provide signals as required for a complete and operational system. Signals indicated on P&ID drawings and specified herein, at a minimum, are to be provided over the network connection.
4. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
5. In addition to quanity of I/O points shown on Contract drawings provide at least 5% spare of all types and wire spares from the PLC to the terminal blocks.
6. Provide RAM memory protected by backup battery.
7. Provide UPS sized to provide at least 10 minutes of backup power to PLC.
8. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
9. Provide at least 5% spare I/O of all types and wire spares from the PLC to the terminal blocks.
10. Human Machine Interface (HMI):
    a. Provide 10 inch Allen-Bradley PanelView Plus 7 (or equivalent product) with Color display and touch screen that is compatible with Ethernet communication network.
    b. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.
    c. Provide a fully documented HMI program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability
    d. The Plant Water System vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.

**2.08 - DRAIN AND VENT WATER PIPING**

A. Provide drains from stuffing box and casing vent and drain piping and valves to discharge into gutters or sumps as indicated and as directed by the Engineer.

B. Drain and vent piping: Schedule 10 Type 316L stainless steel with VicPress connections or Schedule 40 Type 316L stainless steel with socket welded connections. Provide a sufficient number of unions to permit removal of each valve and in-line device.

C. Provide pipe and fittings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

D. Valves: Provide size and type as indicated and in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

**2.09 - GAUGES**

A. Provide gauges assemblies for suction and discharge of each pump in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Suction Gauges: compound type.

1. Scale: inches Hg to psi

C. Discharge gauges: Provide standard range with top limit above pump shutoff head at maximum pump speed.

1. Scale: psi

**2.10 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.11 - SHOP TESTING**

A. Provide motor shop testing in accordance with SECTION 01171, MOTORS.

B. Pump Tests:

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater.

2. Provide certified performance tests as specified herein for all pumps

3. Certified performance testing.

a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

b. Full speed tests:

(1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

(2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.

c. Variable speed tests:

(1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

(2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

(3) Run a second test at a speed approximately midway between full and minimum speed.

(4) Run additional tests for each reduced speed operating condition specified and indicated.

d. Factory tests on pumps:

(1) Use factory calibrated test drives.

e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

5. Testing Acceptance Grade and Tolerances:

a. ANSI/HI 14.6 Acceptance Grade: 1U.

b. Efficiency Tolerance: -0 percent.

c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.

6. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.

8. Repeat tests until specified results are obtained.

9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

B. Install pumping units on a concrete pad and align thereon.

1. Coupling halves must be disconnected and only reconnected after alignment.

2. Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.

C. Horizontal pumps: Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.

D. Final Coupling Alignment:

1. Perform only after base is installed and piping is connected and pump nozzle connections tested as specified herein.

2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.

E. After alignment is correct, grout using high grade non-shrink grout.

1. For horizontal pumps fill entire base and leave no gaps or voids.

2. Do not imbed leveling nuts in grout.

**3.02 - PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEANUP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servcing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. One complete set of gaskets and O-rings.

b. One spare mechanical seal for each pump provided with mechanical seals.

c. One shaft sleeve.

2. For each set of pumps of the same size and performance.

a. One set of all special tools required.

**3.08 - FIELD TESTING**

A. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.
    a. Provide vibration signature test data for each pump and drive assembly.
        (1) Limit: 50 percent of ANSI/HI allowable limits.
    b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F .
    c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.
2. Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.
3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
4. Repeat tests until specified results are obtained.
5. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.
    a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.
    b. All calibrations must be within 30 days of the field testing.
    c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.
    d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11324**

**CHEMICAL PERISTALTIC METERING PUMPS AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Chemical Peristaltic Metering Pumps and Appurtenances as specified and/or as shown on Contract Drawings.

B. Provide each chemical pumping system complete. And before acceptance make each system fully operational and ready for use by the Owner.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections with DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Prior to initial submittal, arrange conference in Engineer office with Engineering Representatives of equipment vendor who are familiar with specification to discuss overall job concept.
2. When the Contractor proposes equipment which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing necessary changes and embodying special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.
3. Submit certified shop drawings, manufacturer's specifications, catalog data, descriptive literature, illustrations, and other materials necessary for proper appraisal of quality and function.
4. Include factory work sheets which identify each piece of equipment as specified herein and on drawings.
5. Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.
6. Number and identify equipment to correspond with terminology on drawings. Use these numbers on all submittal sheets and shop drawings.
7. Furnish for each system piping schematic and wiring schematic with interconnection diagram and a complete description of operation.

8. Submit wiring diagrams for metering pumps showing all required field wiring and terminations.
9. Vendor to confirm with calculations that the pumps offered can handle the piping as shown.
10. Operating and maintenance instructions and parts lists.
11. Templates or certified setting plans, with tolerances, for anchor bolts.
12. Recommended spare parts other than those specified.
13. Recommendations for short and long term storage.
14. Submit recommended charging pressures for pulsation dampeners.
15. Submit accuracy and readability limits for pump speed indicators.
16. Manufacturer's product data and specifications for shop painting.
17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
18. The latest ISO 9000 series certification or certified quality assurance/control program document.
19. Provide qualifications of service/start-up personnel.
20. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Based on incompatibility with the service conditions, provide technical data and provide proposed materials.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
21. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required."
    a. Failure to include all drawings applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
22. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    b. Failure to include a copy of the marked up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. General:

1. Do the work required by and in accordance with applicable State and local codes; arrange for all permits, inspections and tests required by these codes. Provide systems and items of equipment that conform to applicable safety standards including those for safety of personnel.

2. One vendor to provide equipment and appurtenances, regardless of manufacturer, and is responsible for the satisfactory operation of the systems. Substitutions on functions specified are not acceptable.

3. Provide components to manufacturer's standard for service intended unless otherwise required.

4. Pumps of the same type to be the product of one manufacturer. Provide equipment of manufacturers' latest and proven design. Pumps to be standard cataloged products.

5. Drawings and specifications direct attention to certain required features of the equipment, but do not purport to cover all details entering into its design, construction and installation; nevertheless, furnish and install equipment so that systems will be complete and ready for operation.

C. Service:

1. Services of Manufacturer's Representative stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

2. Provide services of factory-trained Service Personnel, specifically trained on type of equipment specified.

a. Submit qualifications of Service Engineer for review.

b. Person-day requirements listed exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.

c. Installation: Sufficient time to assist in location of anchor bolts; setting, leveling, alignment, field erection, etc.; coordination of piping, electrical, miscellaneous utility connections, but not less than:

(1) 1 person-days.

d. Start-Up: Sufficient time for calibration, testing and start-up, but not less than:

(1) 1 person-days.

e. Performance Testing: Time for field acceptance testing, but not less than:

(1) 1 person-days.

f. Instruction: Sufficient time for classroom and/or field operation and maintenance instruction, but not less than:

(1) 1 person-days.

g. Credit to the Owner unused service person-days specified above at the manufacturer's published field service rate plus any costs of travel.

3. The minimum days specified above does not relieve the manufacturer of responsibility of providing sufficient service to place components and systems in satisfactory operation. Provide, in addition to time periods specified above, time and material used to correct defective equipment at no additional cost to Owner.

4. 8-hour days specified are exclusive of travel time.

5. Turn on no form of energy to any part of systems prior to receipt by Engineer of certified statement of approval of installation from Contractor containing his supplier's authorization to energize system unless done by the supplier's servicemen may do so for purposes of checkout.

6. The Manufacturer's Representative must maintain a factory trained serviceman with parts within 150 miles of this Owner.

D. Pumps, Motors and Controllers:

1. Pump manufacturer shall furnish the pumps, motors and variable frequency drives, if required, regardless of manufacturer, as a complete package to ensure proper coordination and compatibility of equipment.

2. Prior to shipment to job site, pump manufacturer must perform a test on the combined motor and pump assembly.

**1.08 - WARRANTY – Not Used**

**1.09 - REFERENCES**

A. ASTM International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A48: Standard Specification for Gray Iron Castings

3. A322: Standard Specification for Steel Bars, Alloy, Standard Grades

4. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

B. National Electrical Manufacturers Association (NEMA):

1. ICS 1: Industrial Control and Systems General Requirements

2. MG1: Motors and Generators

3. Underwriters Laboratory

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Pump capacities and operating data are indicated in the Metering Pump Schedule.

B. Sodium Hypochlorite (SH).

**1.** The system shall consist of two totes (supplied by others) and two metering pumps with two shelf spares for application in the 6" SBI line off of the SBR Transfer Pumps discharge. The Owner will provide the totes, filled with the proper chemicals, for facility start-up and operation.

2. The sodium hypochlorite shall be transferred from the totes to the metering pumps with manually initiated controls.

C. Polyaluminum Chloride (PACL).

**1.** The system shall consist of two totes (supplied by others) and two metering pumps for application in the 6" SBI line off of the SBR Transfer Pumps discharge. The Owner will provide the totes, filled with the proper chemicals, for facility start-up and operation.

2. The polyaluminum chloride shall be transferred from the totes to the metering pumps with manually initiated controls.

**2.02 - GENERAL**

A. Provide systems constructed of components which are compatible and suitable for intended service.

B. Drawings and specifications indicate energy sources that will be provided. Provide all other devices necessary to obtain proper operation of system from these energy sources.

C. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**2.03 - PUMPING EQUIPMENT**

A. Peristaltic Metering Pumps (Maximum pressure 30 psi):

1. Acceptable manufacturers:

   a. Watson-Marlow.

   b. Verder.

   c. Or an acceptable equivalent.

2. Pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, self-contained variable speed drive, and flexible extruded tube.

3. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 30 foot vertical water column. Maximum pressure rating: 30 psi. Pump shall not use check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.

4. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Provide high corrosion/impact materials as specified.

   a. Track Construction: polyphenylene sulfide (PPS)

   b. Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.

   c. Rotor Construction: polyphenylene sulfide (PPS)

5. Tube Retainer Mechanism: Provide a two spring–loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pumphead.

6. Rotor Assembly: Compressing rollers shall be 316SS with low friction stainless steel bearings and PTFE seals. Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading.

7. Pumpheads requiring disassembly or special tools for tube changing are not acceptable.

8. Pumphead shall accept tubing sizes 1.6 mm, 3.2 mm, 4.8 mm, 6.4 mm, 8.0 mm and 9.6 mm with 2.4mm wall thickness and materials including, Marprene, Bioprene, Silicone, Sta-Pure & Chem-Sure. Pumps that require tools for adjustment or changing pumpheads to accept different tubing materials or sizes are not acceptable.

9. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with 64 Shore A durometer and minimum 2.4mm wall thickness. If required for chemical compatibility, pump manufacturer shall recommend an alternate tubing material.

10. Drive Rating: Continuous 24 hour operation, 40 degrees C ambient.

11. Supply: 110-120V, 50/60 Hertz, single phase. Supply nine-foot length power cord with standard 115V three-prong plug. Max drive power consumption: 135VA.

12. Housing: Enclosure: NEMA 4X. Unpainted housings, including 316SS, are not acceptable.

13. Pumps must meet the following minimum requirements for operator interface functionality.
    a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
    b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
    c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
    d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
    e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
    f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm.
14. Supply auto control features to meet the following minimum functionality requirements.
    a. Remote Control Inputs:
        (1) Speed Control:
            (a) Primary Analog 4-20mA speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.
            (b) Secondary Analog 4-20mA or 0-10VDC scaling input, with input signal trimmable and programmable scaling factor.
            (c) Start/Stop Control: dry contact. Configurable command sense allowing open to equal run or open to equal stop. Configurable to be a keypad start/stop override in Manual mode.
            (d) Auto/Man Mode Control: dry contact.
        (2) Status Outputs:
            (a) Four relay contacts rated for a 30 VDC with a maximum load of 30W, NO or NC software configurable to indicate the following:
                1) Running/Stopped status
                2) Forward/Reverse status
                3) Auto/Manual (Remote/Local) status
                4) General Alarm status
            (b) Speed output – Analog 4-20 mA
15. Drive motor- brushless DC motor with integral gearbox and tachometer feedback.
    a. Speed Control Range of 2200:1 from 0.1 to 220 rpm +/- 0.1 rpm throughout the range.
    b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm
    c. Circuitry complete with temperature and load compensation and protection.
16. Pump Fittings:
    a. Provide each metering pump with tubing fittings. To allow connection to hard piping as shown on the drawings.
    b. Fittings to be reusable one piece requiring no clamps or tools to install.

**2.04 - METERING PUMP APPURTENANCES**

A. Pulsation Dampeners:

1. Provide discharge pulsation dampeners on metering pumps where indicated suitably size for displacement of each pump to limit discharge pressure to plus/minus 10 percent. Provide pulsation dampeners of type which has a diaphragm separating air chamber from liquid chamber. Provide diaphragm of molded construction and that prevents air charge from being dissolved in process fluid. Provide lower chamber of Type 316 stainless steel lined, or of inert plastic material to prevent corrosion by process fluid. Provide materials suitable for intended service. Charge air chamber with compressed air to pump manufacturer's recommended charging pressure. Equip upper chamber with tire valve type of charging valve and air pressure gage with shutoff valve.

2. Provide a bicycle pump with handle and sufficient capacity to charge the pulsation dampeners. Bicycle pump to be easy to handle.

B. Pressure Relief Valves:

1. Provide pressure valves where indicated on drawings. Provide pressure relief of polyvinylchloride construction, and having Hypalon or Teflon diaphragms, suitable for the fluid being pumped, to protect upper works of valve from process fluid. Provide spring opposed diaphragms with loading pressures adjustable by means of screw in top works. Field-adjust valves to settings required of the system. Setting to be the maximum pressure to occur downstream of the valve, as installed in system, while pump is operating.

C. Calibration Standpipes:

1. Equip each group of pumps indicated on drawings with calibration standpipe for measuring pump output.

2. Provide standpipes of Schedule 40 clear PVC pipe with Schedule 80 fittings. Thin wall tubing and acrylic plastics not acceptable.

3. Equip each standpipe with flanged connection to suction piping, and fitted with ball valve for air venting, as indicated on drawing. Provide fittings of socket weld type. Provide valves and fittings as specified under other sections referenced.

4. Provide one calibration standpipe for each group of pumps indicated, of the height indicated on the drawing, and of a diameter such that the measurable capacity of the standpipe is approximately one and one-half minutes discharge of each pump at maximum pumping capacity. Length of the standpipe indicated is the length of clear observable pipe and does not include length of fittings or connections. Permanently calibrate each standpipe in gallons and tenths.

5. Provide valves and flanges at each pump suction for attachment of calibration standpipes. Install pump suction and discharge piping so as not to interfere with location and use of standpipes.

**2.05 - SHOP TESTING**

A. Provide in accordance with SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING.

B. Motor Test:

1. Give each motor a standard commercial tests in the shop of the motor manufacturer, and submit certified copies of the test results to the Engineer for review prior to installation of the motors.

C. Pump Test:

1. Certified performance testing.

a. Variable Speed Pumps:

(1) Variable speed pump tests: Conduct tests as specified above for full speed at reduced speeds. Run one speed test at speed required to discharge the minimum rating point. Run a second test at a speed approximately midway between full and minimum speed.

b. Factory tests on pumps must be conducted using the actual job motor and gear reducer.

2. Run tests in accordance with the latest standards of the Hydraulic Institute, where applicable.

3. Inlet Vacuum Test:

   a. Test assembled pump running on air.

   b. Run test for a minimum of 5 minutes and record vacuum reading which must meet or exceed 95 percent full vacuum.

4. Provide testing of variable frequency drives in accordance with SECTION 01172, VARIABLE FREQUENCY DRIVE UNIT.

5. In event that specified tests indicate that pump, motor or variable frequency drive will not meet specifications, Engineer has the right to require complete witnessed tests for all pumps, motors and variable frequency drives at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to Owner.

**2.06 - SHOP PAINTING**

A. Provide as specified in SECTION 09940, SHOP PAINTING for pump casings.

B. Give a shop coat of grease or other suitable rust-resistant coating to ferrous surfaces obviously not to be painted.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install equipment and appurtenances in accordance with manufacturer's printed instructions, as indicated and specified.

B. Install pumping units on a concrete pad. Assure there is no pipe stress on pump piping connections.

**3.02 - PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Furnish following spare parts, identical and interchangeable with similar parts installed in work:

1. For each chemical metering pump:

   a. Three replacements for each tube/hose.

   b. Two complete sets of gaskets.

2. One of each type and material back pressure regulator with one spare diaphragm and spring for each.

3. One spare diaphragm and air valve for each discharge pulsation dampener.

4. One complete spare VFD control package for each type installed, including power supply, signal isolation/interface, and controls.

5. Provide all other manufacturer's recommended spare parts necessary to maintain each piece of equipment for a period of one year.

B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.

C. Deliver spare parts at same time as equipment to which they pertain. Properly store and safeguard such spare parts until completion of work, and then deliver to Owner.

**3.08 - FIELD CALIBRATION AND TESTING**

A. General:

1. Coordinate testing with operation of other portions of the facility. Arrange for temporary piping and wiring modifications which may be needed if chemical cannot be fed at intended dosing points, or if other interconnected electrical equipment is not operational.

2. Calibrate in the presence of the Engineer.

3. After cleaning, completely test each chemical feed system to verify that equipment is capable of performing its specified function in satisfactory manner without mechanical or electrical defects, binding, or operational difficulties. Correct defects and deficiencies and repeat all tests until satisfactory results are obtained. Correct excessive vibration leakage or noise. Make connections watertight or dusttight.

4. Demonstrate accuracy of units and bring within limits specified herein.

5. At the time of the tests, make final adjustments necessary to place equipment in satisfactory working order.

6. Test and calibrate equipment and accessories specified herein in accordance with manufacturer's printed instructions over full operating range of equipment.

7. Water testing is permitted where appropriate for preliminary testing purposes; however, conduct acceptance tests using appropriate chemicals for which each system was designed.

8. Complete preliminary and calibration testing and corrections prior to acceptance testing, as specified herein, to be conducted with the manufacturer's technical representative.

9. Copies of tests to be furnished to the Engineer.

10. Neutralize and dilute chemicals wasted during testing procedures with 10 volumes of water prior to disposal into plant drain system. Direct dumping into drains without prior neutralization and dilution is hazardous and not permitted.

11. Identify any exceptions to specification in documentation.

B. Chemical Pumps (Acceptance Tests):

1. Submit five copies of manufacturer's preliminary and calibration pump curves showing numerical values of pump discharge to nearest tenth of a gallon per hour.

2. Perform testing at 100, 75, 50 and 25 percent of speed settings.

3. Submit five copies of individual pump calibration curves to Engineer at least 15 days prior to acceptance testing. Notify Engineer in writing when pumps are ready for acceptance testing, and make no adjustments or modifications to pumps after that time, without written permission of Engineer.

4. During acceptance testing demonstrate correct functioning of control stations.

5. Perform testing in the following manner:

a. Test pumps by filling calibration standpipe with chemical, and measuring time to pump a given volume out of the standpipe, with all other equipment valved off. Make test measurements of at least

fifty seconds duration, using two stopwatches reading time to nearest one-hundredth second. Discard measured times differing more than one-half second. Average times differing by one-half second or less. Record averaged time for use in determining acceptability of pumps.

b. For pumps equipped with back pressure valves, perform testing at the back pressure valve setting of 50 psig.

6. To determine deviation compare measured pump output at various settings with output indicated by manufacturer's calibration curves. Pumps with deviation greater than plus or minus 3.0 percent of maximum pump output are not acceptable. Add one percent to allowed tolerances specified herein for pumps having variable speed drives.

7. Add 0.5 percent to the deviation for the slurry pumps acceptance.

8. Demonstrate pumps are capable of pumping zero flow at zero percent stroke, 100 percent speed settings. Pumps unable to meet this requirement are not acceptable.

9. If pump output varies excessively, it is possible the pump is air bound. Operate pump for five minutes at back pressure valve setting of 50 psig. Pumps unable to relieve themselves of air within five-minute period are not acceptable.

10. Operate pumps for period of four hours to demonstrate satisfactory operation.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11326**

**MECHANICALLY CLEANED FINE SCREENS AND APPURTENANCES**

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# PART 1 – GENERAL

## 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide In-Channel Mechanically Cleaned Rotary Screens, Gear Reducers, Motors, Controls and Appurtenances as specified and/or as shown on Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specification.

## 1.02 - MEASUREMENT AND PAYMMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

## 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

## 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

2. Data regarding equipment performance and motor characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate equipment, showing they meet indicated and specified requirements for flow capacity and pressure drop.
        (1) For units of same size and type, provide curves for a single unit only.
    b. Results of shop performance tests as specified.
    c. Submit curves for guaranteed performance on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.
3. Drawings showing materials of construction, thicknesses, operating and maintenance envelope and assembly weight.
4. Hydraulic calculations verifying compliance to the design criteria.
5. Strength calculation verifying compliance to the specified criteria.
6. Control Panels:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, location of panel interior and exterior mounted components. Provide control panel elevation drawings with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, electrical and instrumentation drawings.
7. Shop drawing data for accessory items.
8. Certified setting plans, with tolerances, for anchor bolts.
9. Manufacturer's literature as needed to supplement certified data.
10. Operating and maintenance instructions and parts lists.
11. Listing of reference installations as specified with contact names and telephone numbers.
12. Certified results of hydrostatic testing.
13. Bearing temperature operating range for the service conditions specified.
14. List of recommended spare parts other than those specified.
15. Shop and field inspection reports.
16. Bearing Life: Certified by the equipment manufacturer. Include design data.
17. Equipment shop test results.
18. Motor shop test results.
19. Qualifications of field service engineer.
20. Recommendations for short and long-term storage.
21. Shop and field testing procedures, set up and equipment to be used.
22. Special tools.
23. Gear reducer data including service factor, efficiency, torque rating and materials
24. Schematic control and power wiring diagrams including interconnecting and internal wiring diagrams
25. Control panel drawings
26. Number of service person-days provided and per diem field service rate.

27. Manufacturer's product data, specifications and color charts for shop painting.
28. Provide listing of reference installations with contact names and telephone numbers.
29. List of recommended spare parts other than those specified.
30. Equipment weight and lifting points for installation and removal purposes.
31. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
32. The latest ISO 9001 series certification.
33. Provide a scaled drawing showing the equipment, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.
34. Number, size and weight of pieces shipped.
35. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
   1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Ship screens in one piece.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in

accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Equipment specified shall be the product of one manufacturer.

C. The Contractor shall obtain the screens, gear reducers, motors and appurtenances from the mechanically cleaned screen manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

D. Equipment specified shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

E. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

F. Shop tests as specified.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical and miscellaneous utility connection:

   a. 1 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

   a. 1 person-days.

4. Performance Testing: Field performance test equipment specified.

   a. 1 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of specified equipment shall have a minimum of five (5) operating installations with equipment of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different width, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

K. Electrical Equipment Labeling Requirements:

1. Provide equipment labeled by a nationally recognized testing company where standards have been established. Where equipment is not available with label, provide service of a nationally testing company to examine the equipment and certify in writing that it complies with its safety standards. Tests and inspections of equipment shall be at no additional cost to Owner.

L. Provide all components made of stainless steel passivated by full submergence in a pickling bath for perfect surface finishing. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

1. Fully submerge all stainless steel parts in a pickling bath for at least 8 hours to remove welding spots and to protect the stainless steel against corrosion. Sand or glass bead blasted or brushed or otherwise not equivalently treated stainless steel is not acceptable.

M. Provide fabrication in compliance with all applicable ASTM standards or equivalent international standards.

N. Factory welding to use shielded arc, inert gas, MIG or TIG method.

1. Filler wire: Add to all welds to provide for a cross section equal to or greater than the parent metal.

2. Butt welds: Fully penetrate to the interior surface and gas shielding to interior and exterior of the joint.

**1.08 - REFERENCES**

A. American National Standards Institute (ANSI):

1. S1.11: Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets.

B. American Society for Testing and Materials International (ASTM):

1. A48: Specification for Gray Iron Castings.

C. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Automatic self-cleaning mechanical screen with screen basket, spiral assembly, transport tube, press zone, drive system, pivot stand and controls.

B. Screening system capacities and operating data are indicated in the Mechanically Cleaned Screen Schedule.

C. Screens will be installed in the channels as specified and indicated.

D. Service**:** Raw wastewater.

E. Screens will discharge to a container as indicated.

F. Interface:

1. Provide driving mechanism headworks and housing arranged in accordance with limitations imposed by space available.

2. Provide room for inspection, adjustment and repair of equipment.

3. Contractor and Equipment supplier shall verify channel invert, configuration, width and depth of new channels.

G. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**2.02 - MANUFACTURERS**

A. Huber Technology.

B. Lakeside.

C. Kusters.

D. JWC Environmental

**2.03 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.04 - FINE SCREEN CONSTRUCTION**

A. Provide spiral assembly consisting of the spiral, brush, and drive shaft.

1. Provide spiral constructed of high-strength AISI Type 316L stainless steel. Provide the spiral with a transition conical section at the beginning of the transport tube which will reduce its OD (outside diameter) from the screen basket to the transport section. Provide the spiral constructed of two concentric flights formed continuously from bar stock and welded together to form a spiral.

2. Spiral fitted with HDPE brush to clean screen basket openings, fastened to the spiral edge in the screening section.

3. Provide drive shaft welded directly to the spiral. The shaft shall be a solid, carbon steel, keyed shaft for direct insertion into the hollow shaft of the gear motor drive.

B. Provide screen basket constructed of perforated 14 gage (minimum) Type 316L stainless steel. The screen basket shall be fitted with rubber flaps to provide a seal between the channel walls and the screen basket.

C. Provide transport tube with taper from screen basket to press zone constructed of 11 gage Type 316L stainless steel. Transport tube fitted with three (3) wear bars in the taper section and three (3) wear bars in the straight section, to prevent the spiral from wearing on the surface of the tube. The wear bars 3/16-inch thick Type 316 stainless steel.

D. Provide press zone assembly of perforated dewatering cylinder surrounded by a jacket and a spray wash system.

1. Press Zone 14 gage minimum type 316L stainless steel cylinder, solid on the top, and perforated slots on the bottom 180 degrees. The dewatering cylinder contained within an 11 gage Type 316L stainless steel jacket, to direct the pressate into a drain hose, to be returned to the downstream side of the screen.

E. Provide discharge section of 11 gage Type 316L stainless steel. Provide a 360 degree reverse-pitched spiral on the shaft in the discharge zone to prevent the plug from advancing into the drive. The reverse-pitched spiral to have a serrated cutter to break the plug off and allow the solids to fall through a vertical tube.

F. Provide screens with a pivoting support stand design to allow removal of the screen basket from the channel for maintenance purposes.

1. Supports and Support Stand: Type 316 Stainless Steel.

**2.05 - SCREENING CONVEYOR AND DEWATERING SYSTEM**

A. Provide an integral screw type screenings conveyor to transport and dewater screened material.

B. Screw conveyor capable of continuous operation and capable of handling all materials removed by automatic filter screen.

C. Provide 316 stainless steel discharge chute as indicated.

D. Removable continuous plastic bagging device mounting directly to the discharge chute.

**2.06 - SCREEN SPRAY WASH SYSTEM**

A. Provide spray systems for screen cleaning and compaction and dewatering chamber flushing. Provide each system complete with solenoid valve, isolation ball valves, piping and fittings, nozzles suitable for unfiltered plant effluent and Y-strainer.

1. Piping Size: 1-1/4-inch.

2. All Materials: Type 316 Stainless Steel.

B. Provide spray wash system for continuous cleaning during screen operation.

C. Compaction zone flush water system: periodically clean compaction/ dewatering zone via stainless steel wash header in the compaction/dewatering chamber.

D. Solenoid valves: two-way acting, NEMA 7. Solenoid valves to be powered and controlled by the screen control system.

**2.07 - CONTROL SYSTEM**

A. Provide each screen with controls for fully automatic operation of the screen. Screen to operate on a timed sequence and continuously operate on high level differential signal until normal level is reached.

**B.** To the maximum extent practical, utilize a Programmable Logic Controller (PLC) within the operation of the control system. PLC shall be MicroLogix 1400 or approved equal.

C. Coordinate the PLC I/O interface with the overall plant control system.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract electrical drawing 00 E-601.

E. The intention of the PLC interface is to allow the plant control system to monitor the operation of the equipment. As a minimum, the following information is to be available to the plant control system through the PLC I/O:

1. On/Off Status

2. All individual failure alarms

3. Upstream and downstream level

F. Provide control panel in an enclosure rated as specified. Control Panel to Include:

1. Provide UL 508Alisted control panel.

2. NEMA 4X Type 316 stainless steel.

3. Main power fusible disconnect switch rated 65 kAIC minimum at 480VAC.

4. NEMA rated reversing motor starters with control power transformer, 480/120 vac.

5. All instruments, valves, and ancillary devices for the screen shall be powered from the screen control panel. Provide step-down transformers as required.

6. Motor overload protection via MCP with overload shutdown reset pushbutton.

7. Screen PLC.

8. Running time meter

9. Indicating Lights for:

a. Power on/off

b. High level differential

c. Screen standby

d. Motor overload

e. Overload shutdown

10. Run/Off/Auto switch for screen.

11. Forward/Reverse switch for screen.

12. Hand/Off/Automatic switch for each solenoid valve.

13. Panel heater and thermostat.

14. Adjustable pneumatic type timer 0-60 minutes.

15. Panel to be wall mounted.

G. Local Control Panel:

1. Provide local control panel to be mounted adjacent to screen in the Headworks room.

2. Enclosure: Class I, Division 1, Group D, cast aluminum.

H. Provide ultrasonic level measurement system for level sensing upstream and downstream of screen:

1. Sensor to measure over operating range of screen.

2. Provide transmitter with 2 alarm switches adjustable over full range of measurement. Transmitter to be mounted inside screen control panel.

3. Provide mounting bracket for sensor with adjustable base to allow leveling of sensor.

4. Input power 120 vac, from screen control panel control transformer.

5. Explosionproof cast aluminum construction for transmitter and sensor.

6. Input level values to plant computer system for indication.

I. Miscellaneous

1. All Panels require UPS. Provide UPS sized to provide at least 15 minutes of back-up power to the PLC.

2. Provide 10” HMI, Allen Bradley PanelView Plus or approved equal.

3. Provide a managed industrial Ethernet switch with at least four (4) ports, installed with the panel in order to connect the panel to the plant SCADA system. Managed Ethernet switch shall be Allen Bradley Stratix 8000 or approved equal.

4. Physical switches (Screen HOA FOR, (2) Screen SOV HOA and E-Stop) shall be provided on the LCS and are not required on the main PLC cabinet.

5. Screen level measurement shall be Single Siemens HydroRanger 200 HMI with (2) STH Transducers or approved equal.

6. All PLC’s shall be AB CompactLogix, AB MicroLogix or approved equal.

**2.08 - SCREEN DRIVE SYSTEMS**

A. Motor:

1. Provide in accordance with SECTION 01171, MOTORS and as specified and indicated.

2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of equipment under any condition of operation specified and indicated without operating in the motor service factor.

3. Motor enclosure and motor speed: As indicated in the mechanically cleaned Screening Equipment Schedule.

4. In addition to the requirements for bearings specified under Electric Motors in SECTION 01171, MOTORS, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

6. Operate without overheating at the speeds specified and indicated.

7. Service Factor: 1.15, with 1.0 inverter duty rating for screens equipped with variable frequency motor conditions.

8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

9. Rating: 460V, 3-phase, 60 Hertz.

10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

11. Site Altitude: Less than 3,300 feet above sea level.

12. Integral gear reduction units are not acceptable.

13. Provide capacity sufficient to start and operate screen 50 percent blinded without exceeding nameplate ratings for current and power and without operating in the service factor.

14. Provide drive units, including the reduction gearbox, shaft-mounted and positioned to facilitate maintenance work.

B. Gear Reducer:

1. Provide parallel shaft arrangement classified for continuous, AGMA Class II, 24-hour duty.

2. Provide ASTM A48 Class 30 cast iron housing.

3. Gears: Case hardened alloy steel forgings with precision ground gear teeth minimum AGMA quality 12.

4. Provide horizontal parallel or bevel right angle shafting, arrangement or as indicated in the Mechanically Cleaned Screen Schedule.

5. Design reducer to match output speed requirements of screens.

6. Match torque-rating of driven equipment.

7. Minimum gear reducer service factor 1.50 minimum, based on motor horse power rating.

**2.09 - MECHANICALLY CLEANED SCREEN SCHEDULE**

| | |
|---|---|
| Type: | Raw Wastewater, which includes both domestic and industrial conditions. |
| Temperature: | 45 degrees to 65 degrees F |
| pH: | 6-8 |
| Screen Data: | |
| Number of Screens: | 1<br>Note: In the future, another screen may be furnished and installed (not part of this Project) in place of the manual bar rack in the bypass channel. |
| Hydraulic Capacity: | |
| Design Peak Flow: | 1,042 gpm/screen (1.5 mgd) |
| Design Average Flow: | 135 gpm/screen (0.2 mgd) |
| Maximum Headloss in Wastewater at peak Design Flow at 10 inches downstream submergence: | 10.5. inches |
| Screen Openings Diameter: | 1/4-inch (6 mm) |
| Screening Basket Diameter: | 20 inches |
| Maximum Screen Incline: | 48 degrees |
| Wash System: | |
| Flow Rate: (Max): gpm | 15 |
| Pressure Required, psi: | 60 |
| Drive Motor Hp: | 1-1/2 |
| Screen Channel: | |
| Width, in: | 20 |
| Maximum Water Depth, in : | 28 |
| Channel Depth, in : | 44 |
| Discharge Height: | |
| From channel bottom to discharge chute bottom, feet | 2-3/4 |

**2.10 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.11 - SHOP TESTING**

A. Comply with the requirements specified in SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING and as specified herein.

B. Provide motor shop testing in accordance with SECTION 01171, MOTORS.

C. Screen Testing:

1. All shop tests will be witnessed by the Engineer.

2. Control Panel Tests:

a. Test all functions and alarms of each control panel. After acceptance and prior to shipping apply dielectric grease and install corrosion inhibitors as specified.

3. Screen Tests:

a. Fully factory assemble each mechanically cleaned screen and operate the screens in designed position.

b. Operate each screen for 2 hours and record results.

c. Conduct testing using job motors control panels.

D. Repeat tests until specified results are obtained.

E. In event that specified tests indicate that equipment will not meet the specifications, AECOM has the right to require complete witnessed tests for all equipment at no additional cost.

F. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to Owner.

G. Provide a 30 day minimum notice prior to testing.

H. When witness performance testing is specified, provide roundtrip airfare, all transportation and lodging for witness testing for two (2) people. If air travel is more than 6 hours provide business class airfare.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with shop drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

B. After alignment is correct, grout using high grade non-shrink grout.

1. Do not imbed leveling nuts in grout.

**3.02 - PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of the lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. Furnish following spare parts for mechanically cleaned screens:
    a. One set of brushes.
2. One set of all special tools required.

**3.08 - FIELD TESTING**

A. Comply with the requirements specified in SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING and as specified herein.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, and a completed and signed pretesting check list. See Division 1 for checklist.

C. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct a dry running test and a performance test for each unit in presence of the Engineer to determine its ability to deliver its rated capacity under specified conditions.

1. Performance Test:
    a. During tests, observe and record flow rates, channel water depths, headloss, and motor inputs.
    b. Test Duration: Determined by the Engineer, but not less than ten cycles.
    c. Each screen must demonstrate thirty (30) days of continuous, defect-free operation prior to final acceptance.
    d. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
2. Repeat tests until specified results are obtained.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11333**

**SEPTAGE RECEIVING STATION**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for Septage Receiving Station Work and, where appropriate, applying or installing such materials for the various items of Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. The Owner has pre-selected the manufacturer of the Septage Receiving Station. Refer to SECTION 99999, ATTACHMENTS for the Proposal received from Huber Technology. In the event of a discrepancy between the Proposal and this section, this section shall govern.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Septage Receiving Station. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 - DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

1. Certified shop and working drawings including complete characteristics and performance data for all equipment.
    a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.
        (1) Provide complete dimensional and performance data for screens, bearings, drives, motors, and all appurtenances.
        (2) Provide complete electrical and control schematics with interconnecting wiring diagrams.
    b. Electronic files shall conform to the following minimum requirements:
        (1) Files shall be AutoCad 2013 or Higher.
        (2) Files shall be submitted as part of the Shop Drawing submittal.
        (3) Submit Files on CD or DVD.
        (4) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.
        (5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.
        (6) Files shall be drawn to scale.
    c. Drawings shall be in conformance with all other requirements as specified in this specification.
    d. Provide a scaled drawing showing the equipment, drives, and motors including equipment weights, lifting points and attachments, and clearances for equipment removal and maintenance.
2. Data regarding septage screening equipment, motor, and drive characteristics and performance:
    a. Prior to fabrication and testing, include in data guaranteed performance curves based on actual shop tests of mechanically duplicate equipment, showing they meet specified requirements for head loss, capacity, and horsepower.
    b. Results of certified performance and witness tests as specified.
    c. Submit curves for guaranteed performance, certified test and witness tests on 8-1/2-inch. by 11-inch. sheets, one curve per sheet.
3. Control Panels:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.
4. Shop drawing data for accessory items.
5. Submit data from a minimum of three (3) separate tests showing compliance with the “Paint Filter Test” as described in EPA Publication SW-486 Method 9095. Photos shall also be submitted in order to document compliance with each test. The manufacturer must also state which facility the tests were performed at, when the tests were performed, and who witnessed the tests.

6. Printed installation manual.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.
9. Operating and maintenance instructions and a list of recommended spare parts other than those specified.
10. Listing of reference installations as specified with verified contact names and telephone numbers.
11. Bearing temperature operating range for the service conditions specified.
12. Shop and field inspection reports.
13. Bearing Life.
14. Motor and Drive shop test results.
15. Qualifications of field service technician that will perform site services. Manufacturer shall submit two candidates. Non-approved candidates will be disallowed from performing any site services.
16. Recommendations for short and long-term storage.
17. Shop and field testing procedures and equipment to be used.
18. Special tools.
19. Number of service person-days provided and per diem field service rate. A minimum of two days shall be provided.
20. Location and contact information for the nearest parts and service center.
21. Manufacturer’s product data and specifications for painting.
22. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
23. Latest ISO 9001 Series Certification, AISC Category 1 Certification, or Quality Control Plan.
24. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
    1. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include all drawings, or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked and indexed to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Manufacturer, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping:

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturers written recommendations and instructions.

**1.06 - DESIGN CRITERIA**

A. Septage Receiving Station shall comply with the service conditions outlined in paragraph 2.02 and consist of a cylindrical fine screen complete with screen basket, cleaning mechanism, concentric screw conveyor, dewatering screw, screening press with drive unit and pre-engineered housing complete with hinged and gasketed cover with vent, tank spray wash system, quick disconnect coupling inlet, grit trap with grit classifier, rock trap, manual inlet isolation valve, hydraulic inlet valve, inlet flow meter, inlet full-port sampling ball valve, outlet connection, and a ultrasonic liquid level sensing system, pH probe/transmitter, insulation and appurtenances as specified and indicated. The unit shall be complete with electrical control panel card reader and motor starter and mounted on a common fabricated steel base.

B. The Septage Receiving Station shall include:

1. Rock Trap; Type 316L stainless steel construction

a. Class 150 ANSI 4-inch inlet flange and 8-inch outlet flange

b. Full diameter hinged cover

2. Screen Tank with washing unit including washing nozzle, solenoid valve, 1-inch, Class1 Division 1, 120VAC, Class 150 ANSI 4-inch screen inlet flange.

3. Type 316L Stainless Steel Construction; including tank covers, tank supports and adjustable support legs for field leveling.

4. Type 316L Stainless Steel shafted horizontal grit conveyance screw with constant speed gear motor, 0.75 HP, 460 VAC, 3 phase gear motor, Class1 Division1

5. Type 316L Stainless Steel shafted inclined grit discharge screw with constant speed gear motor, 1.5 HP, 460 VAC, 60 Hz, 2 phase gear motor, Class 1 Division 1.

6. Closed grit discharge chute; Type 316L stainless steel.

7. Plant water strainer, type 316L stainless steelbodied Y-type with washable SS filter insert, 20 mesh.
8. Ball valve with electrical actuator.
9. Magnetic flow meter and transmitter for recording and totalizing each hauler load.
10. pH probe and transmitter to monitor incoming pH levels and to close the inlet valve and initiate an alarm if the pH level is out of the control range setpoints:
11. Fine Screen; Type 316L stainless steel construction with shafted screw and integrated maintenance free bearing;
    a. Inclined auger tube and screen basket
    b. Screen Drive; Class 1 Division 1 Motor, 2 Hp, 480 VAC, 60 Hz, 3ph, VFD
    c. Spray bar cleaning system
    d. Integrated screenings washing system with automatic press zone
    e. 3 solenoid valves, 1-inch Class1 Division 1 120VAC, 60 Hz, Brass body
    f. Screenings discharge chute; Type 316L stainless steel
    g. Screenings bagger
12. Hauler Access Station to be provided with the following features:
    a. Enclosure: Type 316L stainless steel, NEMA 4X, access door with locking handle
    b. Industrial display with card reader and keypad
    c. Receipt printer; kiosk-style printer, illuminated chute, large capacity paper roll
    d. User magnetic cards, pre-programmed or ID Code
    e. Station with sufficient I/O to provide for control of garage door.
13. Control Panels
    a. PLC-Based control panel as specified herein.
    b. NEMA 4, Type 316L stainless steel operator interface/control station.
    c. NEMA 4X, Type 316L stainless steel local control station.
14. Any other equipment and controls required to meet the Equipment performance requirements.

**1.07 - REFERENCES**

A. American Institute of Steel Construction (AISC).

B. American Society of Testing and Materials (ASTM).

C. American Welding Society (AWS).

D. Steel Structures Painting Council (SSPC).

E. American Gear Manufacturers Association (AGMA).

F. Environmental Protection Agency (EPA) Publication SW-846 Method 9095.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - QUALITY ASSURANCE**

A. Provide as specified herein.

B. Welding: In accordance with latest applicable American Welding Society Code.

C. Provide shop and field tests as specified.

D. Provide services of factory-trained Service Technician, specifically trained on type of equipment as follows:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect installation of grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical, control and miscellaneous utility connections: 1/2 person-day.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 1/2 person-day.

c. Field Performance Testing: Field performance test equipment specified. 1/2 person-day.

d. Manufacturer Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1/2 person-day. The owner reserves the right to video record training events to train new staff in the future.

3. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

4. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

E. Provide a list of five references with verified contact names and numbers. References shall be in the same service as specified.

F. If equipment proposed is heavier or taller than specified, provide all structural, architectural, electrical and mechanical revisions at no additional cost to the Owner.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings.

B. The Contractor and the manufacturer shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS OF SEPTAGE RECEIVING STATION**

A. Huber Technology, Inc.

a) The Owner has pre-selected Huber Technology, Inc as the manufacturer of the Septage Receiving Station. No Substitutions are allowed.

**2.02 - SERVICE CONDITIONS**

A. Screen capacity and other operating data shall be as follows:

1. Number of units: 1

2. Minimum Hydraulic Capacity, gal/min: 400 at 3% solids concentration

3. Screen Opening, inches: ¼

4. Screening Basket Diameter, inches: 31

5. Minimum Screenings Screw Conveyor Diameter, inches: 9
6. Drive Motor Size, hp: 2
7. Inlet Pipe Size, inches: 6
8. Outlet Pipe Size, inches: 8
9. Inlet Height above Tank Base, inches: 29.5
10. Maximum Headloss at Minimum Hydraulic Capacity, inches: 11

B. The Septage Receiving Station will screen septic tank sludges containing significant quantities of sand, grit, rags, debris, and gravel. Screenings shall be washed, transported, compressed and dewatered by a single mechanism with only one motorized moving part.

C. The cylindrical fine screen shall be designed to handle the septage flow rate specified.

D. All electrical components mounted on the equipment shall be rated Class 1, Division 1.

**2.03 - OPERATION**

A. The operation of the screen handling equipment shall be automatically initiated at a preset high liquid level after manually opening a motorized inlet valve via the vendor supplied control system. The screen cleaning mechanism shall remove solids from a screenings basket and deposit them into a screw conveyor. The screenings shall be transported up the screw conveyor and through a compression chamber.

B. The screening equipment shall wash the screenings prior to compaction in an enclosed tube to prevent spray and aerosols and shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in Method 9095 of EPA Publication SW-846.

C. The screen shall be capable of picking up rocks and objects 3-1/8 inches in diameter and depositing them for washing and passage through the compaction/dewatering zone.

D. A rock trap shall precede the Septage Receiving Station.

E. The control system shall be designed so that the cleaning characteristics of the screen can be changed via a selector switch to handle both "normal" septage/scavenged sludge loads and "grease" loads or through the use of an automatically initiated two speed drive system. Systems utilizing variable frequency drives (VFDs) shall be acceptable.

**2.04 - SEPTAGE SCREENINGS EQUIPMENT CONSTRUCTION**

A. Cylindrical Fine Screen

1. The cylindrical fine screen shall be designed and built to withstand the maximum possible static hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized to prevent deflections or vibrations which may impair the screening, conveying and pressing operations. All submerged components and all components of the cylindrical fine screen in contact with the screened solids shall be of stainless steel construction.
2. The diameter of the screening basket shall be as specified.

B. Screen Cleaning Mechanism

1. The screen basket shall be of a cylindrical shape that shall be open at the top. The screen bars shall be perpendicular to the centerline of the screen. The basket ring support bars shall have adequately machined slots so that the rake teeth can penetrate the basket ring bars to ensure proper cleaning of the full basket depth.

2. The nominal bar spacing shall be as specified. Each ring shall be fabricated from sections that have been cut from flat stainless steel sheet to minimize warping of the rings. Each basket ring shall be provided with integral strengthening gussets at each welded attachment point for added basket strength. To ensure basket strength and to maximize screenings capture, the minimum ring heights for the 3-plane cylindrical basket shall be as follows:

   a. ¾ inch

   b. 1 inch

   c. 1-1/2 inch

3. The main screen basket upper support ring shall be a minimum of 5/8-inch thick and shall be machined to match the transport tube main support flange to ensure proper alignment of the basket and the rotating rake arm. The main screen basket lower support ring shall be 7/8-inch minimum.

4. The minimum diameter of the screening basket shall be as specified. The basket diameter shall be matched with a sufficient number of bar spacings to ensure that the septage flow rate specified is achieved and to provide less than the maximum headloss specified.

5. Side seal plates shall be provided to enclose the circular screen and the rectangular tank. Side seal plates shall be two-piece fabricated of 10 gauge minimum stainless steel and shall be of sufficient height to prevent bypassing of flow around the screen at the septage flow rate specified.

C. Rotating Rake and Cleaning Comb

1. The rotating rake assembly shall penetrate the depth of the bar screen to ensure positive solids removal. Rake shall be Type 316L cast stainless steel or water-jet cut Type 316L stainless steel for superior life. Rake tooth root design shall match the design of the basket rings to ensure proper cleaning of the screen bars.

2. The rake shall reverse at least once during the cleaning cycle to pass through the topmost position where it shall be cleaned by a cast Type 316L stainless steel or water-jet cut Type 316L stainless steel hinged cleaning comb installed at the top of the screen basket. Cleaning comb shall be supported at both ends by a nylon bearing and shall pivot and return to the standby position.

3. The rotating rake and the screw conveyor shall be fixed to the same shaft and driven by a common drive.

4. A stainless steel backed nylon brush shall be attached to the rake arm and positioned to make contact with the screening trough to sweep material caught on the edges of the trough. Two sets of spare brushes shall be provided.

D. Screenings Conveyor and Screenings Dewatering Press

1. The screen screw conveyor transport tube nominal diameter shall be as specified with a minimum Schedule 10S wall thickness. A minimum of three (3) equally spaced anti-rotation bars with 1/4-inch minimum thickness shall be welded to the inside of the transport tube along the longitudinal axis from the compaction zone to the beginning of the screenings collection trough.

2. A basket support plate flange shall be a minimum of 3/4-inch and shall be welded to the screen transport tube to attach the screen basket and to provide for attachment of the screenings collection hopper. A 1/2-inch minimum thick drive support flange shall be welded to the upper end of the screen transport tube for attachment of the drive assembly. After all welding of components to the screen transport tube have been completed the fabrication shall be placed in a lathe to machine the face of the upper drive flange, to machine the face of the lower basket support plate flange for mating the basket and to machine the lower bearing housing.

3. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be all AISI Type 316L stainless steel construction with a minimum thickness of 3/16-inch with increased thickness in the screenings collection trough and at the beginning of the compaction and dewatering zone.

4. The upper and lower screenings conveyor torque tube shall be accurately machined and fitted with a solid stainless steel shrink-fit welded design.

5. The lower end of the screenings conveyor shall be supported by a sealed, water-flushed, self-lubricated lower bearing with stainless steel wear sleeve. The lower bearing shall not take any thrust load from the screw

conveyor. Flush water shall be furnished with a stainless steel water feed line connected to the lower bearing housing to maintain a positive pressure in the bearing cavity. A minimum of two seals shall be provided each with a UHMW polyethylene seal retainer plate. The stainless steel bearing housing shall be field replaceable and shall be machined to mate with the screenings collection housing by a bolted connection.

6. Rake arm attachment hub outer diameter shall match the outer diameter of the stationary bearing housing to minimize material wrapping around the shaft. A seal plate shall be furnished to mate between the stationary lower bearing support and the rotating arm to prevent material intrusion into the bearing seals. Rake arm mounting hub shall be split to provide a compression fit only on the shaft.
7. Drainage holes shall be provided along the entire length of the screenings collection trough invert to allow for gravity drainage of washwater without flushing screenings out of the trough. Drainage hole diameter shall be smaller than the bar spacing specified. The width of the drainage section shall be based upon a minimum 65-degree arc. The entire drainage section shall have a minimum 50% open area for free water drainage.
8. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design and shall be fabricated of 12 gauge minimum stainless steel welded to the transport screw housing for a water-tight design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the wastewater channel through circular holes that are machined into the screenings transport tube.
9. Compaction zone housing shall be furnished with a bolted and gasketed access cover as well as a bolted dewatering section panel inside the dewatering chamber to allow direct access to the screw conveyor should the compaction zone ever become plugged.
10. Water that is released from the screenings shall be returned via a reinforced rubber hose attached to the dewatering section. Drain design shall allow for removal and cleaning of the drain hose should it ever become plugged without removing the drive, discharge head or screw conveyor.

E. Drive Assembly

1. The rake mechanism and transport screw shall be driven by a direct-connected cycloidal-helical hollow-shaft high-thrust speed reducer. The speed reducer shall have a minimum service factor of 1.56 with a minimum torque rating of 15,700 in.-lb and a minimum thrust rating of 5,800 lbf at a design maximum speed of 12 rev/min.
2. The speed reducer shall be bolted to the upper end of the transport tube shaft that has been machined.
3. Motor
    a. Provide motors in accordance with Specification 16220 – Electric Motors.
    b. Class 1, Division 1, Group D explosion proof.
    c. 1800 RPM
    d. 460 Volt, Phase, 60 Hertz
    e. 1.15 S.F. (1.0 Inverter Duty)
    f. Premium Efficiency, Continuous Duty
    g. Class F insulation, 40ºC Temperature
    h. NEMA C-face motor design
        (1) Explosion-proof motor shall be furnished with over-temperature thermostats in the windings designed for cutout at approximately 160°C.
4. Proximity sensor for locating the rake position shall be mounted to the outer drive housing with a fabricated stainless steel bracket.

F. Screen Spray Wash Systems

1. Provide a minimum of three (3) spray systems. Each spray wash system shall be furnished with a control solenoid valve, flow adjustment ball valve, Type 316L stainless steel piping and fittings, flexible reinforced PVC hose and nozzles. Piping, fittings and valves shall be 3/4-inch diameter minimum. A plant water strainer shall be provided for the incoming plant water supply. The wash water flow requirements shall be a maximum of 25 gal/min with a pressure of 60 to 75 psig. Provide the duration of the wash cycle. The three (3) spray wash systems shall include:

   a. Lower spray wash system shall be located near the upper end of the screenings basket just prior to where screenings enter the screw conveyor transport tube. The lower wash system shall have the minimum of nine (9) spray nozzles.

   b. Screenings spray wash system shall be located in the upper section of the transport tube no more than 17 inches from the beginning of the compaction zone to break up and return organic materials to the flow stream and to ensure maximum screenings washing. A minimum of two (2) spray nozzles shall be provided. The screenings spray wash system and screenings screw conveyor shall be designed to prevent washing screenings down the center of the screw conveyor.

   c. The dewatering chamber flush water system shall periodically clean the compaction and dewatering zone via a stainless steel wash header located in the upper end of the compaction/dewatering chamber. Header shall be of a circular design located in the uppermost end of the compaction zone dewatering chamber. Header shall have multiple orifices to wash the entire perimeter of the dewatering chamber.

2. The three (3) solenoid valves shall be 3/4-inch minimum, Type 316L stainless steel body suitable for 120 VAC operation. Solenoid valves shall be normally closed and rated for up to 100 psig. Solenoid valves shall be slow close type to minimize water hammer.

3. The three (3) flow adjusting ball valves shall be provided.

4. Solenoid valves and matching ball valves shall be connected to a 4-inch square tubing manifold with 1/4-inch thick minimum wall to ensure even pressure distribution to each spray wash system. The solenoid valve wiring shall be factory pre-wired to a junction box on a common spray wash manifold for wire connection to external power to the control panel. Junction box, conduit and fittings shall be rated NEMA 7 for Class I, Division I locations.

5. Main isolation ball valve for 4-inch square tubing manifold shall be provided.

6. Water strainer shall be provided suitable for a 1-inch connection and a maximum flow rate of 25 gal/min and suitable for an operating pressure of 60 to 75 psig. Water filter shall be a stacked filter element design with washable 80-mesh (200 micron) polyethylene or polypropylene disc elements, polypropylene head and bowl and Buna N gaskets.

G. Housing

1. The screen housing shall be constructed of stainless steel with 10 gauge minimum sides and bottom and 3/16 inch minimum end plates. Housing shall be adequately stiffened to prevent distortion due to the liquid sludges. Support legs shall be provided for anchoring to a base slab and lifting lugs shall be furnished for unloading the tank. Support legs shall be adjustable + 3/4 inches in vertical height for allowing leveling of the unit.

2. A stainless steel connect coupling shall be provided for the inlet connection. Coupling and inlet piping size shall be as specified. Inlet connection shall be Schedule 40S pipe. Inlet piping centerline above grade shall be as indicated and specified to allow for complete gravity unloading of a septage tanker and to maximize the flow capacity from the tanker to the septage acceptance plant. The tank shall be provided with an inlet baffle that shall extend the entire width of the tank to help contain splash and spray.

3. An inlet pinch-type valve, of the size indicated and specified, shall be provided for controlling flow into the unit. Valve shall be equipped with a Type 316 Stainless Steel water based hydraulic actuator. Valve shall operate at a minimum pressure of 45 psig and shall use approximately 0.5 cubic feet of water per open or close cycle. A 3/4-inch 3-way solenoid valve shall be provided to control the pinch valve operation. Hydraulic actuator, piping and fittings shall be pre-piped and furnished with the valve.
    a. Piping, valves and fitting for hydraulic system shall be Type 316L stainless steel.
    b. Water for the hydraulic actuator shall be provided through the screen wash water supply system.
4. Outlet diameter shall be provided as specified and shall accept an ANSI 125 lb. flanged bolt pattern.
5. Housing shall be provided with a 10-gauge minimum stainless steel hinged access cover complete with gaskets and a quarter turn hold down hasp. A minimum of two (2) stainless steel pneumatic cylinders shall be provided to assist in opening and closing the cover. Cover shall be an inset design to ensure that no leakage occurs should the gasket material fail.
6. Cover shall be provided with a permissive sensor such that when the cover is opened, its signal shall shut down operation of the screen for safety purposes. The cover sensor wiring shall be run to junction box on the fixed portion of the tank cover for wire nut connection to external power. Conduit and fittings shall be included between the sensor and junction boxes along with flexible conduit to allow the cover to open. Junction box, conduit and fittings shall be rated NEMA 7 for Class 1, Division 1 locations.
7. A 1-1/2-inch full-port sampling ball valve and connection shall be provided for septage sampling.

H. Odor Containment

1. The septage screenings equipment shall be completely containerized and enclosed from the inlet quick connect, through the motorized inlet valve, rock trap, flow meter, screen basket, screenings washing system, screenings compaction and dewatering system, and discharge. The only components open to the atmosphere shall be the screenings discharge chute, the tank vent and rock trap vent.
2. Provide the tank enclosure with a 4-inch flanged vent so that an external odor control duct system can be provided. Connect vent piping to Septage Screening Equipment housing vent.

I. Inlet Flow Meter

1. A 4-inch diameter magnetic flow meter shall be provided and installed in the inlet piping. The flow tube shall be a wafer style, Danfoss or Krohne with an integrally mounted transmitter. The flow tube shall include alignment and grounding rings for mounting between ANSI Class 150 flanges, furnished by others. All process-wetted materials in the body of the flow tube shall have a Tufnell liner. Two standard electrodes, AISI Type 316L stainless steel, shall be provided. The transmitter shall include an operator interface, and shall produce an analog output signal of 4-20 am. The magnetic flow meter assembly shall be FM approved Class I, Division 1 explosion proof areas.
2. Provide Flow Rate Indication and Totalization displayed on the front face of the Control Panel.

J. Rock Trap

1. Provide a rock trap that incorporates the use of a removable basket.
    a. Basket shall be removable from the side.
    b. Materials of Construction:
        (1) Housing: Type 316L Stainless Steel
        (2) Baskets and Hardware: Type 316L Stainless Steel
2. Rock trap shall remove large rocks and heavy objects that can damage the Septage Acceptance Plant.
3. Drawings depict the used of a separate inline rock trap. Designs incorporating the use of integral rock traps shall also be acceptable.
4. Provide vent and vent piping.

5. Provide interconnectionpiping.
    a. Connect piping to invert of rock trap.
    b. Provide minimum 1-1/2 inch drain with isolation Ball Valve.
    c. Provide Type 316L Stainless Steel pipe and fittings as specified.

K. Inlet Isolation Knife Valve.

L. Automated Inlet Pinch Valve.

M. Ultrasonic Level Element

**2.05 - HOUSING WASHING SYSTEM**

A. Provide a wash system for the housing which shall be constructed with stainless steel piping and fittings, flexible reinforced Type 316 stainless steel hose and stainless steel rotary spray nozzle.

1. Provide solenoid valves for control of wash water flow.
2. Provide isolation ball valves.
3. Solenoids shall be rated NEMA 4X for Class 1, Division 1 areas.

B. The system shall automatically clean the inside of the housing after an adjustable preset idle period.

C. All outdoor spray water piping and hydraulic lines to pinch valve and valves shall be heat traced and insulated. The insulation shall be such that it can be easily removed for repair of water line.

**2.06 - CONTROL SYSTEM**

A. Automatic controls for operation of the Septage Receiving Station and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.
2. Provide NEMA 4, Type 316L Stainless Steel enclosure. The Control Panel for the Septage Receiving Station will be located in the garage (Room 102).
3. Panel shall be labeled UL 508A.
4. Provide motor starters, and variable frequency drives (VFDs) internal to the control panel as required. Provide VFDs in accordance with Specification 16260 – Low Voltage Variable Frequency Drives.
    a. VFDs shall be UL listed drives
    b. VFDs shall be 6-pulse type provided with 5% impedance line reactors and dedicated main VFD circuit breakers.
5. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
6. Heaters or AC units required for the control panel shall be powered from the control panel.
7. Provide the control panel with an integral surge protection device (SPD):
    a. 120VAC, 10kAIC rated.
    b. Visual indication of plug status.
    c. UL listed.

8. Provide the control panel enclosure with the following
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Emergency stop (ESTOP) maintained pushbutton to shut down all system equipment.
    c. LED type indicating lights for the following:
        (1) Control power on pilot light (White)
        (2) Screen running pilot light (Green)
        (3) High level pilot light (Amber)
        (4) Overload shutdown pilot light (Red)
        (5) Screen fault pilot light (Red)
    d. Screen re-set push button (Black)
    e. Hand-Off-Auto selector switches for the following:
        (1) Screen drive
        (2) Lower wash system solenoid valve
        (3) Screenings wash system solenoid valve
        (4) Dewatering wash system solenoid valve
        (5) Tank wash system solenoid valve
    f. Forward-Off-Reverse selector switches (spring return to center) for screen drive.
    g. Elapsed time meter.
    h. Remote 120VAC dry contact outputs for the following:
        (1) Screen Running
        (2) Malfunction alarm
        (3) High water level alarm
9. All instruments, valves and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
11. Provide RAM memory protected by backup battery.
12. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
13. Provide fully documented ladder logic on a CD-Rom.
14. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide 10 inch Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.
15. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
16. Provide control and monitoring of the system as shown on the contract drawings.
17. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
18. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.

19. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
20. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.
21. The Septage Receiving Station vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
22. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.
23. White phenol nameplates with black lettering.
24. 480 VAC terminal block.

B. In addition to the Main Control Panel, furnish a NEMA 4X Type 316L stainless steel remote control station for the Septage Receiving Station for mounting locally at the equipment. The local control station will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. The local control station shall house the following components:

1. Emergency Stop Push Button
2. H-O-A Control Switch
3. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
    a. Station Receiving Drive.
    b. Wash Water Spray Bar Motor.
4. A common FAULT light (LED), panel alarm and acknowledge button with suitable contacts.

C. Septage Hauler Station with Keypad Access.

1. Provide a septage hauler station located adjacent to the hook-up point for the septage receiving station. The system software shall be compatible with the Town's requirements for billing/recordkeeping.
2. Provide the septage hauler station consisting of the following:
    a. A keypad with access for the septage hauler.
    b. Activation via the keypad opens the inlet valve permitting discharge of septage into the unit.
    c. PIN access to permit up to 75 different users. The keypad shall communicate with the PLC in the control panel.
3. Alternatively, the hauler station shall be equipped with a bar code reader identifying the hauler's identity and granting or denying access to the system.
4. A printer terminal with paper cutter and out-of-paper alarm. Provide the system so that the receipt is printed upon each use with a print copy stored on a take-up reel.

**2.07 - ANCHOR BOLTS**

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be Type 316L stainless steel unless noted otherwise. Anchor bolts shall be J-type embedded, or expansion-type.

B. Anchor bolts shall be set by template and protected from misalignment by the Contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrink grout. All miscellaneous hardware shall be Type 316L stainless steel.

**2.08 - SCREENINGS BAGGER ATTACHMENT**

A. The discharge chute shall be furnished with a bagging device to contain and encase dewatered screenings.

B. The bagging device shall be fabricated of 12 gauge minimum stainless steel.

**2.09 - PAINTING**

C. Electric motors, speed reducers, and other self-contained or enclosed components shall be painted.

D. Apply rust preventative compound to all machined, polished, and nonferrous surfaces which are not to be painted.

E. Passivity all stainless steel surfaces by using the following procedure:

1. Wire brush all weld areas to remove weld spatter. Brushes shall be of Type 316L stainless steel.

2. Glass bead blast or chemically treat all external non-wetted stainless steel to a uniform finish.

**2.10 - SOURCE QUALITY CONTROL**

A. The equipment manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code - Steel" published by the American Welding Society or equivalent standard.

B. Fabricate all parts and assemblies from sheets and plates of Type 316L stainless steel sheet with a 2D finish conforming to AISI 316L and ASTM A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 and A403.

C. Perform all welding in the factory using shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section and weld metal equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the jointField welding of stainless steel will not be permitted.

D. Bolts, nuts and washers shall be AISI 316L stainless steel furnished in accordance with ASTM A193 unless otherwise specified.

**PART 3 - EXECUTION**

**3.01 -INSTALLATION**

A. Contractor shall install all items in accordance with printed instructions of the manufacturers as indicated and specified.

B. The manufacturer's representative shall subsequently inspect the installation by the Contractor and make recommendations for adjustments necessary for proper operation.

**3.02 - FIELD TESTING**

A. After installation of equipment and inspection by the manufacturer’s representative test all equipment functionality in the presence of the Engineer to verify the equipment ready for Acceptance testing.

B. During field tests, observe and record capacity, motor inputs, bearing housing temperature, noise and vibration. Immediately correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner. Contractor to provide all labor, piping, equipment, calibrated gauges and flow meters.

**3.03 -PROCESS PERFORMANCE GUARANTEE**

A. The Septage Receiving Station will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur one (1) year from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the MANUFACTURER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

B. The MANUFACTURER shall be responsible for the process performance of the Septage Receiving Station and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 -WARRANTY**

A. The MANUFACTURER shall be provide an warranty of the Septage Receiving Station warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

C. It is the MANUFACTURER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 -ACCEPTANCE TESTING**

A. After installation of equipment and after services of the manufacturer's representative as described herein, test the unit's performance on five consecutive loads of septage. Unit shall be demonstrated to achieve the design septage hydraulic capacity specified, while operating free from vibration, jamming, and overheating. The Contractor shall furnish all temporary equipment required for testing. Should the system fail to achieve the required hydraulic capacity, the manufacturer shall, at its own expense, make all necessary modifications until the design hydraulic capacity is achieved through retesting with five consecutive loads of septage.

B. Prior to final acceptance of the screen, three tests shall be conducted according to the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-846.

Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

C. Contractor shall have responsibility for performing formal Acceptance Testing with support from manufacturer's representative. Representative shall include technical and operational advice, response to questions, and other assistance as necessary for successfully completing the Acceptance Tests. On-site support from the on-site Representative during all phases of installation and testing shall be as specified herein.

**3.06 - FIELD PREPARATION AND PAINTING**

A. Provide field painting as required. One quart of each paint utilized shall be supplied for touch up as required.

B. The CONTRACTOR shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The CONTRACTOR shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components.

D. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the CONTRACTOR.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11339**

**SUBMERSIBLE MIXERS AND APPURTENANCES**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide and test submersible mixers, motors and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS, and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size and arrangement as indicated and specified.

2. Data regarding mixing equipment, drive and motor characteristics and performance:

a. Prior to fabrication and testing provide guaranteed performance curves based on actual shop or field tests of mechanically duplicate equipment showing they meet indicated and specified requirements for capacity, and horsepower.

(1) For units of the same size, and type, provide curves for a single unit only.

b. Results of shop performance tests as specified.

c. Submit curves for guaranteed performance and shop performance tests on 8-1/2 inch by 11-inch (A4) sheets; one curve per sheet.

3. Shop drawing data for accessory items.

4. Certified setting plans, with tolerances, for anchor bolts.

5. Manufacturer’s literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts list.

7. Listing of reference installations as specified with contact names and telephone numbers.
8. Bearing temperature operating range for the service conditions specified.
9. Motor data.
10. Recommended spare parts other than those specified.
11. Recommendations for short and long term storage.
12. Recommended baffle design, if baffles are required.
13. Hoist data and dimensional data.
14. Qualifications of Field Service Engineer.
15. Tag numbers for all equipment.
16. Special tools.
17. Number of service person-days provided and per diem field service rate.
18. Certified test reports verifying quality of gears in Gear Reduction Units.
19. Field inspection/testing reports.
20. Certified mixer shop test results.
21. Shop and field testing procedures and equipment to be used including the details of all equipment and testing set-up
22. Provide scaled drawings showing each mixer location with full movement of hoist and any obstruction(s).
23. Schematic control and power wiring diagrams.
24. The latest ISO 9001 series certification or quality system plan.
25. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
   1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 – PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment are specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Submersible mixers to be the product of one manufacturer.

C. Submersible mixers to be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Gears: Inspected and certified, before assembly.

E. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

F. The Contractor shall obtain the submersible mixers, motors, cables, masts, controls and control panels, from a single submersible mixer manufacturer as a complete and integrated package to insure proper coordination, compatibility and operation of the equipment.

G. Service of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified.

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve the Contractor of the obligation to provide sufficient services to place equipment in operation as specified.

2. Installation: Inspect location of anchor bolts, setting, leveling, alignment, field erection, etc.; coordination of piping, electrical and miscellaneous utility connections; but not less than:

   a. 1 person-days

3. Field and Functional Testing: Calibrate, check, align and perform functional testing with water: Tests to include all items specified.

   a. 1 person-days

   b. Provide letters from Contractor certifying that the field and functional testing has been completed and that the equipment is operational and ready for field performance testing.

4. Performance Testing: Field performance test equipment as specified.

   a. 1 person-days per system

5. Vendor Training: Provide classroom and field operation and maintenance instructions, including all slides, videos, handouts and preparation to lead and teach classroom sessions:

   a. 1 person-day.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of submersible mixers must have a minimum of five (5) years of successful operating experience with the size and type of mixer and service conditions specified and indicated.

**1.08 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:

1. A36: Standard Specification for Carbon Structural Steel
2. A48: Standard Specification for Gray Iron Castings
3. A276: Specification for Stainless Steel Bars and Shapes.

B. American Iron and Steel Institute (AISI) Standards.

1. 329: Stainless steel.
2. 410: Stainless steel.
3. A48-40B: Propeller – Stainless Steel

C. Anti-Friction Bearing Manufacturers Association (AFBMA).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Mixer and operating tank data are indicated in the Mixing Equipment Schedule and as specified herein.

B. Provide mixers capable of operation within maximum and minimum liquid levels of tank as specified and indicated.

C. Mixers are normally to be operated automatically and provided with a manual control device.

D. Service:

1. Post-Equalization Tank Mixer: designed to maintain TSS in suspension.

E. Provide mixer complete with local control panel.

**2.02 - MANUFACTURERS**

A. Sulzer

B. KSB

C. EMU

**2.03 - SUBMERSIBLE MIXER CONSTRUCTION**

A. Design submersible mixers and appurtenances for long, continuous, and uninterrupted service; easy adjustment and replacement of parts:

1. Steel members: Minimum 1/4-inch thickness.
2. Bolts: Minimum 1/2-inch diameter.

B. Structural Steel: Provide in accordance with ASTM A36.

C. Iron Castings: Provide in accordance with ASTM A48 Class 40.

D. Provide Type 316 stainless steel for fasteners and hardware.

E. Stainless steel in accordance with AISI 329, AISI 410.

F. Provide an epoxy coating of a minimum thickness of 0.010 inches to protect all surfaces coming into contact with sewage, other than stainless steel.

**2.04 - SUBMERSIBLE MIXERS**

A. Provide components of each mixer, including motor capable of continuous underwater operation while propeller blade is completely submerged.

B. Components of mixer, including motor, capable of continuous operation completely unsubmerged for a minimum of 2 hours.

C. Motor Housing:

1. Material: Cast iron or Type 316 stainless steel with cast iron motor end caps at mounting end and Type 316 stainless steel at propeller end.

2. Machine and fit watertight joints with viton "O" rings.

3. Bolts and hardware: Type 316 stainless steel.

D. Seals:

1. Provide each mixer with two sets of independent Type 316 stainless steel mechanical seals with silicon carbide seal face material running in an oil bath.

2. Propeller shaft: Provide end face type mechanical seals.

a. Provide seals with a positively driven rotary face ring.

(1) Seals without a positively driven face ring are not acceptable.

3. Provide seals that can be readily inspected and replaced.

4. Provide two separate seal oil chambers for shaft sealings system.

a. Provide drain and inspection ports and plugs with positive anti-leak seal. All ports and plugs to be accessible from the outside of the mixer assembly.

E. Propeller:

1. Type: single, non-clogging two or three vane, backward curved design.

2. Material: Type 316 Stainless Steel, or Closed Cell Polyurethane.

3. Propeller shall be based on requirements of tank geometry to optimize mixing and energy consumption.

4. Dynamically balance each propeller.

5. Secure to shaft with a tapered fit or friction clutch device. Provide friction clutch to act as a safety device against object jamming the propeller.

6. Propeller shall be of large diameter and large blade surface area type insuring soft sludge treatment and maximum propeller efficiency.

7. Mixers with propeller shrouds shall not be accepted.

8. Propeller blades shall be non-clogging, backward curved design starting at the flange. Propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications.

F. Propeller/Motor Shaft:

1. Material: ASTM A276 Type 316 stainless steel.

G. Motor:

1. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

2. Provide a submersible, asynchronous speed type, housed in an air filled watertight chamber.

a. Oil filled motors are not acceptable.

3. Service Factor: 1.15.

4. Class F insulation to a temperature of 311 degrees F.
5. Stator: Dipped and baked three times in Class F varnish.
6. Provide motors capable of 24 hour continuous duty, capable of sustaining 20 evenly spaced starts per hour.
7. Provide junction chamber with watertight cable attachment.
8. Rotor bars and short circuit rings: aluminum.
9. Motor shaft: ASTM A276 Type 420 stainless steel.
10. Provide two permanently lubricated motor bearings:
    a. Minimum L-10 life: 100,000 hours at full load.
11. Provide thermal sensors to monitor stator temperatures. Provide stator with two thermal switches imbedded in the end coils of the stator winding.
12. Provide motor moisture detector mounted in housing.
13. Rating: 480 volt, 3-phase, 60 Hertz.
14. Provide each mixer, with appurtenances and cable, capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.

H. Cable entry:

1. System shall be field replaceable.
2. Provide the cable entry as an integral part of the stator casing.
3. Provide a cable entry composed of a conical cable holder with a flange bearing against a shoulder in the stator-casing opening.
4. Provide cable entry cone of Cast Iron AISI A48-40B.
5. Provide cable cast into the cable entry cone in order to provide a leak proof, torque-free seal at the cable entrance.

**2.05 - GUIDE RAIL SYSTEM**

A. Provide a Type 316 stainless steel guide rail system used to support each mixer during operation and guide each unit during installation and during lubrication/preventative maintenance, and inspection.

1. The assembly shall consist of a bottom bearing console, stop console, guide rail, fixing bracket and guide holder assembly that is field rotatable.
2. Provide bottom assembly bolted to floor of tank.
3. Guide rails shall be designed to absorb thrust of the mixer.

B. Provide mixer stop console fastened to the guide rail at a position specified by the manufacturer.

**2.06 - CONTROL SYSTEM**

A. Provide control panels for the mixers as specified and indicated.

1. Enclosure: NEMA 4X Type 316L stainless steel.
2. Provide enclosure with reset buttons, switches, contacts, and all necessary appurtenances, completely factory wire to provide a coordinated and operating set of controls.
3. Magnetic motor starters with 3-pole overload protection and manual reset provided within Motor Control Centers specified under Division 16.
4. RUN-OFF-AUTO selector switches.

5. Alarms:
    a. Individually sense. Provide reset controls for:
        (1) High temperature, each motor.
        (2) Moisture detection, each motor.
    b. Provide dry alarm contacts for remote common alarm.
6. Provide terminal board for all-external circuits.

B. Operation:
1. In AUTO position the mixers will operate continuously.
2. Provide shutdown of mixers on moisture detection or high stator temperature.

**2.07 - SHOP TESTS**

A. Motor Tests:
1. Standard commercial test.

B. Mixer Tests:
1. Provide check list showing that materials, types and ratings of the propellers, motors and electrical connections and shop test are in accordance with the contract documents.
2. Test for correct rotation and current draw.
3. Vacuum test to show mechanical integrity.
4. Test mixers immersed. After immersion test inspect mixers for oil seepage, water infiltration, insulation defects and resistance.

**2.08 - SHOP PAINTING**

A. Primer and Finish Paint. Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch up to all surfaces after installation and testing is completed and equipment is accepted.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with manufacturer’s printed instructions, as indicated and specified.

**3.02 - PAINTING**

A. After installation and testing have been accepted, Contractor shall apply touch up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.04 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.05 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed

1. For each mixer:

a. Two sets of grease and oil seals.

b. Two sets of gaskets.

2. One set of all special tools required.

**3.06 - FIELD PERFORMANCE TESTS**

A. After installation and services of manufacturer's factory trained engineer, operate each unit to demonstrate ability to continuously operate without vibration, jamming, and overheating.

B. Operate impellers satisfactorily at least one tank drawdown cycle and take measurements of motor amperage.

C. Operate each hoist with mixer with davit hoist specified in SECTION 14300, HOISTING EQUIPMENT.

D. Make all adjustments necessary to place equipment in working order at time of testing.

E. Test on Product only.

F. Remove and replace equipment at no additional cost to the Owner if unable to demonstrate to the satisfaction of the Engineer that the mixer assemblies perform the services specified and that they will operate free from vibration and overheating and that the hoist system operates properly.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11345**

**POLYMER BLEND FEED EQUIPMENT AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide and test polymer blend feed equipment and appurtenances as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Chemical for testing to be supplied by the Contractor.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following.

1. When the Contractor proposes equipment which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.
2. Provide a detailed layout with dimensions of the equipment proposed in the area allotted on the contract drawings.
3. Provide calculations for polymer blending.
4. Provide confirmation on piping layout and sizing as indicated on the drawings.
5. Certified shop and working drawings.
6. Certified setting plans, with tolerances, for anchor bolts.
7. Operating and maintenance instructions and parts lists.
8. Shop drawings details for accessory items.
9. Number and identify components to correspond with terminology on drawings. Use these numbers on all submittal sheets and shop drawings.

10. Control Panels:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, locations of panel and panel exterior mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags indicated on Contract mechanical process, instrumentation and electrical drawings.
11. Recommendations for short and long term storage.
12. Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.
13. ISO 9001 certification or other quality control manual demonstrating a complete system for quality management.
14. Polymer blend feed equipment manufacturers must be capable of providing a list of customers using at least five (5) similar system for at least ten (10) years.
15. Material Certification:
    a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
16. Certified results of factory tests.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".
    1. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes. Provide systems and items of equipment that conform to applicable safety standards including those for safety of personnel.

C. Provide components to manufacturer's standard for service intended unless otherwise required.

D. Provide equipment of manufacturers' latest and proven design. Polymer unit to be a standard cataloged product and as specified and indicated.

E. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

F. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

   a. 2 person-days.

4. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 3 person-days.

5. Performance Testing: Field performance test equipment specified.

   a. 3 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

8. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

G. Note, an area is allotted to this equipment, as indicated. If necessary, provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.01 - SYSTEM DESCRIPTION

A. Systems:

1. Polymer system capacities are indicated in the Polymer System Schedule in the drawing set.

B. Polymer Blend Feed Systems – General:

1. Polymer blend feed system is a complete integrated system and, as such, furnished by one supplier who will provide all equipment and appurtenances, regardless of manufacturer and be responsible for satisfactory operation of entire system.

2. Polymer blend system to have the capability of diluting and activating emulsions, dispersions and solutions of polymer. Furnish the polymer blend feed system designed to mix a 20-50 percent concentrated liquid polymer solution, with viscosities up to 60,000 cps with water and automatically produce a metered polymer solution with capacities indicated hereinafter and to convey the diluted polymer solution to application points shown on the drawings.

3. Polymer blend unit with provisions for mixing, blending and aging the polymer solution. This may be with mixers not to exceed 600 rpm or in-line static mixers. The solution to be mixed in a low shear environment and to be homogenous.

4. The polymer blend dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1 percent to 1 percent concentration of emulsion polymers with active contents up to 75 percent and Mannich polymers with a viscosity of up to 75,000 cps up to a 10 percent solution. To the application point(s) shown on the drawings.

5. Provide polymer system with rotameters and integral rate adjusting valve to control amount of dilution/mixing water.

6. Polymer blend feed system shall be housed in a fiberglass reinforced polyester (FRP) or Type 316 stainless steel enclosure. Provide adjustable controls provided for polymer dosage rate in pounds per day (gallons per day) and dilution water in gallons per hour (minute).

7. Polymer blend feed system capable of operating with a water supply pressure of 40 psi (275 kPa). If system furnished requires additional water pressure to operate, then supplier to furnish in-line water booster pump of sufficient capacity and pressure to operate system and to interlock pump to operate when polymer system is activated. All shall be done at no additional cost to the Owner.

8. Polymer blend feed system shall be factory assembled and pre-wired, capable of being floor or floor stand mounted as indicated.

C. Equipment Limitations:

1. Application Point:

a. Maximum Polymer Blend Unit Length 40 in. x Width: 30 in.

b. Maximum Polymer Blend Unit Height: 48 in.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601

### 2.02 - MANUFACTURERS

A. VeloDyne (Velocity Dynamics Inc.).

B. UGSI.

C. Or an acceptable equivalent.

### 2.03 - POLYMER BLEND SYSTEM COMPONENTS

A. Provide systems constructed of components compatible with the service specified and indicated.

B. Provide polymer blend feed system to consist of pumps, mixers, and appurtenances, as indicated and specified.

C. Provide prewired system for electrically operated and motor-driven equipment including all auxiliary relays so as to require only power and external connections.

D. Provide panels to meet the following:

1. Manufacture NEMA 4X control boxes, electrical panels and similar equipment of fiberglass or reinforced polyester and gasketed to prevent chemical corrosion. Provide electrical control items that are rated NEMA Type 13, unless otherwise specified.

2. Control power for powering equipment: 120V/1 ph/60 Hz.

3. Provide control wiring of No. 14 THWN stranded copper, shield signal wiring.

4. Provide instruments and accessories mounted, wired or piped to terminal strips or bulkhead fittings and identified to provide ease of field connection.

5. Provide white lamicoid nameplates with black filled engraved legends, attached with Type 316 stainless steel screws.

6. Provide contacts for control of motor-operated or electrically operated equipment rated not less than 10 amperes on 120 volts or gold cross-bar contacts for low current instrument signals.

7. Provide fuses and/or switches, required by instrumentation manufacturer, for equipment.

E. Polymer Blend Feed Mixing Chamber:

1. Provide a hydro-mechanical blending device capable of operating at its capacity with a plant water pressure alone at 30 psi.

a. Provide the system capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable mechanical mixer, capable of producing high, non-damaging mixing energy at all flow rates without damage to the polymer's molecular structure.

b. Provide inlet with ball valve for isolation.

2. Provide the mixing chamber with a Type 304 stainless steel motor adapter with flange, Type 316 stainless steel mixing chamber, clear Lexan front cover to view the mixing action and blending effectiveness (clear pipe is not acceptable to meet this requirement) and a PVC water flow control and hydrodynamic mixing valve.

a. Pressure Rating: 100 psi.

b. Provide all holes tapped in plastic with helicoil inserts for increased strength.

c. Provide inlet with ball valve for isolation

3. In order to handle the wide range of polymers available, independent of water pressure, provide a variable speed, Type 316 stainless steel mixing impeller specifically designed for blending liquid polymer.

a. Provide the mixer designed to induce high, non-damaging mixing energy over the systems full flow range.

b. Provide the impeller speed controlled by an SCR motor controller and wash-down duty motor.

c. Provide baffles on the outside of the impeller to encourage flow from the center to the outer diameter of the mixing chamber to provide effective inter/back mixing within the chamber.

d. Provide the mixer drive shaft sealed by a mechanical seal with an integrally mounted and factory plumbed seal flushing valve.

e. Provide the seal arrangement accessible for replacement. Systems without a seal flushing system are not acceptable.

f. Systems that rely solely on plant water pressure to create mixing energy are not acceptable.

4. Provide two (2) neat polymer check valves specifically designed to isolate neat polymer from dilution water.
    a. Provide valves designed with an open, unobstructed path to the valve seat.
    b. Valve body: Teflon with Viton seals.
    c. Valve poppet and spring: Type 316 stainless steel and designed to prevent polymer from flowing through the spring, causing build-up and plugging. Plastic spring covers are not acceptable.
    d. Provide the valve accessible for cleaning and designed so that no tools are required for removal, cleaning or replacement.
    e. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing are not acceptable.
    f. Provide the locking pin used to hold the valve in place attached to the mixing chamber with a lanyard.

F. Polymer Blend Feed Dilution Assembly:
1. Provide the dilution water flow rate monitored by a rotameter type flow meter having a range of 0.5 to 5 gpm
2. Provide unions on the flow meter for removal and cleaning.
3. Provide a 120V, 1-phase, 60 Hertz, Type 304 stainless steel solenoid valve for on/off control of total dilution water flow.
4. Provide a 2-1/2 inch diameter non-liquid filled pressure gauge and Type 316 stainless steel diaphragm seal to monitor dilution water inlet pressure.
5. Provide an industrial duty differential pressure switch rated NEMA 4 to sense low dilution water differential pressure, manufactured by Ashcroft or equal.
6. Provide the dilution water inlet connection located as indicated.
7. Valve shall be powered and controlled from the polymer blend unit control panel.

G. Diaphragm Neat Polymer Metering Pump:
1. Provide metering pumps to be as recommended by the polymer blend feed system manufacturer with capacities to meet the requirements of the system as specified and indicated.
2. Provide pump capacity control using SCR or variable stroke-rate and stroke-length, with accessible dials.
3. Provide controls to allow remote changing of capacity.
    a. Variable stroke-rate and stroke-length, with accessible dials.
    b. Provide the following signals at the polymer local control panel. Control the polymer unit via plant PLC.
        (1) Pump speed control signal 4-20 mA.
        (2) Pump speed feedback signal 4 – 20 mA.
        (3) LOCAL/REMOTE switch position.
        (4) System fault.
4. Provide metering pump discharge with vent valve, back pressure valve and pressure relief. Pressure relief may be internal.

5. Metering pump accessories to include:
    a. Calibration tank with valves, to check capacity of metering pumps.
    b. Flush/prime kit.
    c. Hand primer pump.

H. Polymer Blend Feed Solution Mixing Assembly:
1. Provide a static mixer for secondary mixing of polymer solution.
2. Provide a 2-1/2 inch diameter non-liquid filled pressure gauge and Type 316 stainless steel diaphragm seal to monitor system discharge pressure.
3. Provide a high discharge pressure switch
4. Provide a swing type check valve to prevent back flow sized for the total solution flow of the system. Provide valves constructed of PVC and Viton.
5. Provide the solution discharge connection located as indicated.

I. Polymer Blend Feed Controls:
1. Provide a single control panel integral to the systems frame for all polymer system controls. Provide equipment, installation, services and appurtenances to achieve and complete and fully functioning system.
2. Provide UL 508A listed control panel.
3. Enclosure: NEMA 4X and constructed of Type 316 stainless steel.
4. Provide 480VAC rated control panel with through-the-door main disconnecting circuit breaker with minimum rating of 65 kA symmetrical.
5. Provide the control panel to include all digital displays, potentiometers, switches, lights, relays, motor controllers and other control devices required for a complete operable system.
6. Control panel shall provide all device power to polymer blend system components including valves, instruments and ancillary devices. Provide step-down transformers as required.
7. Provide all skid mounted electrical components interconnected to the control panel and terminated at numbered and labeled terminal blocks. Provide the terminal blocks sized for 14 gauge wire.
    a. Provide wiring run through wire race-way and numbered with adhesive type labels.
    b. Position the control panel such that there are no obstructions in front of the control panel per related NFPA requirements.
8. Control features:
    a. Operator Interface – Discrete Selector Switch:
    b. Main Power Rotary Disconnect Switch
    c. Emergency STOP push button
    d. System ON / OFF(reset) / Remote
    e. One-Turn Potentiometer – Mixer Speed
    f. Ten-Turn Potentiometer; one for each pump

9. Status / Alarm Indicators:
    a. Main Power ON
    b. Display of polymer Metering Pump Rate (GPH)
    c. Low Water Differential Pressure Alarm
    d. High Polymer Pump Line Pressure Alarm
    e. Low Polymer Flow Alarm
10. Inputs:
    a. Remote Start / Stop (discrete dry contact)
    b. Pacing Signal Based on Process Flow (4-20mA)
11. Outputs:
    a. System Running (discrete dry contact)
    b. Remote Mode (discrete dry contact)
    c. Common Alarm (discrete dry contact)
    d. Polymer Pump Rate (4-20mA)

J. Polymer Blend Feed Equipment Skid:
1. System's frame: Type 316Lstainless steel construction.
2. Provide all piping rigidly supported.
3. Position the control panel at operator eye level.
4. Provide all system components accessible for maintenance.

**2.04 - ACCESSORIES**

A. Drum Accessories:
1. Provide a polymer drum suction assembly.
    a. Quick disconnect cam-lock fittings
    b. 3/4-inch full port ball valve
    c. 10 feet of 3/4-inch braided PVC hose.
2. Provide a drum suction pipe constructed of clear PVC with a PVC tee at top and a polymer check valve on the bottom.
    a. Provide a 2 inch bung connection with compression fitting to allow suction pipe height adjustment in the drum.
3. Provide two (2) polymer drum dolly designed to transport up to 55 gallon drums and tilt the drums when in service to drain contents into a 5 gallon pail for dispensing.

**2.05 - MOTORS**

A. Provide in accordance with SECTION 01171, MOTORS and as specified and indicated.

B. Enclosure: TEFC, except as specified

C. Service Factor: 1.15

**2.06 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.07 - SHOP TESTING**

A. Provide certified shop testing that polymer system meets the capacities required.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install equipment and appurtenances in accordance with manufacturer's printed instructions.

B. Install polymer processing units as shown on the drawings. Assure there is no pipe stress on piping connections and grout base.

**3.02 - FIELD TOUCH-UP PAINTING**

A. After installation and accepted testing by the Engineer apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Furnish following spare parts, identical and interchangeable with similar parts installed in work:

1. One control circuit board with drive motor fuses and controller fuses for each different size of motor furnished.

2. For metering pump:

a. Two each of all check valves and seals.

b. Two complete sets of all gasket and seals.

3. For polymer processing systems:
    a. Two alarm and control switches of each type.
    b. Ten of each type lamp, unless otherwise specified.
    c. One pressure switch of each type.
    d. Two relays of each type.
    e. Two electric selector switches of each type.
    f. Two pressure-reducing valves.
    g. One pushbutton station of each type.
    h. One of each size timer.
4. Provide all other manufacturer's recommended spare parts necessary to maintain each piece of equipment for a period of one year.

**3.08 - FIELD TESTING**

A. General:
1. Calibrate in the presence of the Engineer.
2. Coordinate testing with operation of other portions of the facility, as required. Arrange for temporary piping and wiring modifications which may be needed if chemical cannot be fed at intended dosing points, or if other interconnected electrical equipment is not operational.
3. After cleaning, completely test each polymer blend system to verify that equipment is capable of performing its specified function in satisfactory manner without mechanical or electrical defects, binding, or operational difficulties. Correct defects and deficiencies and repeat all tests until satisfactory results are obtained. Correct excessive vibration, leakage or noise. Make connections watertight as appropriate.
4. Demonstrate accuracy of units and bring within limits specified herein.
5. At the time of the tests, make final adjustments necessary to place equipment in satisfactory working order.
6. Tests to be done using chemicals for which each system was designed. Chemicals to be provided by the Contractor.
7. Complete preliminary and calibration testing and corrections prior to acceptance testing, as specified herein, to be conducted with the manufacturer's technical representative.
8. Copies of tests results and data to be furnished to the Engineer.
9. Neutralize and dilute chemicals wasted during testing procedures with 10 volumes of water prior to disposal into plant drain system. Direct dumping into drains without prior neutralization and dilution is hazardous and not permitted.

B. Polymer System (Acceptance Tests):
1. Submit copies of manufacturer's preliminary and calibration with data showing numerical values of discharge to nearest tenth of a pound per hour (50 g/h), at 100, 75, 50, and 25 percent settings.
2. Submit copies of individual calibration curves with data to Engineer at least 15 days prior to acceptance testing. Notify Engineer in writing when equipment is ready for acceptance testing, and make no adjustments or modifications to pumps after that time, without written permission of Engineer .
3. During acceptance testing demonstrate correct functioning of control stations.
4. To determine deviation compare measured feeder output at various settings with output indicated by manufacturer's calibration curves. Feeders with deviation greater than plus or minus 3.0 percent of maximum pump output are not acceptable.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11350**

**ULTRAVIOLET DISINFECTION EQUIPMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Ultraviolet Disinfection Equipment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 0700,GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of the contract drawings included with the bid request, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.

C. Submit the following after award:

1. Certified shop and erection drawings.

2. Submit drawings of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

3. Drawings shall include plan views, sectional views, title block, Tag Numbers, serial numbers, Parts List (identifying each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

4. Drawings shall be in conformance with all other requirements as specified in this specification.

5. Drawings of equipment shall be to scale.

6. Control Panel:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, location of panel internal and panel exterior mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, electrical and instrumentation drawings.

D. Additional Requirements for submittals:
1. Dimensions and installation requirements.
2. Descriptive information including catalogue cuts and manufacturer's specifications for all major components.
3. Electrical schematics and layouts.
4. Independent bioassay validation letter and dosage calculations demonstrating compliance with the specified dose requirements.
5. The UV Manufacturer shall submit a Bioassay Validation Report for the proposed reactor. The bioassay testing and results shall have been validated by a qualified independent third party in full compliance with the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003) The bioassay must demonstrate that the proposed UV system design and number of lamps will deliver the specified dose.
6. Disinfection performance guarantee and warranty letters.
7. Submit documentation of the UV manufacturer's service capabilities including location and experience.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Shipping:
1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Provide spare parts at the same time as equipment.

C. Receiving:
1. The equipment supplier shall be required to coordinate delivery and start-up of the equipment with the Contractor.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Equipment shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated, and in accordance with SECTION 01400, QUALITY ASSURANCE.

B. The Manufacturer shall be regularly engaged in the manufacture of UV disinfection systems with a proven track record of at least one hundred (100) installations, each with a flow rate of at least 435 L/min. The manufacturer shall provide experience documentation for UV disinfection systems in municipal wastewater applications.

C. Bioassay testing shall evaluate reactor performance over the wide range of flow rates, UV Transmittance (UVT) (measured at 254 nm, 1 cm path length) and MS2 Reduction Equivalent Dose (RED). The bioassay testing must encompass the range of design and operating conditions described herein. Extrapolations of flow rates, UV Transmittance values, or UV doses outside the range actually tested, shall not be permitted.

D. Validation testing shall verify that the headloss generated by the proposed reactor is less than or equal to the specified limits.

E. If medium-pressure lamp technology is proposed, a detailed mechanical and chemical cleaning strategy must be provided by the Manufacturer to prevent algae growth in the reactors.

F. The UV manufacturer must demonstrate that the electrical consumption based on Reduction Equivalent (bioassay) Dose, at peak flow and specified water quality (UV transmission), does not exceed the amount specified herein.

G. To be acceptable, the UV system shall have been independently validated in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003). UV system sizing to be completely based on data collected during validation testing. No extrapolations outside tested range will be allowed.

**1.08 – WARRANTY**

A. The equipment furnished under this section (excluding UV lamps) shall be free of defects in materials and workmanship, including damages that may be incurred during shipping for a period of five (5) years from the Project Acceptance Date.

B. The UV lamps shall be warranted for 12,000 hours of operation (prorated after 9,000 hours) or 36 months after shipment, whichever occurs first.

C. The ballasts shall be warranted for five (5) years from the Project Acceptance Date.

**1.09 - REFERENCES**

A. American Gear Manufacturers Association (AGMA).

1. 6001: Design and Selection of Components for Enclosed Gear Drives
2. 6025: Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.
2. S2.19: Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Possible Unbalance, Including Marine Applications

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1. 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

D. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

E. American Society for Testing and Materials (ASTM):

1. A48/A48M: Standard Specification for Gray Iron Castings.
2. A336/A336M: Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
3. A1043/A1043M: Standard Specification for Structural Steel with Low Yield to Tensile Ratio for Use in Buildings

F. International Organization For Standardization (ISO):

1. 1217: Displacement compressors - Acceptance tests
2. 2151: Acoustics Noise test code for compressors and vacuum pumps Engineering method (Grade 2)
3. 9001: Quality management systems - Requirements

G. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

2. MG1: Motors and Generators.

H. Occupational Safety & Health Administration (OSHA)

1. 29 CFR Part 1910: Occupational Safety and Health Standards

I. Underwriters Laboratory (UL):

1. UL 508A: Standard for Industrial Control Equipment.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. The UV manufacturer shall provide equipment to disinfect process effluent with the following characteristics:

| | |
|---|---|
| Peak (Design) Flow: | 680 gpm |
| Average Flow: | 240 gpm |
| Design UVT (minimum): | 55% (at 254 nm, 1 cm path length) |
| Total Suspended Solids: | 10 mg/L (average), 15 mg/L (maximum) twice a month |
| Effluent Temperature Range: | 33 $^{o}$F to 85 $^{o}$F |
| Max. Inlet Pressure: | 100 psig |
| UV Max Effluent Fecal Coliform | 200 Fecal Coliform/100 ml |

B. Design Dose:

1. The UV disinfection system shall be designed to deliver the Reduction Equivalent Dose (RED) specified herein. To ensure the UV system can deliver the RED at the end of lamp life, with fouled sleeves, the RED shall incorporate an End of Lamp Life (EOLL) factor and Fouling Factor (FF). EOLL is the ratio of lamp output at end of the lamp life relative to new lamp output. FF is the ratio of UV light transmission through the quartz sleeve at worst-case fouling conditions relative to a new quartz sleeve.

2. The RED shall be delivered under Peak (Design) Flow and Design UVT conditions specified herein.

3. The RED must be verified by third party witnessed bioassay testing as specified herein.

C. Headloss through the UV shall not exceed 15 inches-H2O under peak flow conditions.

D. Electrical:

1. The total power consumption of all duty UV reactors treating the design criteria specified herein, shall not exceed 11.3 kW.

2. Voltage shall be 480VAC, 3-phase.

3. The UV system is fed from Panel Board DP.10-5 as shown on Drawing 10 E-608. DP.10-5 ratings are as shown on Drawing 10 E-602.

4. The design layout does not include motor operated valves associated with the UV System. Flow into each UV Reactor is controlled by manual butterfly valves.

E. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

F. The UV system shall consist of two UV Reactors (one operating and one stand-by) proving full redundancy. The UV System shall be comprised of the following components:

1. UV reactors: (2) two

2. Number of lamps per reactor: As required to meet the design conditions specified herein and with a system dimension that fits within the foot print shown on the drawings

3. Control Panel: (1) one per reactor

4. PLC: (1) one per reactor.

5. UV Intensity Sensor: (1) one per reactor

6. Wiping System per reactor: Automatic Mechanical

G. Performance Requirements:

1. The UV Manufacturer shall provide a written guarantee that the equipment will continuously meet the specified performance requirements. The UV disinfection system shall be capable of producing an effluent conforming to the following discharge requirements: maximum of 200 CFU/100 ml, or equivalent MPN, based on daily sampling. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Ed.

2. The UV system will be designed to deliver a minimum UV dose of 45 mJ/cm2 at peak flow, in effluent with a UV Transmittance of 55% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the UV dose delivered by the UV system will be the independent third party bioassay, without exception. Bioassay validation methodology to follow protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

3. The UV dose will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analyzed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

4. The UV dose will be adjusted using a quartz sleeve fouling factor to compensate for reduction of UV dose due to wastewater fouling during operation. If no quartz sleeve wiping system is included, a fouling factor of 0.5 shall be applied. If an automatic wiping system is included, a fouling factor of 0.8 shall be applied. If a re-circulating chemical feed system is installed, the FF shall be 0.9.

5. Independent validation for use of a higher lamp aging factor must be submitted to the Engineer for review a minimum of fifteen (15) days prior to bid.

6. The UV system shall be able to continue providing disinfection while the automatic wiping system is in operation.

7. System shall be designed to operate in an environment with ambient relative humidity of 5-90% and ambient air temperature of 0-40 degrees C.

**2.02 - MANUFACTURERS**

A. Trojan

B. Wedeco

C. Approved Equal.

**2.03 - UV DISINFECTION EQUIPMENT CONSTRUCTION**

A. The UV system shall operate in a pressurized closed vessel, use high-intensity low-pressure amalgam UV lamps, electronic ballasts with multiple power settings, and incorporate an automatic sleeve wiping system for lamp sleeves.

B. UV Reactor:

1. The UV reactor shall be manufactured from Type 316L stainless steel. The UV reactor shall be pickled, passivated and bead blasted for uniform external finish.

2. The UV reactor shall be designed to handle a maximum operating pressure of 100 psig, and shall be fully assembled and hydrostatically tested to 1.5 times the rated operating pressure, for at least 10 minutes without leakage, in the factory prior to shipment.

3. UV reactor shall be supplied with ANSI 150 lb. flanged inlet/outlet connections with maximum diameter of 16 inches and provided with the necessary reducers for connections to the 8-inch upstream and downstream piping.

4. UV reactor chamber shall be 20" nominal in diameter.

5. In order to maximize hydraulic efficiency, the UV reactor is to be configured such that flow enters parallel to the lamps and exits through a flange located perpendicular to the UV lamps.

6. Each UV reactor shall contain high-intensity low-pressure amalgam UV lamps arranged horizontally and parallel to the direction of flow.

7. Each lamp shall be enclosed in an individual quartz sleeve, one end of which shall be closed and the other sealed with compressed o-rings.

8. UV reactor shall be provided with an end cap and safety switch. Power will be removed to the entire chamber when a reactor end cap is removed.

9. Not Used.

10. The UV reactor shall be provided with access ports for easy access to the quartz sleeves.

11. Provide UV reactor with (2) two sample taps and valves.

12. All access for internal reactor components, including lamps, sleeves and wiping system shall be from the same end. Designs requiring access from more than one side of the reactor are not permitted.

13. Piping shall be designed so that the reactor remains full of water at all times during operation. Air trapped in the reactor will result in reactor shut down to avoid overheating.

14. The UV reactor shall be installed in a horizontal orientation.

15. Dry weight of the reactor shall not exceed 1600 lbs.

16. Wet weight of the reactor shall not exceed 2200 lbs. Provide pipe supports in accordance with SECTION 15056, PIPE SUPPORTS. Pipe supports to be provided by the Contractor with coordination with the manufacturer in order to allow for proper operation and maintenance on the UV System.

C. UV Lamps:

1. Lamps will be high-intensity low-pressure amalgam. The lamps will be preheated to ensure long lamp life. Lamps that are not amalgam or that are based on driving a low-pressure lamp at amperages greater than 500 milliamps will not be acceptable.

2. The filament will use a clamped design and be significantly rugged to withstand shock and vibration.

3. Electrical connections will be at one end of the lamp and have four pins, dielectrically tested for 2,500 volts. Lamps that do not have 4 pins will be considered instant-start. To be considered as an alternate, instant-start lamp systems will supply replacement spare lamps equal to 50% of the total number of lamps in the system.

4. Lamps will be rated to produce zero levels of ozone.

5. Lamps shall be operated by constant output electronic ballasts.

6. Lamps shall be monochromatic with minimum 90% of UVC output at wavelengths between 230 to 275nm.

D. Lamp End Seal and Lamp Holder:

1. The open end of the UV lamp sleeve will be sealed by a compression o-ring.

2. The o-ring compression is made by a sleeve nut that will require no special tools for installation or removal.

E. UV Lamp Quartz Sleeves:

1. Type 214 clear fused circular tubing as manufactured by General Electric or equal.
2. Lamp sleeves shall be domed at one end and be accessible through the reactor service entrance.
3. The nominal wall thickness will be 1.5 mm.

F. UV Transmittance Sensor

1. One (1) side-mounted sensor shall be provided per reactor chamber.
2. The sensor will measure the transmittance of light emitted by a UV lamp. The detection system will be factory calibrated. Sensors that can be field calibrated will not be permitted.
3. The UV transmittance sensor shall be capable of being removed from the UV vessel without interrupting the disinfection process or draining the UV vessel.

G. UV Intensity Sensor:

1. One (1) side-mounted sensor shall be provided per reactor chamber.
2. The sensor will measure only the germicidal portion of the light emitted by a UV lamp. The detection system will be factory calibrated. Sensors that can be field calibrated will not be permitted.
3. The UV intensity sensor shall be capable of being removed from the UV vessel without interrupting the disinfection process or draining the UV vessel.

H. Ballasts:

1. Electronic ballasts shall be used to power UV lamps.
2. Each ballast shall supply power to and control two (2) low-pressure amalgam lamps.
3. The power factor shall not be less than 94% between 208 to 277Vrms at 100% power.
4. The ballasts shall utilize a preheat circuit to ignite the lamps.
5. The ballasts will continue to operate without suffering damage when a short circuit is present across the ballast output terminals.
6. The Total Harmonic Current Distortion shall be less than 8%.

I. Control Panel:

1. Power distribution for each UV reactor shall be through the associated control panel housing all power supplies. Signal wiring interfacing the UV reactor with the control panel shall be as shown on the contract drawings.
2. Power for all instruments and ancillary system components shall be obtained from the UV control panel.
3. Each control panel shall be designed to operate with the following electrical supply: 480VAC, 3-phase, 60 Hz
4. The enclosure shall be UL listed and bear a UL 508A label.
5. Located within 15 ft of the UV reactor (external running cable length).
6. Provided with a lockable disconnect handle that will shut down the reactor/cabinet power when the cabinet door is opened.
7. Controls:
    a. UV reactors shall be controlled by a microprocessor which continuously monitors and controls the UV reactor functions. Custom electronics, an input flow signal and UV sensor(s), provide the microprocessor with the necessary indication of system parameters.

8. Operator Interface:

   a. Complete control and monitoring of each reactor shall be accomplished through the operator interface located on the PDC.

   b. The operator interface shall be a LED digital display.

   c. The operator interface shall be menu driven, and shall display the following system information when prompted: reactor status, individual lamp status, lamp operating hours, RED (dose), UV intensity, power level, alarms, alarm history.

   d. The most recent alarms shall be displayed on the operator interface when prompted, recorded by alarm type, date and time of occurrence, and date and time of correction.

9. Remote Monitoring/Control:

   a. Communication between the UV reactors and the plant control center shall be through the following protocol:

      (1) Ethernet. If the vendor's typical communication protocol is not Ethernet, the UV vendor is responsible for all communication configuration to provide Ethernet out of the control panel.

   b. Each reactor shall be able to operate in either Local or Remote (automatic) mode.

   c. Each system shall be provided with the following hardwired I/O for operator interface:

      (1) Discrete input for Reactor On/Off Control from remote location.

      (2) Discrete output indicating Critical Alarm.

      (3) Discrete output indicating Major Alarm.

      (4) Discrete output indicating Minor Alarm.

      (5) Discrete output indicating System Ready.

      (6) Discrete ON/OFF status.

      (7) 4-20ma Flow Signal Analog input.

      (8) Lamp failure alarm.

      (9) Multiple lamp failure alarm.

      (10) UV dose is approaching minimum design dose warning alarm.

      (11) UV dose below minimum design dose alarm.

      (12) UV sensor failure alarm.

      (13) Low UV-intensity alarm.

      (14) Low-Low UV-intensity alarm.

J. Safety Features:

   1. Each UV reactor shall be equipped with a temperature switch to prevent the reactor from overheating. The temperature switch shall be wired to the PDC and, when activated, will shut the reactor down and initiate a critical alarm condition.

   2. Not Used.

K. Wiping System:

1. Each UV reactor shall be equipped with an automatic on-line sleeve wiping system.

2. The wiping system shall be screw-driven.

3. The wiping system shall wipe the lamp sleeves using an automatically initiated and controlled cleaning cycle. The wiping system shall be fully operational while still providing disinfection.

4. Wiping cycle intervals shall be field adjustable via the operator interface. Manual wiping system control shall also be through the operator interface.

L. Temperature Switch:

1. A temperature switch shall be fitted to each reactor for protection against heat build-up under no flow or drained chamber conditions.

2. The temperature switch shall cause the UV system to shut down and alarm in event of higher than recommended water temperature (or air temperature if the lamps are operated in a dewatered situation).

M. Drain:

1. Each reactor shall be furnished with a drain valve connection so the reactor can be dewatered for inspection or cleaning after the inlet and outlet valves are closed.

**2.04 – SPARE PARTS**

A. Provide list of recommended spare parts, with unit pricing.

**2.05 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.06 - SHOP TESTING**

A. A functional test of the UV reactor shall be performed in at the factory prior to shipment.

**PART 3 - EXECUTION**

**3.01 - SYSTEM STARTUP, CHECKOUT AND ACCEPTANCE TESTING**

A. After completed installation of the applicable system and appurtenances, the equipment supplier shall coordinate with the Contractor and supply all labor and equipment necessary to conduct start-up and checkout procedures as described in manufacturer's printed instructions. If adjustments are required or components replaced, checkout procedures shall be conducted again until equipment functions properly.

B. A vendor Startup and Checkout Report shall be provided to the Contractor by the equipment supplier prior to conducting Acceptance Testing.

**3.02 - ACCEPTANCE TEST PROCEDURE**

A. After the field functional testing is complete, the Contractor shall conduct an Acceptance Test for the Non-potable Process Effluent UV system. The equipment supplier shall provide on-site assistance to the Contractor during Acceptance Testing.

**3.03 - FIELD AND FUNCTIONAL TESTSING**

A. After installation of the UV equipment, and after inspection, operation, testing and adjustments have been completed by the manufacturer's field service technician, conduct functional testing for each UV unit in the presence of the Contractor to determine its ability to operate as specified. Promptly correct and replace all defects or defective equipment revealed by or noted during tests, at no additional cost, and repeat tests until specified results acceptable to the Contractor are obtained.

1. UV equipment pressure testing shall test the equipment to pressures indicated in the Process Piping Schedule or to the maximum pressure recommended by the UV equipment manufacturer. If the pressure recommended by manufacturer is less than pressure indicated in Process Piping Schedule, isolate the UV equipment from pipe during pipe pressure testing.

B. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection - 1 person-day.

3. Functional Testing: Calibrate, check alignment and perform a functional test with portable water - 1 person-day.

4. Field Performance Testing: 1 person-day.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions - 1 person-day.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11365**

**ROTARY DRUM THICKENERS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for Rotary Drum Thickeners and, where appropriate, applying or installing such materials for the various items of Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. Provide and test Rotary Drum Thickeners, valves, sludge condition devices and tanks, mixers, motors, variable frequency drives, controls and control panels and appurtenances as specified herein.

C. The Owner has pre-selected the manufacturer of the Rotary Drum Thickeners. Refer to SECTION 99999, ATTACHMENTS for the Proposal received from BDP Industries, Inc. In the event of a discrepancy between the Proposal and this section, this section shall govern. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Rotary Drum Thickeners. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 - DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but, are not limited to the following.

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified. Electronic files shall conform to the following minimum requirements:
    a. Electronic Files: AutoCad 2013 or higher, drawn to scale.
    b. Submit electronic files as part of the Shop Drawing submittal.
    c. Submit electronic files on CD or DVD.
    d. Drawings shall include plan views, sectional views, Piping and Instrumentation diagrams, title block, Tag Numbers, serial numbers, Parts List (identifying each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.
    e. Drawings shall be in conformance with all other requirements as specified in this specification.
2. Data regarding thickener characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically equipment, showing they meet indicated and specified requirements capacity, performance and horsepower.
    b. Results of shop performance tests as specified.
    c. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-in. by 11-in. sheets, one curve per sheet.
3. Control Panels
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.
4. Data for accessory items.
5. Certified setting plans, with tolerances, for anchor bolts.
6. Manufacturer's literature as needed to supplement certified data.
7. Operating and maintenance instructions and parts lists.
8. Listing of reference installations as specified with contact names and telephone numbers.
9. Bearing temperature operating range for the service conditions specified.
10. List of recommended spare parts other than those specified.
11. Shop and field inspection reports.
12. Bearing Life: Certified by the equipment manufacturer. Include design data.
13. Shop test results.
14. Qualifications of field service technician.
15. Recommendations for short and long-term storage.
16. Shop and field testing procedures and equipment to be used.

17. Special tools.
18. Number of service person-days provided and per diem field service rate.
19. Schematic control and power wiring diagrams.
20. Manufacturer's product data and specifications for painting.
21. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
22. The latest ISO 9001 series certification or Quality Control Plan.
23. Provide a scaled drawing showing the entire thickener assembly, hoists and bridge cranes including equipment weights, lifting attachments and clearances for equipment removal and maintenance.
24. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. All changes and clarifications shall be indexed to a list detailing each change and clarification. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specifications with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

**1.06 - DESIGN CRITERIA**

A. The Rotary Drum Thickeners equipment is intended to thicken waste sludge generated by the WWTF to reduce off-site hauling costs for dewatering and disposal/reuse. The Rotary Drum Thickeners will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. The Control Panel for the Rotary Drum Thickeners will be located in the garage (Room 102). Odorous exhaust from the truck bay is directed to the odor control carbon filter located outside. The waste sludge storage tank and thickened sludge storage tank will be served by mixing blowers to maintain sludge conditions of the combined sludges prior to thickening and hauling respectively.

B. Each Rotary Drum Thickeners shall include:

1. Flocculation/Sludge conditioning Tank; equipped with vortex mixer and polymer injection ring, low inlet with provisions to drain the tank, and a discharge flume assembly to transfer conditioned sludge to the first stage of the rotary element. The manufacturer shall be required to provide recommended layout for the system and the final location of the in-line conditioning system. Design shall allow adjustment of the flocculation time.

2. Multiple stages that progress dewatering throughout the system:

a. Woven wire mesh to maximize flow and easily changed for performance/O&M; and

b. Equip each stage with roll bars, split augers, ports and/or deflectors to induce shear, water release and drainage rate.

3. Drum Drive assembly will be mounted on a rigid base with provisions for adjustment of the drive, sprocket, and roller chain interface.

4. Trunnion Wheel assemblies to be mounted to the base frame to provide positive horizontal placement of the rotary drum screen assembly.

5. Washing system; complete with self-cleaning adjustable mount washing header, spray tips and stainless steel pressure gauge and dial, and booster pumps as recommended by manufacturer.

6. Spray Water Solenoid valve.

7. Shower deflection panels shall contain spray and minimize mist and allow easy access for visual inspection and access to the trunnion wheels for maintenance.

8. Filtrate water collection; by gravity through the 4-in tank drain.

9. Type 304L Stainless Steel Construction; including tank covers, tank supports and adjustable support legs for field leveling.

10. Closed grit discharge chute; Type 304L stainless steel.
11. Plant water strainer, brass bodied Y-type with washable Type 316 stainless steel filter insert, 20 mesh.
12. Magnetic flow meter and transmitter for recording and totalizing inlet waste sludge.
13. Electrical Devices.
    a. Main unit drive; per manufacturer, gear motor rated for severe duty, with VFD, 460 VAC, 3 phase, 60 Hz. Class 1 Division1.
    b. Conditioning Tank drive; per manufacturer, gear motor rated for severe duty, with VFD, 460 VAC, 3 phase, 60 Hz Class 1 Division1.
    c. Wash Water Booster Pump; per manufacturer, fixed speed, 460 VAC, 3 phase, 60 Hz Class 1 Division1.
    a. Control Panel as defined herein.
14. Spare parts; one set each: trunnion wheels, driven sprocket, drive sprocket, idler sprocket, drive chain.
15. Any other equipment and controls required by the PROPOSER to meet the Rotary Drum Thickener system performance requirements.

C. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.07 - REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:
1. A36: Specification for Structural Steel.
2. A48: Specification for Gray Iron Castings.
3. A322: Specification for Carbon and Alloy Steel Bars.
4. A536: Specification for Ductile Iron Castings.
5. A743: Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, and Nickel-Base Corrosion-Resistant for General Application.
6. B584: Specification for Copper Alloy Sand Castings for General Applications.

B. American National Standards Institute (ANSI):
1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. American Bearing Manufacturers Association (ABMA):
1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.

D. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - QUALITY ASSURANCE**

A. Provide as specified herein.

B. Equipment shall be the product of one manufacturer.

C. Equipment shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the thickeners, mixers, tanks, inline condition devices, solenoid valves, motors, gear reducers, controls, control panels and variable frequency drives, from a single manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

G. Services of Manufacturer's Representative as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection: 1 person-day.

4. Field Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 3 person-days.

5. Acceptance Testing: Conduct acceptance testing as specified herein. 3 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1 person-day.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

8. Any additional time required.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. BDP Industries, Inc.

B. The Owner has pre-selected the BDP Industries, Inc. as the manufacturer of the Rotary Drum Thickeners. No Substitutions are allowed.

**2.02 - GENERAL**

A. Provide fully automatic, fully enclosed, internally fed, continuous operating, and self-cleaning sludge thickening units.

B. Thickeners to include cylindrical wedge section thickener with internal shafted screw, 190-degree rotation spray bar system with nozzles, sludge discharge chute, flocculation reactor and mixer, drives and controls.

C. Thickeners must be totally enclosed. Thickeners with open ended discharges are not acceptable.

**2.03 - SCHEDULE**

A. General: Condition and thicken sludge feed to produce thickened sludge that is discharged from thickening unit, automatically, without clogging.

1. Design requirements as follows:

a. Feed Sludge Characteristics:

b. Type of Sludge

(1) Waste activated sludge from an SBR process and processed septage.

(2) Solids Concentration (Mixed WAS and Septage at 50/50 Ratio): Range: 0.3 to 0.5 percent.

2. Thickening Equipment Requirements:

a. Number of thickeners: 1 plus 1 as bid alternate.

b. Design Solids loading capacity: 400 lbs. dry solids/hour at 0.5 percent solids. Design operating hydraulic rate: (excluding polymer): 100 gpm at 0.3 to 0.5 percent solids with a range of 80 to 150 gpm

c. Magnetic flow meter to measure feed sludge to thickener.

d. Maximum polymer consumption: 10 lbs/ton dry solids.

e. Minimum solids capture: 95 percent.

f. Solids output: 5 percent (dry weight basis).

g. Maximum total connected power: 4.5 horsepower (including 2 hp thickener drive, 0.25 hp sludge conditioning tank drive, and 0.25 hp spray wash booster pump.

h. Wash water: 38 gpm maximum at 60 psi minimum.

i. Thickener cylinder

(1) Screen Openings, inch: 0.01

(2) Diameter, inches: 27.50*

(3) Length, inches: 69*

*Varies per manufacturer

**2.04 - THICKENING EQUIPMENT**

A. Provide cylindrical wedge wire with a constant bar spacing as specified installed as a filtration unit.

B. Provide a multi-stage progression of the sludge to be thickened achieved with the inclined installation of the thickener and the internal helical screw.

C. Provide brushes on the conveyor screw to clean the screen, preventing sludge from sticking at the inside of the wedge wire.

D. Provide a rotating spray bar.

E. The screw conveyor speed shall be adjusted to the individual requirements of the sludge to be thickened, from 0 to 7 rpm through a VFD. The screw conveyor shall be the only rotating part of the sludge thickening unit.

F. The entire unit shall be totally closed; units not totally enclosed are not acceptable.

G. Provide a turbulence-free inlet for each unit.

H. Provide an inspection hatch in the reactor to inspect, the filtrate outlet in the wedge wire, the wedge wire, operation of the spray nozzles and the quality of the thickened sludge.

I. Provide an integrated spray wash systems constructed of Type 304L stainless steel piping and Type 304L stainless steel spray nozzles covering the entire area of the wedge wire screen, and shall rotate 190 degree around the basket in each direction, to provide a total automatic spray system, cleaning the wedge wire. Provide solenoid valves for flow control for each part of the system.

J. Provide a 4-inch flanged connection on the high point of the drum for connection to an odor control duct as indicated.

**2.05 - SLUDGE CONDITIONING**

A. Sludge Condition Tanks

1. Vertical enclosed type, sized to provide optimum mixing and flocculation of sludge and conditioning chemicals. Provide a hinged and gasketed cover.

2. Type 316L stainless steel construction, furnished with the following:

a. One (1) 4-inch 150 lb. flanged sludge inlet connection

b. One (1) 3-inch (minimum) flanged drain connection with 3-inch stainless steel ball valve.

c. Provide gravity flow through one (1) 8-inch line from conditioning tank to the thickener.

3. Provide a system with all parts accessible for cleaning, maintenance or operational adjustment with no seals or bearings in contact with liquid.

4. Mixing Devices

a. Provide the vertical tank fitted with a Type 304L stainless steel vertical mixer and internal baffles. Provide mixer with an integral motor mounted variable frequency drive. Provide Type 316L stainless steel discharge lines at top of tank to provide conditioned sludge feed to the rotary drum thickener.

b. Speed Range: 0 to 12 rpm

B. In-Line Sludge Conditioning

1. Type 316L stainless steel solids handling mixing valves sized to provide optimum mixing and flocculation of sludge and conditioning chemicals.

2. Pressure drop through mixing device not to exceed 12 psi at a flow range of 125 to 185 gpm.

3. Provide one (1) in-line mixer per thickener, provide each mixer with a weighted adjustable mixing device. Provide ends flanged and drilled to 150 lb. ANSI B16.1 Standard.

4. Provide each mixing device with a polymer injection ring with four tangentially mounted polymer injectors as indicated.

5. Elbows, bends or special pipe sections are not acceptable.

6. The equipment supplier to be responsible for the final location and layout of the in-line conditioning system.

**2.06 - DISCHARGE CHUTES**

A. Provide a Type 304 stainless steel enclosed discharge chute to direct thickened sludge flow to the Thickened Sludge Storage Tank below. Provide configuration as indicated.

**2.07 - CONTROLS**

A. Automatic controls for operation of the Rotary Drum Thickeners (RDTs) and associated appurtenances shall be provided in Programmable Logic Controller (PLC)-based control panels. Provide control panel per RDT. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.

2. Provide NEMA 4 Type 316L Stainless Steel enclosure. The Control Panel for the Rotary Drum Thickeners will be located in the garage (Room 102).

3. Panel shall be labeled UL 508A.
4. Provide motor starters, and variable frequency drives (VFDs) internal to the control panel as required. Provide VFD's in accordance with Specification 16260, Low Voltage Variable Frequency Drives.
5. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
6. Heaters or AC units required for control panels shall obtain power from the control panel.
7. Provide the following control panel enclosure with the following:
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Control buttons as defined below.
    c. LED type indicating lights.
8. Provide an emergency stop (ESTOP) maintained pushbutton on the face of the panel.
9. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide the control panel with an integral surge protection device (SPD):
    a. 120VAC, 10 kAIC rated.
    b. Visual indication of plug status.
    c. UL listed.
11. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
12. Provide RAM memory protected by backup battery.
13. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
14. Provide fully documented ladder logic on a CD-Rom.
15. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide 10 inch Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.
16. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
17. Provide control a monitoring of the system as shown on the contract drawings.
18. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
19. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
20. Provide sufficient number of spare contacts for interlocking. Provide at least 8 spare un-powered auxiliary contacts.
21. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
22. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.

23. The RDT vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
24. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.

B. Minimum Control Requirements

1. Thickener Drive and Sludge Conditioning Tank Drive Speed Control.
    a. Provide separate speed controls to control speed of thickener drive and conditioning tank drive. Speed controls calibrated from 0 to 100 percent of unit speed.
    b. Provide START/STOP pushbuttons mounted on front of control panel for each drive. In STOP position, motors de-energized. In START position, motor runs, with speed controlled through speed controls.
2. Wash Water Solenoid Valves: Panel mounted OPEN/CLOSE/AUTOMATIC.
3. Normal RUN/OFF/AUTOMATIC of thickener.
4. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
    a. Thickener Drive.
    b. Sludge Conditioning Tank Drive.
    c. Wash Water Spray Bar Motor.
5. A FAULT light (LED), panel alarm and acknowledge button with suitable contacts, to actuate light and alarm in event of following:
    a. Thickener drive failure.
    b. Sludge conditioning tank drive failure.
    c. Spray system motor failure.
    d. High and low liquid levels in sludge conditioning tank.

C. In addition to the Main Control Panel, furnish a NEMA 4X Type 316L stainless steel remote control cabinet for each Rotary Drum Thickener for mounting locally at the equipment. The remote Control Panel will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. Each remote control cabinet shall house the following components:

1. Emergency Stop Push Button
2. H-O-A Control Switch
3. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
    a. Thickener Drive.
    b. Sludge Conditioning Tank Drive.
    c. Wash Water Spray Bar Motor.
4. A common FAULT light (LED), panel alarm and acknowledge button with suitable contacts.

**2.08 - MOTORS**

A. Provide in accordance with SECTION 16220, Electric Motors and as specified herein.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of equipment under any condition of operation specified and indicated without operating in the motor service factor.

C. Motors: Class 1 Division 1.

D. Provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

E. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

F. Operate without overheating at the speeds specified and indicated.

G. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with VFD's.

H. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

I. Rating: 460V, 3 PH, 60 Hz.

J. Insulation: Class F with Class B temperature rise, 40 deg. C ambient.

K. Site Altitude: 60 feet above sea level.

**2.09 - GAUGES**

A. Provide gauges assemblies for wash water piping.

**2.10 SHOP TESTING**

A. Provide motor shop testing.

B. Provide a mechanical operating test of the thickener and the control panel at the thickener manufacturer's facility.

C. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.

D. Repeat tests until specified results are obtained.

E. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

F. Provide Certified Test Results to the Engineerign prior to shipment of the units.

**2.11 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces two part epoxy paint in accordance with the following.

1. Solids by Volume: Minimum 57 percent (percent $\pm$2).
2. Type: Polyamide epoxy, self-priming.
3. Dry Film Thickness: 4 to 6 mils per coat.
4. No. of Coats required: Three.
5. V.O.C Requirement: 3.06 lbs/gallon, Conform to AWWA D102 Inside systems No.1 and No.2.
6. Use thinners that are acceptable to ANSI NSF Std 61.
7. Color: As specified for piping system of same service or as selected by the Engineer.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

**2.12 - SPARE PARTS**

A. Provide spare parts that are identical to and interchangeable with similar parts installed. for each set of thickeners of the same size and performance.

1. One set of all special tools required.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Install items in accordance with manufacturer's printed instructions and as specified.

B. Install units on a concrete pad and align thereon. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation.

### 3.02 - FIELD TESTING

A. Test piping connections to prove that any nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with nozzles.

B. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer’s field service technician, conduct running test for each thickener in presence of the Engineer to determine its ability to operate at the service conditions specified and indicated and within the temperature limits specified. During field tests, observe and record capacity, motor inputs, bearing housing temperature, noise and vibration. Immediately correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner. Contractor to provide all labor, piping, equipment, calibrated gauges and flow meters.

1. Bearing and Motor Temperature:

    a. Run each unit for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

    b. Bearing temperature not to exceed 180 degrees F.

2. Test Duration: Determined by the Engineer, but not less than four hours of continuous operation at each condition specified and indicated.

C. Make all adjustments necessary to place equipment in specified working order at time of above tests.

D. Test on product only. If product is not available, test with water. Water for testing furnished by Contractor.

E. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

### 3.03 - PROCESS PERFORMANCE GUARANTEE

A. The Rotary Drum Thickeners will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur one (1) year from Substantial Completion of the construction contract. In order to protect the OWNER’s interests, the MANUFACTURER shall provide to the OWNER, through the Contractor, with the shop drawing submittal.

B. The MANUFACTURER shall be responsible for the process performance of the Rotary Drum Thickeners and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 - WARRANTY**

A. The MANUFACTURER shall be provide an warranty of the Rotary Drum Thickeners warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

C. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 - ACCEPTANCE TESTING**

A. After the field functional testing is complete, Contractor will conduct an Independent Acceptance Test. During the Acceptance Test, the feed Septage/WAS and thickened sludge shall be monitored for flow and total solids concentration and the thickener filtrate shall be monitored for TSS concentration. The design/testing criteria to be a 50/50 percent split of Septage/WAS blend at 0.3 to 0.5 percent upstream solids concentration and 5.0 percent minimum downstream concentration.

B. Polymer Selection: For start-up, the thickening equipment vendor shall recommend and provide one (1) month supply of polymer based upon similar applications

C. Rotary Drum Thickeners Acceptance Testing - The Rotary Drum Thickeners will be operated in an “acceptance testing” mode for a minimum of a continuous 4-hour period. Solids content grab samples representing the entire Septage/WAS flow will be collected both upstream and downstream of the Rotary Drum Thickeners. At least one (1) Upstream and two (2) downstream (one sample of the thickened Septage/WAS and one sample of the filtrate/centrate) solids content grab sample shall be collected at 30-minute intervals of the 4-hour continuous operation testing period. Samples shall be analyzed at an independent testing facility to be verified. The length of the testing period may be adjusted based on the volume of feed sludge available as agreed by the Owner and/or Engineer.

D. Rotary Drum Thickeners Acceptance Testing Criteria

1. The Rotary Drum Thickeners shall produce thickened sludge with a minimum of 5 percent solids when:

   - The process influent percent solids are in the range of 0.3 to 0.5 percent; and
   - Polymer addition at up to 10 lbs/Ton.

   and

   - Either flow to a single Rotary Drum Thickener is at least equal to the upper limit of the normal operating hydraulic loading rate defined by the final approved design; or
   - The solids load sent to a single Rotary Drum Thickener is at least equal to the maximum day solids loading capacity defined by the final approved design (whichever is more limiting when the solids content is 0.5 percent).

2. Each thickening unit shall capture a minimum of 95 percent of solids during the test period.

E. Contractor shall have responsibility for performing formal Acceptance Testing with support from manufacturer’s representative. Representative shall include technical and operational advice, response to questions, and other

assistance as necessary for successfully completing the Acceptance Tests. On-site support from the on-site Representative during Acceptance Testing shall be as specified herein.

**3.06 - FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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**SECTION 11373**

**AIR DIFFUSER SYSTEMS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide air diffuser systems as specified and/or as shown on the drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop Drawings, including all equipment and components.

2. Brochures and/or Catalogue Cuts.

3. Performance curves.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. The Air Diffused System shall be designed to operate in the following locations:

1. Pre-Equalization Tanks;
2. Waste Sludge Holding Tanks; and
3. Thickened Sludge Holding Tank.

E. Performance of the Air Diffused Systems shall be as follows:

| Location and Function | Type of Diffuser | Number of Drop Legs and Grid Manifolds | Minimum Number of Diffusers | Air Flow Rate (scfm/diffuser) | Maximum Headloss (inches $H_20$) |
|---|---|---|---|---|---|
| Pre-Equalization Tank No. 1 | Medium Bubble Flexible Elastomer | 1 | 52 | 9.8 | 1.4 inches @ 9.8 SCFM per diffuser |
| Pre-Equalization Tank No. 2 | Medium Bubble Flexible Elastomer | 1 | 52 | 9.8 | 1.4 inches @ 9.8 SCFM per diffuser |
| Waste Sludge Holding Tank No. 1 | Medium Bubble Flexible Elastomer | 1 | 42 | 9.6 | 1.3 inches @ 9.6 SCFM per diffuser |
| Waste Sludge Holding Tank No. 2 | Medium Bubble Flexible Elastomer | 1 | 42 | 9.6 | 1.3 inches @ 9.6 SCFM per diffuser |
| Thickened Sludge Holding Tank | Medium Bubble Flexible Elastomer | 1 | 66 | 9.2 | 1.2 inches @ 9.2 SCFM per diffuser |

**1.07 - WARRANTY**

A. The manufacturer shall guarantee all materials and equipment to be free from all defects due to faulty materials or workmanship for a period of three years from the date of manufacturer's letter verifying proper installation and service of equipment.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Aquarius

B. EDI

C. Evoqua

**2.02 - MATERIALS**

A. Diffusers

1. The medium bubble diffusers shall be non-clog type.
2. Each cone style diffuser shall consist of a minimum 6-inches diameter plastic cone having a flat upper lip against which a circular elastomeric reinforced EPDM cover is retained and prevented from detachment by a Type 304 stainless steel nut and bolt.
3. Elastomer cover shall be rated to operate with air temperatures of 230 degrees Fahrenheit.
4. Air shall enter the bottom of the diffuser from the header and escape at the cone periphery under the cover. When the air supply is stopped, the cover shall seat against the cone, thus closing the interior of the diffuser to entry of clogging solids.

B. Diffuser Mounts

1. Each cone style diffuser shall be attached to the distributor pipe by means of a Type 316 stainless steel hardware.
2. The diffuser shall be installed in the field. The assembly shall be completed such that the diffuser is level after installation.

C. Manifolds

1. A manifold pipe and drop pipe connection shall be provided for each diffuser grid. The manifold pipe shall be of the length and diameter indicated on the Contract Drawings. The manifold pipe and fittings shall be Type 316 316 Stainless Steel.
2. The pipe and fittings shall contain two parts titanium dioxide to provide protection against ultraviolet light. The welds shall be in accordance with ASTM D2855.

D. Distributors

1. Distributor pipes shall be provided for the mounting of diffusers. The diameter, length, and quantity of distributors shall be as indicated on the Contract Drawings. The distributor pipe and fittings shall be of the same quality and standards as the manifold pipe. Diffuser mounts shall be fastened with Type 316 stainless steel hardware.
2. Expansion joints and pipe supports shall be installed in accordance with these sections. Distributors shall be installed so that all diffusers are within ¼-inch of a common horizontal plane.

E. Pipe Supports

1. Sufficient pipe supports shall be provided to keep the drop manifold, and distributor piping in place, to allow for pipe expansion/contraction, and to level the pipe. Pipe supports shall be provided at the end of all pipe lengths. Intermediate supports shall be provided at intervals not to exceed eight feet unless a greater spacing is indicated on the plans.
2. The pipe supports shall consist of a support hold-down mechanism and pipe clamp. The pipe clamp shall allow for a vertical adjustment of plus or minus two inches. The end supports shall be fixed. The intermediate supports shall allow for pipe movement caused by the pipe expansion/contraction. The pipe supports including all nuts, washers, clamps, bolts, and accessories shall be fabricated from Type 316 stainless steel. The supports shall be designed for buoyant forces with 2.0 safety factor. Anchor bolts shall be Type 316 stainless steel, designed for buoyant forces with a 4.0 safety factor.
3. Pipe supports shall be mounted on the reinforced concrete floor of the structures. All stainless steel hold down assemblies shall be identical.

F. Expansion Joints

1. Expansion joints shall be provided for on the air piping to allow for expansion and/or contraction of the pipe if recommended by the air diffuser system supplier. The expansion joints shall be airtight and allow for a total range of pipe movement of two inches.

2. If recommended by the diffuser system supplier, the joint at the header section of each distributor pipe shall consist of a single expansion coupling. The couplings shall be fixed in the factory to one end of the distributor pipe and contain an O-ring gasket to provide an airtight seal when connected to the mating connection point. Expansion joints connecting sections of distributor or manifold pipes shall also employ single expansion couplings as specified above.

G. Drop Leg Connections and Flexible Couplings

1. Drop leg piping to within two feet above the diffuser manifold piping will be furnished by DIVISION 15 - MECHANICAL.

2. A two foot stub out pointing upward and a flexible coupling shall be provided by the diffuser manufacturer for each drop leg/grid. The flexible coupling shall be a Type 316 stainless steel band with Type 316 stainless steel fasteners. The full inside face of the flexible coupling shall be lined with a ribbed neoprene liner to provide positive bubble tight sealing at the design test pressure. Two foot stub out shall be manufactured using the same material provided for the manifold piping system.

## PART 3 - EXECUTION

### 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

### 3.02 - INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Installation of the equipment shall be in accordance with written instructions provided by the manufacturer and as approved.

### 3.03 - PAINTING – Not Used

### 3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

### 3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided for installation, startup and testing for the system – One working day per location.

### 3.06 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided for training on the system – One working day.

B. Training shall be performed at the project site.

### 3.07 - LUBRICATION REQUIREMENTS – Not Used

### 3.08 - SPARE PARTS

A. One complete diffuser assembly shall be furnished for every 20 complete diffusers assemblies provided.

**3.09 - FIELD TESTING**

A. When each distributor pipes has been completely installed, but prior to mounting of the diffusers, the Contractor shall clean all dirt and debris from the piping. This may be performed with the facility air supply system (follow blower manufacturer's recommendation for operating the blower with no back pressure; artificial back pressure may be required). After the piping has been cleaned, the Contractor shall mount the diffusers.

B. The holding tanks shall be filled with fresh clean water so that the diffusers are submerged by approximately 1/4-inch. The Contractor should check each diffuser to verify that all diffusers are within 1/4-inch of the water surface. If any of the diffusers are not within 1/4-inch, the Contractor shall make appropriate adjustments to the pipe supports.

C. When the diffusers have been adjusted, the Contractor shall place three feet of clean water over the diffusers. The facility air supply system shall be applied to the diffusers at approximately 1/4 of the design air flow (caution regarding operation of the blowers with low back pressure). The Contractor shall observe that there are no air leaks at any of the piping connections, and that the air flow appears even through each diffuser. Repairs shall be made if leakage is observed.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11377**

**ROTARY POSITIVE DISPLACEMENT BLOWERS AND APPURTENANCES**

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**PART 1 - GENERAL**

**1.01 - SCOPE**

A. Provide and test rotary positive displacement blowers, motors, V-belt drives, silencers, acoustical enclosures, variable frequency motor controllers and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 0700,GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data regarding blower, motor and acoustical enclosure characteristics and performance:

   a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate blowers, showing they meet indicated and specified requirements for capacity, pressure rise, horsepower, temperature rise and efficiency.

      (1) For units of same size and type, provide curves for a single unit only.

   b. Provide catalog performance curves at maximum blower speed indicated and specified for each service showing maximum and minimum speeds available.

   c. Results of shop performance tests as specified.

   d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

2. Materials listing
3. Shop drawing data for accessory items.
4. Certified setting plans, with tolerances, for anchor bolts.
5. Manufacturer's literature as needed to supplement certified data.
6. Operating and maintenance instructions and parts lists.
7. Listing of reference installations as specified with contact names and telephone numbers.
8. Certified results of blower pressure testing.
9. Certified results of dynamic balancing.
10. Bearing temperature operating range for the service conditions specified.
11. List of recommended spare parts other than those specified.
12. Shop and field inspection reports.
13. Bearing Life: Certified by the pump manufacturer. Include design data.
14. Blower shop test results.
15. Motor shop test results.
16. Qualifications of field service technician.
17. Recommendations for short and long-term storage.
18. Resonant frequency analysis for variable speed systems.
19. Shop and field testing procedures, set up, equipment to be used and testing tolerances to be followed.
20. Special tools.
21. Number of service person-days provided and per diem field service rate.
22. Results of field vibration test data including a vibration signature for each blower and drive assembly. Provide vibration testing procedure for review.
23. Recommended location of inlet and discharge pressure and temperature instrumentation.
24. Blow-off valve assembly and details.
25. Schematic control and power wiring diagrams.
26. Manufacturer’s product data, specifications and color charts for shop painting.
27. The latest ISO 9001 series certification.

28. Provide a scaled drawing for each blower service showing the blower, drive and enclosure, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

29. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The material and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Drawings.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Blowers shall be the product of one manufacturer.

C. Blowers shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the blowers, motors, filters, silencers, acoustical enclosures, controls and appurtenances from the blower manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. Variable frequency motor controllers are supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

2. The blower system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the blower and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, blower manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the blower and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection.

b. Also include all motor data and information that has been used for the coordination.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 2 person-days.

4. Field Performance Testing: Field performance test equipment specified.

a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of blowers shall have a minimum of twenty five (25) operating installations with blowers of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

K. For variable speed blowers systems the blower manufacturer must perform an analysis of the combined motor and blower assembly for resonant frequency or their harmonics independent of a structure.

1. Submit a copy of these calculations for the record.

2. Should calculations indicate the probability of encountering such frequencies within the speed range required, provide all additional supporting devices necessary to affect the unit mass, and raise or lower resonant point.

3. Provide and install such additional devices at no additional cost to the Owner.

**1.08 - REFERENCES**

A. American Gear Manufacturers Association (AGMA).

1. 6001: Design and Selection of Components for Enclosed Gear Drives

2. 6025: Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

2. S2.19: Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Possible Unbalance, Including Marine Applications

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1. 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

D. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

E. American Society for Testing and Materials (ASTM):

1. A48/A48M: Standard Specification for Gray Iron Castings.

2. A336/A336M: Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts

3. A1043/A1043M: Standard Specification for Structural Steel with Low Yield to Tensile Ratio for Use in Buildings

F. International Organization For Standardization (ISO):

1. 1217: Displacement compressors - Acceptance tests

2. 2151: Acoustics Noise test code for compressors and vacuum pumps Engineering method (Grade 2)

3. 9001: Quality management systems - Requirements

G. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

2. MG1: Motors and Generators.

H. Occupational Safety & Health Administration (OSHA)

1. 29 CFR Part 1910: Occupational Safety and Health Standards

## PART 2 - PRODUCTS

### 2.01 - SYSTEM DESCRIPTION

A. Blower capacities and operating data are indicated in the Blower and Compressor Schedule.

B. System Operating Conditions:

1. Site Altitude, above mean sea level: 60 feet
2. Temperature Range: 0 to 100 degrees F
3. Relative Humidity Range: 0 to 100 percent
4. Provide blower motors sized for operating at the minimum and maximum temperatures without overloading at the relief valve setting.

C. Equipment Limitations:

1. Blowers: MIX.BLW-1 and 2
   a. Maximum Total Blower Assembly Weight: 3,000 lbs.
   b. Maximum Enclosure Assembly Height: 88 in.
   c. Maximum Enclosure Length x Width: 72 x 65 in.
2. Blowers: MIX.BLW-3
   a. Maximum Total Blower Assembly Weight: 1,200 lbs.
   b. Maximum Enclosure Assembly Height: 60 in.
   c. Maximum Enclosure Length x Width: 46 x 50in.
3. Blowers: MIX.BLW-4
   a. Maximum Total Blower Assembly Weight: 2,300 lbs.
   b. Maximum Enclosure Assembly Height: 68 in.
   c. Maximum Enclosure Length x Width: 63 x 56 in.
4. Blowers: SBR.BLW-1 through 3
   a. Maximum Total Blower Assembly Weight: 3,000lbs.
   b. Maximum Enclosure Assembly Height: 66 in.
   c. Maximum Enclosure Length x Width: 60 x 61in.

D. Noise Criteria:

1. Upper noise levels with intake and discharge silencers not to exceed the following:

| Frequency | dB(1 p), | (Ref. 0.0002 microbar) |
|---|---|---|
| 63 | 104 | 75.1 |
| 125 | 100 | 81.8 |
| 250 | 94 | 85.9 |
| 500 | 91 | 82.5 |
| 1,000 | 88 | 79.2 |

| Frequency | dB(1 p), | (Ref. 0.0002 microbar) |
|---|---|---|
| 2,000 | 86 | 73.1 |
| 4,000 | 87 | 67.5 |
| 8,000 | 87 | 56.2 |

2. Overall noise level from assembled blower and silencers not to exceed 90 dB(A) at 3.0 feet from equipment. Noise level from individual assembled blower not to exceed 80dB(A) at 3.0 feet, in the free field. Noise level in the room with three blowers running at maximum conditions not to exceed 97dB(A).

E. Coordinate blower assembly package dimensions and weights with hoists as specified in SECTION 14300, HOISTING EQUIPMENT.

**2.02 - MANUFACTURERS**

A. Rotary Positive Displacement Blowers:

1. Aerzen.
2. Kaeser.
3. Robuschi.

**2.03 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.04 - BLOWER CONSTRUCTION**

A. Blowers: Rotary positive displacement type. Driven as indicated in the Blower and Compressor Schedule.

B. Provide blower configuration as indicated in the Blower and Compressor Schedule.

C. Design and proportion all parts of blowers to be especially adapted for the service specified and indicated. Provide room for inspection, repair and adjustment.

D. Blower Housing:

1. Cast iron ASTM A48/A48M Class 30 externally ribbed to prevent distortion.
2. Provide lifting devices on casings for ease of handling.
3. Face and drill flanges of inlet and discharge connections in accordance with 150-lb. ASME B16.1 (PN10) Standard.
4. Provide components with machined registered concentric shoulder fits to ensure precision alignment.
5. Provide tapped connections on inlet and discharge for pressure and temperature instrumentation connections.
6. Provide integral controlled pre-inlet for active pulsation control.

E. Rotors:

1. Type: Tri-lobe straight design. Two lobe types are not acceptable.
2. Provide stiff-shaft design with the first lateral critical speed at least 120 percent of the maximum allowable speed. Any torsional natural frequency shall be at least 10 percent above or 10 percent under the operating speed of the blower.
3. Material: Nodular cast iron with steel through shaft. Plug rotor cavities, dust tight to prevent contamination.
4. Dynamically balance rotors and shafts in accordance with ISO 1940/ANSI S2.19 G3.
5. Precision machined to final tolerances, coatings are not acceptable.
6. Material: Carbon Steel ASTM Type A1043/A1043M.

F. Bearings:

1. Anti-friction type.
2. Oil Splash lubricated. Grease lubrication is not acceptable.
3. Provide the drive shaft bearing sized for an overhung V-belt drive under maximum continuous operating load.
4. Provide bearings with minimum ABMA L-10 or B-10 life rating of 100,000 hours at specified operating conditions, based on latest ABMA and ANSI Standards. In addition, the bearing selection shall be such to achieve Mean Time Between Overhauls of five (5) years or more with normal maintenance.
5. Provide bearing covers and spacer ground for setting axial clearances for uniform bearing load.

G. Timing Gears:

1. Single helical type.
    a. Minimum AGMA quality rating: 12.
    b. Service factor: 1.70 minimum in accordance with AGMA.
2. Hardened alloy steel, ASTM A336/A336M CLF12.
3. Provide gears secured on tapered shaft ends using hydraulic expansion and interference fit allowing for stepless clearance setting and greater efficiency through accurate timing.

H. Bearing and Timing Gear Lubrication:

1. Splash Lubrication:
    a. Self-contained system.
    b. Provide oil level sight glass.

I. Seals:

1. Rotor Chamber Seals: Non contacting, no friction vented labyrinth seals, each containing:
    a. 4 piston rings.
    b. Oil deflector ring.
    c. Grooved, multiple labyrinth bushing.
2. Drive shaft seal: lip seal. Lip seal internal to the machine are not acceptable.
    a. Provide radial lip seal riding on a replaceable shaft sleeve. Lip seals riding directly on the blower shaft are not acceptable.
    b. Shaft sleeve.
    c. Provide access for seal replacement.

**2.05 - DRIVES**

A. V-Belt Drive:

1. Service Factor: 1.40 based on motor nameplate horsepower.
2. Belts: Matched cogged type V-belts.
3. Anti-static belt type.
4. Provide passive automatic V-belt tensioning device.
5. Dynamically balance sheaves for linear tip speeds > 6500 feet/min.
6. Provide metal guards for protection of personnel, guards to conform to OSHA standards. Guard material shall be perforated galvanized steel. Expanded metal, if used shall be limited to small surfaces not exceeded 1 foot$^2$.

**2.06 – OUTSIDE INLET SILENCER/SCREEN**

A. Blower manufacturer to provide a combination silencer and screen at the end of the inlet pipe outside.

B. Manufacturers:

1. Solberg.
2. Or an acceptable Equivalent.

C. Housing: Carbon Steel with a baked on enamel finish.

D. Screen: 316 stainless steel wire mesh.

E. Ends: ANSI 150 Flanges.

**2.07 - INLET FILTERS/SILENCERS**

A. Cast aluminum housing or welded steel construction.

B. Provide so that the inlet filter element is the last component in contact with the air prior to entering the blower. Any absorption material used in the intake silencer shall be upstream of the inlet filter element.

C. Provide washable filter elements of spun PVC construction:

1. Provide filter maintenance indicator.
2. The filter media shall have an average efficiency of 90 percent by weight per ASHRAE 52.2 with synthetic dust.

D. Provide arrangement that allows for the inspection of the blower rotor chamber without filter/silencer housing removal.

1. Pressure Rating: 15 psi.

**2.08 - BASE FRAME/DISCHARGE SILENCER**

A. Provide a combination unit, cast iron or welded steel construction.

B. The discharge silencer shall be designed to reduce the noise emitted by the piping leaving the blower package to 85 dB(A).

C. Provide capable of internal inspection without blower removal.

D. Distortion resistant, cylindrical vessel.

E. Provide low pressure drop design without diffuser elements.

F. Nonabsorption material type. Fibrous materials or any absorption materials, which could deteriorate over time and are not acceptable.

**2.09 - DISCHARGE MANIFOLD**

A. Welded or cast construction, flange mounted to discharge silencer discharge.

B. Designed to accommodate check valve and pressure relief valve..

**2.10 - DISCHARGE CHECK VALVES**

A. Provide full-bore type without the use of any internal springs.

B. Provide the discharge check valve removable without disconnecting the discharge piping.

C. Provide Type 316L stainless steel flap.

D. Elastomer materials: Suitable for continuous operation at 300 degrees F .

**2.11 - PRESSURE RELIEF VALVES**

A. Spring loaded, field adjustable with integral dampening air piston.

B. Body: Cast iron, flanged.

C. Trim: Bronze.

D. Provide valves mounted vertically, downstream of discharge silencer and upstream of the discharge check valve and any potential obstruction to the air stream. Valve shall discharge within segmented section of sound enclosure, to isolate relief valve discharge from blower and motor airspace.

E. Provide a single valve sized to pass full blower capacity.

F. The valve shall start opening at the blower maximum rated pressure.

G. The pressure rise across the fully opened valve not to exceed 10 percent of the pressure setting.

H. Valve setting: At least 0.7 psi higher than the maximum operating pressure to prevent chattering.

I. Provide the valve with a proportional characteristic and close within 0.1 psi of the pressure set point. Valves with a closing point lower than the set point are not acceptable.

**2.12 - DISCHARGE FLEXIBLE CONNECTORS**

A. Silicone rubber type, with Type 316 stainless steel clamps.

B. Working pressure: 15 psig

C. Temperature Rating: 300 degrees F.

**2.13 - CONTROL PANEL**

A. Mount controls directly on blower package/enclosure.

B. Component Enclosure:

1. NEMA 4X.

C. Completely wire components to terminal boards.

D. Provide the following instruments flush mounted:

1. LOCAL/REMOTE Switch.
2. START-STOP pushbuttons, momentary-contact type with lock-out latch.
3. Inlet and Discharge Manometer: Remote magnetic dial type.
    a. Inlet Calibration: Inches w.c. vacuum and psi.
    b. Discharge Calibration: Pounds per square inch.

4. Inlet and Discharge Temperature: Non-mercury type.
   a. Case: Phenolic or aluminum with white laminated plastic dial.
   b. Unit with 4-1/2-inches dial with range of approximately 50 to 300 degrees F and accuracy of at least 1 percent of full scale range.
5. Provide manual reset buttons for limit switches.

**2.14 - VARIABLE FREQUENCY MOTOR CONTROLLER**

A. Provide variable frequency motor controllers in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

**2.15 - BLOWER PACKAGE ASSEMBLY**

A. Provide all blower components as specified herein, pre-piped and mounted on a structural steel frame.
   1. Blower package and sound enclosure to be factory assembled. Assembly to be provided, tested and guaranteed by the blower manufacturer.
   2. Mount blower for vertical flow top to bottom, side/side flow arrangements are not acceptable.

B. Provide a vibration isolator for each leg of the assembly frame.
   1. Provide rubber type to absorb a minimum of 80 percent of the vibration over the entire operating range.
   2. Designed to bear weight of entire assembly without degradation.

C. Sound Enclosure:
   1. Provide to cover the entire blower package and all accessories specified.
   2. Provide mounted on steel skid, with oil drip pan and fork slots for lifting from the proper side.
   3. Galvanized steel sheet, painted as specified.
   4. No welding on external surfaces.
   5. Provide quick release side panels and hinged roof.
   6. Provide heavy duty steel latches and handles.
   7. Provide forced ventilation by means of a fan driven by blower shaft.
   8. Provide pressure relief valve outlet connected to a separate louvered port.
   9. Provide louvers of extruded and anodized aluminum.

**2.16 - MOTORS**

A. Provide in accordance with SECTION 16220, MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of blowers under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Blower and Compressor Schedule.

D. Provide NEMA motors. IEC motors are not acceptable.

E. In addition to the requirements for bearings specified under Electric Motors in SECTION 16220, MOTORS provide blower motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 50,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Service Factor: 1.15, with 1.0 inverter duty rating for blowers equipped with variable frequency motor controllers.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

L. Site Altitude: Less than 3,300 feet above sea level.

M. Provide Inpro/Seal bearing isolators for all blowers controlled by variable frequency motor controllers.

**2.17 – SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.18 – SHOP TESTING**

A. Provide motor shop testing in accordance with SECTION 01171, MOTORS.

B. Blower Tests:

1. Test blowers under a hydrostatic head of at least 20 psi.

2. Provide certified performance tests as specified herein for all blowers.

3. Certified performance testing.

a. Provide performance testing of the entire package assembly in the blower manufacturers facility

b. Run the blower assembly including acoustical enclosure at full speed rating point for 60 minutes prior to start of any testing.

c. Full speed and variable speed tests:

(1) Test blowers at the conditions specified and indicated and take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(2) Provide performance testing in accordance with ISO 1217 and noise testing in accordance with ISO 2151.

d. If blowers do not meet the tolerances specified, modify the equipment and retest until the specified results are obtained.

4. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

5. In the event that specified tests indicate that blower, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all blowers, motors, and variable frequency drives at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with shop drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

B. Install blower package assembly on a concrete pad and align thereon.

**3.02 - PAINTING**

A. After installation and testing with no exceptions by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each blower:

a. One complete set of gaskets and O-rings.

b. Two filters.

2. For each set of blowers of the same size and performance.

a. One set of all special tools required.

**3.08 - FIELD TESTING**

A. Test piping connections to prove the blower nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with blower nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without a procedure with no exceptions noted, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 1 for checklist.

C. After installation of blower assemblies, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each blower in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record capacity, differential pressure, blower bearing housings and motor bearing temperature, noise and vibration and motor inputs.

a. Provide vibration signature test data for each blower and drive assembly.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Run each blower for minimum one hour prior to taking temperature readings of the blowers and motors.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

    a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all blower systems even in those cases where permanent flow meters are installed.

    b. All calibrations must be within 30 days of the field testing.

    c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 11398**

**DIESEL ENGINE-GENERATOR SET AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Diesel Engine-Generator Set and Appurtenances as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Furnish, place in operation, and test standby diesel engine driven generator set, EPA Compliant, complete with enclosure, instrumentation and controls, and required supporting systems as specified herein.

D. The unit shall be provided in an outdoor, weather-proof, walk-in, sound attenuated enclosure with an integral sub-base fuel storage tank with a capacity for 72 hours of standby operation.

E. The unit shall have a minimum power rating as indicated on Contract drawings, standby at 80 percent lagging power factor with three-phase, 60-Hertz, 480 volt, four-wire, alternating current generator.

F. The unit shall be arranged for automatic starting and stopping, and load transfer upon failure of the normal source of power through switchboard automatic throw-over system provided under SECTION 16366, LOW-VOLTAGE SWITCHGEAR.

G. The engine generator set shall exhibit less than 20% voltage dip and less than 5% frequency dip during starting of the loads identified in Attachment A to this Section.

H. The engine-generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational standby power supply system.

I. Provide galvanized steel platform and steps, with railing system at both sides of the engine generator set to allow access for operation and maintenance. Platform and stair assembly to permit access to all sides of the generator unit.

J. The generator unit shall comply with the State of Massachusetts, local and federal codes and regulations for standby diesel generators.

K. The Work of this section shall include the Physical Checkout, Inspection and Certification as specified in SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to, the following.

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
2. Outline equipment drawings and elevation drawings with shipping splits with estimated weights defined.
3. Bill of Materials including manufacturer name, model number, and quantities.
4. Equipment catalog cuts clearly annotated to show which products and options are being supplied.
5. Wiring diagrams showing internal and external wiring. Wiring diagrams shall clearly indicate all required field wiring and terminations.
6. Enclosure layout drawings showing locations of internal and external mounted devices including light fixtures, receptacles, panelboards, heaters, batteries and battery chargers and fire alarm system components.
7. Submit catalog cut sheets for devices including light fixtures, receptacles, panelboards, batteries, battery chargers, and fire alarm system components.
8. Engine-generator skid base drawings.
9. Performance specifications of all items of equipment.
10. Engine generator loading calculation, per the requirements of Attachment A to this section.
11. Provide certificate of conformance to UL Standard 2200, Stationary Engine Generator Assemblies.
12. Attenuation curve for the silencing equipment as offered to accomplish the required silencing for this installation.
13. EPA Tier compliance certificate.
14. Data to be provided by engine generator system supplier:
    a. Submit generator loading calculations and data for engine, generator, and accessories: (for rated kW capacity).
        (1) Engine Data
            (a) Manufacturer
            (b) Model
            (c) Number and arrangement of cylinders
            (d) RPM
            (e) Bore X stroke
            (f) Maximum power at rated RPM
            (g) BMEP at rated kW (including any parasitic loads and generator efficiency)
            (h) Piston speed, feet per minute
            (i) Make and model of governor
            (j) Make and model of overspeed shutdown device

(2) Generator Data

(a) Manufacturer

(b) Model

(c) Rated kVA

(d) Rated kW

(e) Voltage

(f) Temperature rise above 40 degrees C ambient. Stator by thermometer and field by resistance in degrees C.

(g) Class of insulation

(h) Generator efficiency including excitation losses at 80 percent PF

1) Full load

2) Three quarters load

3) Half load

(i) Generator subtransient reactance in ohms

(3) Guaranteed maximum fuel consumption rate at generator terminals @ 138,000 BTU/gallon of ultra-low sulfur diesel fuel:

(a) Full load, gal/hr

(b) Three-quarters load, gal/hr

(c) Half load, gal/hr

(4) Generator unit and accessories

(a) Weight of unit

(5) Exhaust gas emissions data, maximum values at full load, 3/4 load, 1/2 load, and 1/4 load:

(a) Temperature in degrees F

(b) Flow in ACFM (mass and volume)

(c) Combustion air volume in CFM

(d) Cold cranking amperes rating of engine starting batteries (CCA).

15. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.

16. Information on the proposed jacket water treatment and procedures for flushing of the cooling systems.

17. Engine-generator skid base drawings, indicating size and location of anchor bolts, and conduit locations.

18. Operations and Maintenance Manuals.

19. As-built drawings and material summary shall be shipped with the equipment.

20. Control panel layout drawings, dimensions, and component bill of materials. Outline drawings showing conduit entry areas and anchoring information. Description of control including operation of interface equipment.

21. Electrical, instrumentation, control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls and electrical components.

22. Time versus current characteristic curves for generator main circuit breaker.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings

**1.07 - QUALITY ASSURANCE**

A. The engine-generator set shall be factory designed, certified prototype tested, and as specified. The manufacturer shall be regularly engaged in the production of this type of equipment and shall maintain a permanent service organization and supply of spare parts, of the types utilized for the equipment specified herein.

**1.08 - REFERENCES**

A. American Gear Manufacturers Association (AGMA)

B. American Institute of Steel Construction (AISC)

C. American Iron and Steel Institute (AISI)

D. American Society of Mechanical Engineers (ASME)

E. American National Standards Institute (ANSI)

F. American Society for Testing Materials (ASTM)

G. American Welding Society (AWS)

H. American Bearing Manufacturers Association (ABMA)

I. Institute of Electrical and Electronic Engineers (IEEE)

J. National Electrical Code (NEC)

K. National Electrical Manufacturers Association (NEMA)

L. Occupational Safety and Health Administration (OSHA)

M. Steel Structures Painting Council (SSPC)

N. Underwriters Laboratories, Inc. (UL)

O. National Fire Protection Association (NFPA)

P. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SEISMIC REQUIREMENTS**

A. Generator unit shall conform to the seismic requirements as indicated and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**1.10 - UNIT PERFORMANCE**

A. The units shall be utilized to provide standby power service in the event the normal source is not available.

B. The voltage regulation shall be within plus or minus one percent from zero load to full-rated load. Upon application or removal of full-rated load in one step, the transient voltage dip and recovery to steady state operation shall be within five seconds.

C. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 0.25 percent (0.15 Hertz) and voltage variation plus or minus one percent of their mean value for constant load from zero load to full rated load. A rheostat shall provide plus or minus five percent voltage adjustment from rated voltage.

**1.11 - ACCEPTABLE MANUFACTURERS**

A. Kohler

B. THE OWNER HAS STANDARDIZED ON DIESEL ENGINE-GENERATOR SETS AS MANUFACTURED BY KOHLER. THEREFORE, THIS IS A PROPRIETARY SPECIFICATION; NO OTHER MANUFACTURERS ARE ACCEPTABLE.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Engine-generator set shall be a factory-assembled unit that is a standard production unit with existing torsional analysis data. Mixing and matching engine and generator by a third party supplier is not acceptable.

B. The engine and generator shall be directly connected with a flexible coupling, shall be free from injurious torsional or other vibration and shall be mounted on a heavy steel sub-base.

C. The engine and generator shall be directly connected and shall operate at the same rotative speed. The use of gearing or other speed adjustment between the engine and the generator, such that the engine and generator operate at different rotative speeds will not be allowed.

D. The engine-generator set shall allow easy access to the various parts for maintenance purposes.

E. The engine-generator set shall be pre-piped and pre-wired.

F. The complete engine-generator unit shall be free from harmful torsional or other vibration throughout the entire operating range of speed and load. The engine manufacturer shall provide an analysis of the complete engine-generator unit, which shall show where any critical speed will be encountered, together with the order, the frequency and magnitude of any critical speed.

**2.02 - ENGINE**

A. The diesel engine shall be of V-type construction, four-stroke cycle, turbo-charged, full compression ignition, diesel, with mechanical fuel injection. The unit shall operate at a speed of not more than 1800 rpm.

B. The rating of the engine shall not exceed the manufacturer's published standby rating. The gross engine horsepower required to produce the standby rating shall not exceed the manufacturer's published continuous duty rating by more than 150 percent. Continuous duty rating shall be as defined in BS649 or DIN6270 but in no case shall it exceed the manufacturer's published continuous duty rating. The gross engine horsepower required for the generator set standby rating described above shall include all parasitic demands such as generator inefficiencies, fuel pumps, water pumps, and all accessories necessary to the unit's proper operation while operating at rated loads.

C. The engine shall be capable of satisfactory operation on ultra-low sulfur diesel fuel.

**2.03 - ENGINE GENERATOR ENCLOSURE**

A. Provide complete factory pre-wired, weatherproof, sound attenuated, walk-in enclosure.

B. Provide fixed means as necessary for personnel and equipment access to generator doors including stairs, platforms or catwalks. Stairs, platforms or catwalks shall be provided in accordance with SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS

C. Building capable of withstanding wind equal to 125 mph.

D. Roof load equal to 50 psf.

E. The sound attenuation shall be provided with noise reduction level of 65 dBA.

F. The inlet and exhaust air handling system shall provide the necessary level of sound attenuation.

G. Provide enclosure with high efficiency, LED type, industrial, enclosed with acrylic lens, fiberglass housing and UL listed light fixtures. Light fixtures shall provide minimum of 30 fc lighting level. Provide light switches at each door.

H. Provide enclosure with fire detection and alarm system including heat detectors, pull stations, alarm horn/strobe and control panel. The fire alarm control panel shall be connected to the plant over all fire alarm system. Coordinate remote indication of fire alarm system status and alarm conditions to the main fire alarm control panel FACP.10-1 supplied under SECTION 16721, FIRE ALARM SYSTEM.

I. The enclosure shall be provided with electrical space heater(s), designed to hold a minimum space temperature of 50 degrees F, with outside temperature of -1 degree F. Building shall be pre-painted aluminum stressed-skin construction, door and door frame, lifting rings, mounting frame, insulation, electrical package, louvers, muffler mounting bracket, and other appurtenances to provide complete unit.

1. Roof:

    a. One piece welded seam roof sheet, thick aluminum alloy, with extruded aluminum recessed side and end rails, pitched for water.

2. Walls:

    a. Posts to be extruded aluminum sections, sized and spaced as required to carry loads.

    b. Aluminum sheet panels, mill-prepainted, inside and outside, and riveted to posts.

3. Panels and Access Doors:

    a. Provide welded aluminum panel frames of extruded aluminum alloy, riveted to side panels.

    b. Provide access doors with extruded aluminum frame, prepainted aluminum panels inside and out, gasketed to form weathertight seal with Type 304 stainless steel locks. Keys to comply with Owner's keying standards.

    c. Provide aluminum stairs, railings and platforms for enclosure access as required. Stairs, railings and platforms shall be provided in accordance with SECTION 05511, PRE-ENGINEERED ALUMINUM STAIRS

4. Mounting Frame:

    a. Provide steel perimeter mounting frame for mounting onto concrete pad.

5. Insulation:

    a. Provide semi-rigid fiberglass (thermoacoustic) or foam insulation mechanically attached to the skin of enclosure. Provide smooth lining over insulation to prevent damage.

6. Floor:

    a. The floor structure shall be rated for a minimum distributed load of 200 lbs./ft2 and reinforced as required to support prevailing point-loading. The floor and underframe assembly shall consist of rectangular steel tubing or structural I-beams welded to form the outer perimeter. This perimeter shall be combined with formed or structural steel cross members (nominal 16-inch centers) to create a welded steel support structure for the installed power generation equipment. Steel channels shall be incorporated into the floor structure for adequate structural support and attachment of the generator set and vibration isolators.

    b. The door(s) shall include heavy-duty continuous aluminum gear hinges and a passage latch, which includes commercial key-sets. The passage latch shall incorporate a handicapped-access style

lever-type operator for ease of egress in the event of emergency. The latch hardware shall allow escape from within when locked externally.

7. Electrical Package:
    a. All equipment and devices shall be U.L. listed.
    b. One incoming power feed to the enclosure shall be 208VAC, 30 amp, 3 phase, 60 Hz, to provide power to generator enclosure.
    c. The enclosure manufacturer shall provide the necessary panelboard(s) and step down transformer(s), sized to handle the required loads.
    d. Provide enclosure electrical package complete and factory pre-wired. The enclosure package shall include lighting, receptacles, heating and ventilation equipment.
    e. Provide ground studs for earth grounding.
8. Louvers and Dampers:
    a. Provide acoustical louvers and dampers for engine generator inlet, exhaust and ventilation air.
    b. Fixed louvers, all aluminum construction, riveted into aluminized steel frame to form rigid, water resistant assembly.
    c. Dampers shall be powered closed, spring open, fail safe type.
    d. Dampers with 24V damper operator.
    e. Properly size louvers and dampers to allow sufficient engine combustion air, radiator cooling air, and ventilation air with maximum 0.5 in. water restriction.

J. Enclosure shall be pre-painted steel construction, with removable panels to allow for maintenance with muffler mounting bracket, and other appurtenances to provide a complete unit.

1. Muffler and Mounting Bracket:
    a. Critical grade silencer with bracket.
    b. Provide exhaust pipe with birdscreen and rain cap.
    c. All interior engine exhaust piping to be insulated.
2. Fuel Piping:
    a. Provided integral with base fuel tank.

**2.04 - EQUIPMENT**

A. Governor:

1. Provide isochronous solid state governor, capable of maintaining isochronous regulation from no load to full rated load within 0.25 percent of rated frequency.
2. The governor controller shall be mounted within the generator control panel. The governor shall have the capability for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5 percent from no load to full load. The controller shall eliminate all electromagnetic interference.
3. Provide a separate overspeed shutdown device which shall, in case of predetermined overspeed of the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

**2.05 - GENERATOR AND EXCITATION SYSTEM**

A. The generator shall be drip-proof, guarded, and be able to connect to the specified engine output and shall be 3-phase, 60-Hertz, 4-wire, 480 volt operation, "WYE" connected. The generator shall be mechanically and torsionally matched to the engine driver and shall be provided to withstand inherent pulsating torques of the engine. Full load efficiency of the combined generator, exciter and regulator shall be not less than 95 percent.

B. The generator shall conform to the applicable parts of the following standards, unless otherwise specified:

1. NEMA MG1, Motors and Generators
2. IEEE 43, Recommended Practice for Insulation Testing of Large AC Rotating Machinery
3. CSA C22.2-100 Designation ABL3
4. Testing shall be in accordance with IEEE-115 and NEMA MG-1 standards

C. The generator windings, insulation and excitation system shall be braced to withstand any possible short-circuit stresses.

D. The temperature rise of the generator windings, when operated at rated prime power load and under continuous duty conditions with cooling air inlet temperature of 40 degrees C, shall not exceed 130 degrees C when measured by the resistance method.

E. The stator frame shall be fabricated bar and plate steel construction.

1. All insulation materials used in the stator shall have a temperature rating of Class H per IEEE Standard 1. The coils shall be of a formed coil construction using a magnet wire meeting NEMA MW36-C specifications.
2. The complete stator shall be wound with a 2/3 stator winding pitch and processed in a vacuum pressure impregnation chamber. Encapsulation of the stator shall be accomplished with a two-part epoxy system.

F. The rotor shall be of the fully laminated, salient pole type. Cooling fans shall be an integral part of the rotor assembly. The rotor shall be dynamically balanced for all speeds up to 125 percent of rated speed per NEMA specification.

1. Insulation materials used on the rotor shall have a temperature rating of Class H. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C specifications.
2. The complete winding and rotor pole assembly shall be in a vacuum pressure impregnation chamber. Encapsulation of the assembly shall be accomplished with a thixotropic, single component epoxy resin.

G. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, and shall be matched with the generator rotor and control system. Both the armature and field windings shall be a vacuum pressure impregnated with epoxy resin.

H. The pilot exciter shall be permanent magnet generator type. The stator winding shall be vacuum pressure impregnated with epoxy resin. The permanent magnet generator shall have the ability to provide a nominal 300 percent of the 130 degrees C rise rated three-phase short circuit for ten seconds at the alternator terminals.

I. The digital voltage regulator shall be hermetically sealed, silicon controlled rectifier type and shall employ a zener reference and three phase sensing. The voltage regulator shall provide automatic protection of the entire unit on 3 phase short-circuits. The voltage regulator shall include automatic over-excitation and under-frequency protection. Input isolation transformers and filters shall be provided. Exciter shall be fast response type with a rotating rectifier and surge suppresser, 3-phase, full-wave bridge.

J. The voltage regulator and associated equipment shall be mounted in the generator terminal box. Manual voltage adjustment potentiometer shall be mounted in the Generator Control Panel.

K. Generator stator leads shall be connected to tinned copper bus bars in an oversize terminal box. The box shall allow bottom entry of cables and conduits shown on the contract drawings.

**2.06 - SYSTEMS**

A. Fuel Storage System:

1. Provide base fuel storage tank, integral to the mounting of the engine generator unit.
2. The fuel tank shall be UL listed as “primary containment aboveground tank for flammable and combustible liquids”.
3. Provide necessary supply and return lines; drainage and supply valve control.
4. Tapped openings in tank shall be bushed to desired size with double-tapped cast-iron tank bushing.
5. Tank vent shall be standard weight, black steel pipe with screwed malleable-iron fittings.
6. Provide double-walled tank, with level indication and auxiliary pre-wired leak detection alarm contacts.

B. Engine Fuel System:

1. Diesel fuel system shall consist of an engine-driven fuel supply pump, fuel filters, and a base tank and lift pump set.

C. Electric (Battery) Starting System:

1. Starting shall be accomplished by a 24-volt, engine mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and sounding the overcrank alarm.
2. The starting batteries shall be low maintenance, premium industrial grade, high-output, long-life, lead acid type especially designed for diesel engine cranking service, and of a capacity as recommended by the battery manufacturer for cranking the engine being furnished. The engine starting batteries shall be sized to also supply power to the generator control panel.
3. Furnish an engine starting battery charger for charging the starting batteries for the engine. The battery charger shall be U.L. listed, fully automatic, filtered, equalize and float-type, appropriate for wall or rack mounting. Supply voltage shall be 120 volts, AC, single phase, 60 Hz obtained from the generator electrical package. The DC output shall be not less than 20 amperes, regulated to within one percent with plus or minus ten percent fluctuations of the input voltage, and shall be current limited at 120 percent of rated output. Accessories shall include DC ammeter and voltmeter (panel type; 2 percent accuracy), adjustable float and equalize controls toggle switch, AC and DC circuit breakers, AC power failure alarm relay, low DC voltage alarm relay and DC ground fault relay. Fault relays shall operate individual alarm indicators on the face of the charger panel and shall also operate a common alarm relay for remote transmission of alarm. Charger shall have a continuous power rating sufficient to power all generator control devices in both the standby mode and the running mode.

D. Lubrication System:

1. The engine shall be provided with a full pressure lubricating oil system arranged to lubricate and cool the pistons and distribute oil to all moving parts of the engine including the turbocharger bearings. The system shall include a full flow oil filter of the replaceable element type, an appropriately sized shell and tube type oil cooler, and an automatic temperature regulator.
2. Furnish a low oil level float switch to alarm to the generator control panel.

E. Engine Cooling System Radiator:

1. General: Provide a unit mounted radiator complete with integral jacket water circulating pump, thermostatic central of cooling system, fan and drive motor sized to maintain full load operation continuously as specified herein for engine-generator set.

2. Provide radiator to operate engine at full rated generator load at 104 F ambient temperature.

3. Provide jacket water treatment for the prevention of both scale formation and corrosion in the engine water jackets and cooling system components which are in contact with the engine jacket water. This treatment shall be added to the cooling system prior to running the field acceptance test

F. Miscellaneous Equipment and Requirements:

1. Heaters:

a. Automatic thermostatically controlled heater(s), shall be provided to maintain not less than 90º F temperature for the engine jacket water system.

b. Heater(s) shall be rated 208V, three phase.

c. Heater shall be automatically deactivated when the engine-generator unit is in operation.

2. Emergency Stop Pushbuttons:

a. Furnish Qty.(3) emergency stop pushbuttons as follows:

(1) One on the engine control panel.

(2) A second “push to stop” button at the WWTF electrical room for remote operation.

(3) A third mounted on the external side of the outdoor generator enclosure located within a NEMA 4X enclosure, provided with a viewing window.

b. The emergency stop buttons shall be maintained type, red colored, push to stop, mushroom type with a hinged plastic Lexan cover, labeled as "Emergency Stop," "Push."

c. Each pushbutton shall be wired to the engine-generator instrument/control panel and shall immediately stop the engine.

3. Annunciator:

a. Provide remote alarm module for mounting in the electrical room. Provide required cable to connect annunciator to engine control panel.

(1) LED style lamps, amber light for “pre-alarm”, red lights for equipment faults.

(2) Provide lamp test and acknowledge silence switches.

(3) Horn output shall be 80 dBA nominal.

b. Supply Communication Cable required between the generator control panel and the annunciator.

4. Control Power Fuses:

a. Fuses shall be mounted in locations where they are accessible. Pullout type fuses shall be provided.

5. Main Circuit Breaker

   a. Provide generator with a molded case circuit breaker to protect generator against overload and short circuit conditions. Circuit breaker shall be rated for 65 kA short circuit symmetrical and shall conform to the provisions of NEMA Standard AB1 and UL Standard 489.

   b. Provide circuit breaker with microprocessor-based rms sensing adjustable trip unit, rating plug, long-time, short-time and instantaneous protective relaying and ground fault protection.

   c. Provide generator main circuit breaker with arc reduction maintenance switch (ARMS). Provide discrete contact for remote indication of ARMS maintenance mode active to the WWTF PLC.

6. Terminal Blocks:

   a. Terminal blocks shall be one-piece, 20 AMP rated, with barriers appropriate for ring tongue terminals and provided with binding head screws. The terminal block rating shall be 600 V.

7. Solid State Circuitry:

   a. Heavy-duty solid state controls, relays, timers or monitors shall meet the following specifications:

| | |
|---|---|
| Accuracy: | + 2% of set point |
| Temp Range: | - 40 C to +65 C (-40 F to 150 F) |
| Protection: | Transient overvoltage withstand of 1500 volts peak, 1 m sec. time constant |
| Ratings: | Current ratings to exceed application of devices. Devices shall be UL listed. |

**2.07 - SYSTEM OPERATING SEQUENCE**

A. The engine generator unit shall be operated in the following manner:

   1. The engine generator unit shall be arranged for automatic or manual starting and stopping.

   2. The engine generator shall be brought up to rated voltage and frequency and closed onto facility main Switchboard through open transition automatic throw-over system.

B. Normal – system utility powered:

   1. During normal system operation, the normal (utility) Switchboard shall power the electrical distribution system with loads as indicated.

C. Loss of utility power - standby operation:

   1. Upon loss of utility power, Switchboard automatic throw-over system shall sense loss of power and after an adjustable time delay the automatic transfer system shall initiate generator start.

   2. When the generator is up to speed and capable of accepting load, Switchboard loads will transfer to generator power.

   3. Upon return of utility power, Switchboard automatic throw-over system shall initiate transfer back to the utility after an adjustable time delay.

   4. After an adjustable cool-down period, the engine-generator shall shutdown.

**2.08 - ENGINE CONTROL PANEL**

A. The engine starting control logic shall be microprocessor based and shall automatically start, protect and monitor the engine-generator set. Electro-Mechanical controls are unacceptable.

B. The following gauges shall be mounted within an engine mounted control panel. Gauges shall be digital:

1. Jacket water temperature cooler temperature into heat exchanger
2. Lube oil temperature
3. Lube oil pressure
4. Lube oil filter differential pressure.

C. An engine coolant level switch shall be furnished. Level switch shall shut down generator on low level.

D. The engine starting control logic shall be capable of controlling the following engine devices.

1. Starting motor magnetic switch.
2. Electrically operated fuel control.
3. Normally open protective switches that close for abnormal conditions of pressure, temperature, speed and liquid level.

E. The panel shall have the following controls:

1. Emergency stop
2. Lamp test
3. Cycle crank
4. Voltage control
5. Cool-down timer
6. Phase selector switch
7. Programmable relays 4 (std)
8. Stop/Auto/Test.

F. The panel shall be provided with the following indicating lights:

1. Low oil pressure
2. High coolant temperature
3. Over speed
4. Over crank
5. Emergency stop
6. Fault shutdown
7. 3 spare lights, programmable input.
8. Not in Auto

G. Protection shall include:

1. Over and under voltage
2. Over and under frequency
3. Low coolant level
4. Oil temperature.

H. Provide contacts to alarm the following functions:

1. Low oil pressure
2. Sub-base oil tank rupture
3. Low fuel
4. Fuel tank leak
5. Battery malfunction
6. Low battery voltage
7. Common fault alarm
8. Not in automatic
9. In exerciser mode
10. E-stop activated
11. Generator run status
12. Low coolant level

I. Provide analog (4-20mA) output from fuel tank control panel for fuel level.

J. Engine Start/Stop Operation: The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a contact at the facility main Switchboard automatic transfer system. The contact(s) shall close for engine run and open for engine stop.

K. If the engine fails to start after 4 adjustable cranking attempts (factory set at 10 seconds on, 10 seconds off, adjustable from 5 to 30 seconds) or if any protective device should operate while the engine is running, the engine shall be disconnected from service and immediately stopped. The engine control logic shall lock the failed set out of service and requires a manual reset. The engine control logic shall include a provision for conversion to single cycle cranking, adjustable from 35 to 210 seconds.

L. Three-position engine control switch:

1. **Stop/Reset:** In this position, the engine shall not be capable of starting and/or running. If the engine was shutdown due to the operation of a protective device, the shutdown malfunction shall be reset when the switch is moved to this position. If the engine is running when the switch is moved to this position, it shall be immediately shutdown.
2. **Automatic:** In this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.
3. **Test:** When placed in this position, the engine shall start and run as if a start signal were received except it shall not be connected to the bus unless a start signal is received. When returned to the automatic position, the engine will shut down.

**2.09 - SHOP PAINTING**

A. The engine-generator set shall be shop primed and finished coated in accordance with the manufacturer's standard practice prior to shipment. A supply of touch-up paint shall be supplied by the manufacturer.

**2.10 - SHOP TESTING**

A. The complete engine-generator set shall be shop tested to simulate a complete and integrated system prior to shipment.

B. The procedure for the shop test of the diesel engine shall cover the engine manufacturer’s standard practice.

**2.11 - SPARE PARTS**

A. Provide a recommended list of spare parts.

## PART 3 – EXECUTION

### 3.01 - INSTALLATION AND START UP

A. The generator unit shall be mounted on a concrete pad.

### 3.02 - FIELD TEST

A. Upon completion of the installation and as soon as conditions permit, the diesel engine driven generator, including the engine, generator, electrical circuit controls, transfer controls other devices shall be tested to assure that the system functions as specified.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

See Attachment A

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**ATTACHMENT A**

| Loads to be powered up by the engine-generator for engine generator load calculation.<br>The Generator shall be capable of picking up the loads in order shown. | | | |
|---|---|---|---|
| **Switchboard<br>SWBD.10-1** | | | |
| **Equipment** | **Total Quantity** | **Quantity Operating** | **HP/AMPS/kVA/kW** |
| **STEP 1** | | | |
| 10-EF-1 | 1 | 1 | 3 HP** |
| 10-EF-2 | 1 | 0 | 5 HP** |
| 10-EF-5 | 1 | 1 | .5 HP** |
| 10-EF-7 | 1 | 1 | .75 HP** |
| 10-EF-10 | 1 | 1 | .5 HP** |
| 10-EF-11 | 1 | 1 | 0.75 HP** |
| 10-SF-1 | 1 | 1 | 3 HP** |
| 10-SF-2 | 1 | 1 | 5 HP** |
| 10-SF-3A/3B | 2 | 1 | 1.5 HP* |
| 10-SF-4 | 1 | 1 | 0.75 HP* |
| 10-SF-5 | 1 | 1 | 0.5 HP* |
| 10-SF-7/10-SF-8 | 2 | 1 | 1 HP** |
| 10-CP-1/2 | 2 | 1 | 3 HP** |
| 10-BP-1/2 | 2 | 1 | 3 HP** |
| T.10-1/LP.10-1 | 1 | 1 | 21 KVA |
| 10-AC-1/10-ACCU-1 | 1 | 1 | 1.5 HP |
| 10-DH-1/2 | 2 | 2 | 5 HP |
| 10-EUH-1 | 1 | 0 | 10 KW |
| 10-COND-1/2 | 2 | 1 | 5 KW |
| MOTORIZED ACCESS GATE | 1 | 1 | 1 HP |
| T.10-2/LP.10-2 | 1 | 1 | 21 KVA |
| MOV-1020/1025A/1025B (SBR 1) | 1 | 1 | 0.5 HP |
| MOV-1025C/1026 (SBR 1) | 1 | 1 | 0.5 HP |
| MOV-1027/1028 (SBR 1) | 1 | 1 | 0.5 HP |
| T.10-3/LP.10-3 | 1 | 1 | 21 KVA |
| MOV-1030/1035A/1035B (SBR 2) | 1 | 1 | 0.5 HP |
| MOV-1037/1038 (SBR 2) | 1 | 1 | 0.5 HP |

| Loads to be powered up by the engine-generator for engine generator load calculation.<br>The Generator shall be capable of picking up the loads in order shown. | | | |
|---|---|---|---|
| **Switchboard<br>SWBD.10-1** | | | |
| **Equipment** | **Total Quantity** | **Quantity Operating** | **HP/AMPS/kVA/kW** |
| MOV-1035C/1036 (SBR 2) | 1 | 1 | 0.5 HP |
| T.10-4/LP.10-4 | 1 | 1 | 24 KVA |
| HST-1 | 1 | 0 | 2.5 HP |
| 10-OHD-1 (Truck Bay) | 1 | 1 | 0.5 HP |
| 10-OHD-2 (Truck Bay) | 1 | 0 | 0.5 HP |
| MOV-1050 (DF 1) | 1 | 1 | 1 HP |
| MOV-1060 (DF 2) | 1 | 0 | 1 HP |
| OHD-102B (Garage) | 1 | 0 | 0.5 HP |
| T.10-5/LP.10-5 | 1 | 1 | 24 KVA |
| 10-SP-1/1A/2/2A | 4 | 2 | 0.5 HP |
| T.20-1/LP.20-1 | 1 | 1 | 21 KVA |
| 20-EF-1 | 1 | 1 | 1.5 HP |
| 20-SF-1 | 1 | 1 | 1 HP |
| 20-OHD-1/2/3/4/5 | 5 | 1 | 0.5 HP |
| **STEP 2** | | | |
| SBR.TP-1/2/3 | 3 | 3 | 25 HP** |
| SBR.MIX-1/2 | 2 | 2 | 10 HP* |
| EFF.P-1/2/3 | 3 | 2 | 30 HP** |
| SL.P-1/2 | 2 | 1 | 10 HP** |
| TSL.P-1/2 | 2 | 1 | 20 HP** |
| OC.F-1 | 1 | 1 | 30 HP* |
| W3.P-1/2/3 | 3 | 2 | 30 HP** |
| FROTH SPRAY PUMP | 1 | 1 | 5 HP** |
| EQ.MIX-1/2 | 2 | 2 | 5 HP* |
| DF-1/2, BW P-1/2 | 2 | 2 | 2 HP* |
| SEP-1 | 1 | 1 | 2 HP* |
| RWW.SG-1/2/3/4 | 4 | 3 | 0.5 HP |

Loads to be powered up by the engine-generator for engine generator load calculation.

The Generator shall be capable of picking up the loads in order shown.

**Switchboard**

**SWBD.10-1**

| Equipment | Total Quantity | Quantity Operating | HP/AMPS/kVA/kW |
|---|---|---|---|
| RWW.SCR-1-CP | 1 | 1 | 2 HP |
| UV-1/2 | 2 | 1 | 13.5 KW |
| **STEP 3** | | | |
| SBR.BLW-1/2/3 | 3 | 3 | 50 HP*** |
| **STEP 4** | | | |
| MIX.BLW-1/2 | 2 | 2 | 50 HP*** |
| MIX.BLW-3 | 1 | 1 | 30 HP** |
| MIX.BLW-4 | 1 | 1 | 40 HP** |

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor.

*** Motor is provided with 18-pulse variable frequency drive.

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**SECTION 11399**

**EFFLUENT DISK FILTERS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for tertiary Effluent Disk Filters Work and, where appropriate, applying or installing such materials for the various items of tertiary Effluent Disk Filters Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. All equipment shall be from a single source supplier.

C. The Owner has pre-selected the manufacturer of the Effluent Disk Filters. Refer to SECTION 99999, ATTACHMENTS for the Proposal received from Aqua Aerobic Systems, Inc. In the event of a discrepancy between the Proposal and this section, this section shall govern.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Effluent Disk Filters. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 - DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

C. Shop Drawings: Submit the following in accordance as specified.

A. Certified shop and working drawings including complete motor characteristics and performance data for all equipment.

a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

b. Electronic files shall conform to the following minimum requirements:

(1) Files shall be AutoCad 2013 or Higher.

(2) Files shall be submitted as part of the Shop Drawing submittal.

(3) Submit Files on CD or DVD.

(4) Drawings shall include plan views, sectional views, piping and instrumentation diagrams, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

(7) Drawings shall be in conformance with all other requirements as specified in this specification.

B. Control Panels

a. Bill of Materials including manufacturer, model number and quantities.

b. Annotated product cut sheets for enclosures and control panel components.

c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.

d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.

e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.

C. Factory work sheets as specified herein identifying each piece of equipment.

D. System piping schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references. Provide elevation views of interior and exterior of all panels.

E. Manufacturer’s literature and specifications. Show catalog dates.

F. Operating and maintenance instructions and parts list.

G. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

H. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

I. List of five (5) operating installations of similar design and following SBR process. Provide current (verified) contact information for each installation.

J. Paint manufacturer’s product data and specifications. Provide data to indicate conformance to shop painting requirements specified including statement of compliance for compatibility.

K. Manufacturer’s literature as needed to supplement certified data.

L. Shop test results.

M. Motor shop test results.

N. Qualifications of field service technician.

O. Schematic control and power wiring diagrams.

P. Shop and Field inspections reports.

Q. Bearing Life: Certified by manufacturer.

R. List of recommended spare parts other than those specified including a list of all parts with unit prices.

S. Recommendations for short and long term storage.

T. List of special tools.

U. Bearing temperature operating range for service conditions specified.

V. Equipment grounding requirements and details.

W. Shop and field testing procedures and equipment to be used.

X. Number of service technician days provided and per diem field service rate.

Y. Manufacturer's product data, specifications, and color charts for shop painting.

Z. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.

AA. The most recent ISO 9000 series certification or Quality Control Plan.

BB. Material Certification

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

D. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

D. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

E. Failure to include all drawings, or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

E. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

D. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

E. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping:

A. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

C. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving:

A. Inspect and inventory items upon delivery to site.

B. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

**1.06 - DESIGN CRITERIA**

A. The Effluent Disk Filter equipment is intended to complement the SBR activated sludge treatment process and provides tertiary filtration of the SBR effluent to meet MassDEP requirements regarding coliform limits and for the protection of the effluent discharge Wick Wells. The Effluent Disk Filter design provides tank capacity with modifications to meet both Phase 1 and Phase 2 design conditions identified herein.

B. Equipment Limitations, per unit:

A. Maximum Total Weight: 9,500 lbs. dry, 40,500 lbs. operating.

B. Maximum Length: 12 ft., inlet to outlet flange.

C. Maximum Width: 10 ft.

D. Maximum Height: 12 ft.

C. The Effluent Disk Filter design by the MANUFACTURER is to include media with a nominal 10 um pore size to provide solids removal for the purposes of providing tertiary filtration prior to UV disinfection. Cloth filter shall be chlorine resistant. If a media with a nominal pore size lower than 10 um is proposed, it should be noted in the PROPOSER’s submittal.

D. The Effluent Disk Filters shall be designed to hydraulically treat the peak flow at the design year with one of the supplied disk filter units (full set of disks not individual disks) out of service.

E. All piping/equipment internal to the Effluent Disk Filter shall be furnished by the MANUFACTURER. All piping external to the filter cells shall be provided by OTHERS. All actuated valves required for the automatic operation of the disk filters (if required) shall be furnished by the MANUFACTURER and shall have motor actuators. All manual isolation valves external to the filter cells shall be provided by OTHERS.

F. Each Effluent Disk Filter should be capable of operating and backwashing independently of the other filter units. The system shall be designed by the PROPOSER so that the disk filters will continue to provide filtration during backwash periods.

G. The Effluent Disk Filters are to be provided with drive motors and variable frequency drives (VFD’s) furnished by the MANUFACTURER.

H. Provide a Effluent Disk Filter backwash cleaning system with backwash pumps. The backwash cleaning system shall include spray headers and/or suction shoes if required, backwash collection trough for removing solids (if required), piping, valves and all ancillary equipment to accomplish disk filter backwash. Provide one (1) backwash pump for each disk filter provided (as required), each sized for 100 percent of the maximum backwash capacity. In the proposal, the PROPOSER shall identify the pump sizing including flow, head, and horsepower required.

I. Proposal Submittal - The following information is to be submitted with the Proposal.

A. Completed Life-Cycle Cost Data Entry Forms.

B. Complete Effluent Disk Filter process design including all calculations for the following:

a. Tank sizing, dimensions and disk arrangement.

b. Backwash system including pump sizing for 100 percent of maximum capacity.

c. Backwash cleaning system.

C. Complete process design submittal with support calculations shall be presented showing effluent quality expected under the following conditions:

a. Design Year Phase 1 and Phase 2 Annual Average Flow/Loading

b. Design Year Phase 1 and Phase 2 Maximum Month Flow/Loading

c. Design Year Phase 1 and Phase 2 Peak Flow/Loading

Refer to paragraph 2.01.B.1 for flow and loading data.

D. Provide any ancillary equipment, controls, etc. required to provide a complete SBR and Effluent Disk Filters system, and to furnish this equipment and controls, not otherwise specifically specified herein.

E. Provide preliminary equipment manufacturer's names covering all process and control equipment items to be supplied as part of the offering. Provide cut sheets of key components along with the model, horsepower, major components, and performance curves.

F. For the following equipment, provide complete design basis including number of units, flow, head or pressure, motor horsepower, equipment sizes, and other information to provide a complete description of the required equipment:

a. Tank sizing, dimensions and disk arrangement.

b. Backwash system including pump sizing for 100 percent of maximum capacity.

c. Backwash cleaning system.

**1.07 - REFERENCES**

A. Hydraulic Institute (HI): Current Standards.

B. American National Standards Institute (ANSI):

A. B16.1: Standard for Cast-Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. American Society for Testing Materials (ASTM):

A. A36: Specification for Structural Steel

D. National Electric Code.

E. American Bearing Manufacturers Association (ABMA):

A. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.

B. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings)

F. American Gear Manufacturers Association (AGMA).

G. National Electrical Manufacturers Association (NEMA).

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - QUALITY ASSURANCE**

A. Provide as specified herein.

B. Equipment shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

C. Welding: In accordance with American Welding Society Code D1.1 or ASME IX. Submit copies of AWS or ASME certificates.

D. Provide shop tests as specified.

E. Equipment manufacturer shall provide filters, panels, and controlsas a complete integrated package.

F. Filter shall be factory tested and ready for operation.

G. Provide Services of Manufacturer's Representative as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

D. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment specified.

E. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not releive the Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections: 1 person-days.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 2 person-days.

c. Field Performance Testing: Field performance test equipment specified. 3 person-days.

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1 person-days.

F. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

G. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of equipment shall have at least ten (10) operating installations with units of the size specified and in the same service as specified operating for not less than ten (10) years. Proposer’s who do not meet the Manufacture’s Experience shall provide with their Technical Proposal a Certified Letter stating that they will provide to the OWNER, with the shop drawing submittal, an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall extend for a period of three years beyond the completion date for the project and shall be retained by the OWNER until the installed equipment has passed the specified performance testing and the equipment has been accepted by the OWNER. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

J. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.09 - SEISMIC REQUIREMENTS**

A. Provide certification and computations related to anchorage of the equipment via an independent Registered Structural Professional Engineer (P.E.) registered in the State of Massachusetts.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements as indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and as indicated.

**PART 2 - PRODUCTS**

**2.01 - EFFLUENT DISK FILTERS**

A. Manufacturer:

A. Aqua Aerobics Systems Inc.

B. The Owner has pre-selected the Aqua Aerobic Systems, Inc as the manufacturer of the Effluent Disk Filters. No Substitutions are allowed.

B. Performance and Design Parameters:

A. Provide filters for filtering decanted effluent from an SBR activated sludge process at the conditions defined below.

| Condition | SBR Effluent TSS, mg/l | Effluent Disk Filter Effluent TSS, mg/l |
|---|---|---|
| Average Conditions (Q = 650 gpm for 75 min) | 30 | 5 |
| Max Day Conditions (Q = 1700 gpm for 75 min) | 50 | 10 |

The Max day condition is defined at 1,700 gpm for a period of 75 mins. This is the peak flow at design year.

B. Each disk filter unit should be capable of operating and backwashing independently of the other filter units. The system shall be designed so that the Effluent Disk Filters will continue to provide filtration during backwash periods.

C. The disk filtration system shall be designed to hydraulically treat the peak flow at the design year with one of the supplied disk filter units (full set of disks not individual disks) out of service. The total backwash discharge volume produced by the disk filter system shall be no more than 2 percent of the treated flow on a daily basis.

The max day (i.e. – peak) condition of 1700 gpm must be met with one unit out of service. Note: Two units shall be supplied (1 duty/1 standby).

D. Each filter shall have a total of 323 square feet of minimum effective submerged filtration area.

E. The disk filter system shall be self-contained in a painted steel vessel.

F. Pipe Connection

a. Inlet: 12-inch

b. Outlet: 14-inch

C. Filter Cloth Assemblies

D. The disk filtration system to be provided shall utilize a surface filtration technology arranged in a vertical disk configuration with a cloth designed to be chlorine resistent.

E. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation.

F. Replacement of filter media must be possible from outside of the disk filter tank.

G. Cloths shall be of woven nylon fiber pile chlorine resistant cloth construction with polyester backing material having a nominal filtration rating of 10 microns. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depths shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss.

H. Each cloth disk assembly shall have a minimum of 54 square feet of effective submerged filtration area. Effluent filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into segments and each section shall be easily removable for service.

I. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk to the inside.

J. Backwash Cleaning System

a. Each backwash/waste pump assembly shall include one (1) backwash/waste pump, header, valves and gauges, and interconnecting piping and controls required for initiation and termination of backwash.

b. Backwash header shall have two (2) flanged connections for connecting to backwash pump suction piping as indicated on the drawings.

D. Solids Removal System

D. A solids removal sump or trough shall be incorporated into the tank. Control and operation of the solids removal system will be by field adjustable timer and also be automated through the filter control system.

E. Drive Mechanism

D. A drive assembly shall be incorporated to rotate the center tube/disk assembly during the backwash cleaning cycles.

E. The adjustable drive assembly shall consist of a gear motor, non-corrosive chain and sprockets.

a. Chain: Nylon with 18-8 stainless steel link pins.

b. Chainguard: Type or stainless steel.

c. Drive Sprockets: Nylon.

d. Centertube Driven Sprocket: U.H.M.W Polyethylene.

F. Reducer design and rating equal or exceed AGMA requirements. Speed reducers shall be selected for not less than AGMA Class II service.

G. Motor HP: ½, 460 V, 3 ph, 60 Hz

F. Tanks and Weirs

D. The disk filter system shall be self-contained in a painted steel vessel (min 10 gauge, finished with interior: near white sandblast (SSPC-SP10) painted with Tnemec N69 polamide epoxy, 2 coats 4-6 mils each for 8-12 DFT. Exterior; SSPC-SP6, painted TnemecN69 Hi-Build Epoxoline, 2 coats 3-4 mils each and 1 coat Tnemec 1075 Endura shield II 2-3 mils for 8-11 mils DFT) or Type 304 Stainless Steel vessel.

E. Tank shall include influent, effluent, and overflow weirs.

F. Provide low point tank drain with ball valve and plug.

G. Center Tube

D. The center tube or drum shall be fabricated of minimum ¼" thick Type 304L stainless steel with all machined surfaces true to the center line. All fastener and machined thread materials shall be 316 stainless steel. All support bearings shall be stainless steel or stainless steel shaft in a low friction plastic bearing. All supports and brackets attached to the tank shall be Type 304 stainless steel.

E. Piping & Manufacturing: All in tank backwash piping: Minimum schedule 80 PVC designed for ease of maintenance. Backwash vacuum head must be easily removable from the backwash manifold.

**2.02 - MOTORS**

A. Provide in accordance as specified herein.

B. Maximum 1,800 rpm.

C. Enclosure: TEFC. Motors shall be capable of being washed down with a hose stream during operation.

D. Insulation: Minimum Class "F" with "Class "B" temperature rise, 40 deg. C ambient unless otherwise indicated or specified.

E. Service Factor: 1.15.

F. Provide capacity to start drive at maximum solids on disks without exceeding nameplate ratings for current and power and without operating in the service factor.

G. L-10 Bearing Life: 100,000 hours.

H. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

I. Rating: 460V, 3 ph, 60 Hz.

**2.03 - BACKWASH PUMPS**

A. Provide a backwash cleaning system with backwash pumps. The backwash cleaning system shall include spray headers and/or suction shoes, backwash collection trough for removing solids, piping, valves and all ancillary equipment to accomplish disk filter backwash. Provide one (1) shelf-spare backwash pump sized for 100 percent of the maximum backwash capacity.

B. Pump operating data including flow, head and horsepower to be defined by the supplier.

C. Type: Horizontal self-priming.

D. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.

E. Provide lifting devices on casings as required for ease of handling.

F. Provide ribs or other suitable reinforcing if required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to adequately support the motor.

G. Design pump bearing frame to support shaft and impeller and to contain stuffing box and bearings.

H. Fit high point of casing with an air vent and low point with a drain.

I. Suction/Discharge Connection: ANSI 150 lb Flanges faced and drilled in accordance with ANSI B16.5.

J. Bearings

A. Grease lubricated anti-friction type or oil lubricated.

B. Bearing shall be in a dust and moisture proof enclosures.

C. Provide means in bearing housing, such as removable plug diametrically opposite grease fitting, to prevent over greasing or bearing.

D. Provide bearings with minimum B-10 life rating of 100,000 hours at specified operating conditions based on latest ABMA and ANSI Standards.

K. Pump Shaft

A. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.

B. Sleeves

a. Extend sleeves through stuffing box.

b. ASTM A743 Grade CA-15 stainless steel.

c. 300-350 BHN.

L. Seals

A. Split mechanical seal

a. Manufacturers: John Crane; Chesterton; or acceptable equivalent product.

b. Materials

(1) Gland: Type 316 stainless steel.

(2) Rotary Holder: Type 316 stainless steel.

(3) Hardware: Type 316 stainless steel.

(4) Springs: Hastelloy C or Elgiloy.

(5) Rotating Faces: 99.5 percent Alumina ceramic.

(6) Stationary Faces: Pure unfilled P8412 carbon.

(7) Elastomers: Viton.

(8) Restriction Bushing: Split type, glass filled teflon.

M. Materials

A. Casing, Front Head, Back Head and Impellers: Cast-iron ASTM A48 Class 30.

B. Shaft: Steel ASTM A332 – C4140

C. Main Frame/Bearing Housing: Cast-Iron ASTM A48 Class 30

D. Internal and Exterior Hardware: Type 316 Stainless Steel.

N. Drain and Vent Piping

A. Provide drains from packing drip reservoirs and baseplate gutters to discharge into gutters, sumps, or floor drains as indicated on the drawings.

B. Install casing vent piping as described for drains.

C. Drain and vent piping shall be Type 316 stainless steel.

O. Drive

A. Direct connected with couplings as specified herein.

B. Motors: Provide as specified herein and in accordance with Specification Section 16220, Electric Motors

P. Couplings

A. All-metal flexible couplings, designed for both angular and parallel misalignment, fully housed, and provided with means of lubrication.

Q. Baseplate

A. ASTM A36 Structural Steel.

B. Build with at least one 4-in. grout hole or equivalent in top, a circumferential gutter with tapped drain connections and provisions for anchor bolts.

C. Design baseplate to have adequate strengths to support pump and drive.

D. Provide planed surfaces of bearings pads for pumps and drives.

R. Provide pressure gauge assemblies as required and specified herein.

**2.04 - VALVES**

A. All actuated valves requried for the automatic operation of the Effluent Disk Filters (if required) shall be furnished by the equipment supplier and shall have motor actuators.

B. Each filter shall include two 2" backwash valve(s) and one 2" solids waste valve) and shall be 3 piece, grooved end ASTM A351 Grade CF8M SS body, 316 SS ball and stem, fullport with a 115 V, single phase open/close service electric actuator. Valve actuator shall include a compartment heater and limit switch feedback. Future expansion of 2 disks will include one additional backwash valve.

C. Each filter shall include a solids waste removal system in filter tank floor designed to remove settled solids for discharge through the backwash/waste pump. The waste removal system shall be automatic with user adjustable intervals and duration through the operator interface.

D. Provide all other valves as indicated on the drawings and as specified.

E. All manual isolation valves external to the filter cells shall be provided by the Contractor.

**2.05 - SPARE PARTS**

A. Provide as specified herein.

B. Provide one set of chains.

C. Provide a list of parts with unit prices.

D. One set of all special tools.

**2.06 - CONTROL SYSTEM**

A. Automatic controls for operation of the Effluent Disk Filters and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide one control panel for each disk filter. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACT LOGIX 5370 L1, L2 or L3 processor.

2. Provide NEMA 4X 316 Stainless Steel enclosure for installation in the Process Area

3. Panel shall be labeled UL 508A.

4. Provide motor starters and Variable Frequency Drives (VFD) internal to the control panel as required. The VFDs shall be heavy duty, industrial type and as manufactured by Allen-Bradley, Danfos or Toshiba.

   The VFDs shall be UL508A Listed solid-state type in a filtered enclosure and blower cooled. The filter element shall be of the removable and replaceable type for each drive unit. Front access shall be provided. Top, rear and side access shall not be required. The enclosure shall be coated with an epoxy resin base and acrylic resin enamel finish.

   The drive shall meet applicable provisions of the National Electric Code and NEMA. The drive shall be arranged for 480 Volts plus 10 percent to minus 5 percent, 3 phase, 57 to 63 Hertz input converted into adjustable frequency/Voltage output in an ambient temperature of -10 to 40 degrees C. The VFD shall be capable of sustaining operation with a line voltage dip of 15 percent of normal operating voltage on a constant or variable torque load. During line dip the VFD shall automatically provide a speed drop allowing maximum capable speed for the duration of the input voltage dip. Each individual drive shall be mounted in a separate enclosure. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads. Each individual drive shall be mounted in a separate enclosure unless otherwise specified. The following features shall be included with each adjustable frequency drive:

   a. Control. The control method shall be sinusoidal Pulse Width Modulation. Output Voltage shall be 3 phase 480 Volts and output frequency shall be 0.1 to 66 Hz when shipped. Frequency shall be selectable by a digital keypad. The frequency resolution shall be 0.1 Hz and the accuracy shall be within 1.0 percent of the maximum frequency at 25° + 10°C. Voltage/frequency (V/f) characteristics shall be characterized by selectable patterns. Up to 82 control functions shall be programmed. The constant torque overload capacity shall be 110 percent continuous and a minimum two-minute rating of 120 percent of the rated current. The variable torque overload capacity shall be 100 percent continuous and 110 percent for two minutes. The frequency setting signal shall be 4 to 20 mA. The VFD shall employ a full wave rectifier to prevent input line notching with a DC bus choke, DC bus capacitors, and Insulated Gate Biplar Transistors (IGBT's) as the output-switching device. SCRs, GTOs and Darlington transistors are not acceptable.

   b. Function. The adjustable parameters consisting of: accelerating time, decelerating time, upper and lower limit of output frequency, and 4 to 20 mA reference bias and reference gain shall be indicated on a digital display. Braking shall be achieved through capacitor charging and starting shall be achieved by external contact. The VFD shall be software configurable to automatically restart following power outage, overcurrent and overvoltage detection. Soft stall shall occur when motor runs continuously at overload.

   c. Protection. The drive shall be protected from stalling, overcurrent, overload, short circuit, overvoltage, undervoltage, loss of one (1) phase of input power, instantaneous power failure (approximately 30 msec), overheating, fuse burnout protection and earth (ground) fault detection. The fault cause shall be displayed (flickering) for overcurrent, short circuit, overload, overvoltage, overheating and earth (ground) fault. There shall be a main capacitor charging indicator for internal circuit. Fault shall be reset by a reset push button on the printed circuit board and an external reset contact.

   d. Displays. The digital display shall be a 2 line, 40 character unit with readout in plain English. A separate LED indicator shall be provided for capacitor charge. Display shall be located on the door of the VFD enclosure.

   e. Internally mounted set point control shall be provided to receive 4 to 20 mAdc signals from process detector to control equipment functions. An external digital display shall be provided outside of the inverter. The following control devices shall be made available for external control of the inverter; frequency meter, frequency setting variable resistor, knob for frequency setting variable resistor and drive switch.

   f. A lockable main molded case circuit breaker disconnect switch interlocked with the enclosure door through the door handle to provide positive disconnect of incoming AC power shall be furnished for each individual drive and enclosure. The circuit breaker shall be rated 42,000 amperes at 480 volts, RMS symmetrical.

   g. Enclosure mounted indicating lamps shall be LED type, heavy duty, with "Push-To-Test" features.

h. Enclosure

- The enclosure shall be designed to prevent unfiltered air from entering within 12 inches from the bottom of the enclosure.
- All openings used for ventilation within 12 inches of the bottom shall have removable replacement filters provided. All openings for cooling air shall be provided on the front of the enclosure.
- Enclosures with auto transformers shall be designed such that the heat is removed from the auto transformer section and not drawn through the electronics and control portion of the enclosure.

i. Each drive shall be provided with the following accessories:

- Local/remote selector switches or keypad switch for local/remote speed control. In the "Remote" mode, the motor speed shall be adjusted in response to the related remote speed control via SCADA or 4-20 mA pacing signal.
- Provide a 4-20 mA speed feedback output signal.
- Provide four (4) Type C dry contacts for remote indication of equipment running status.
- Provide two (2) Type C dry contacts for remote indication of equipment failure. These contacts shall close upon any fault condition in the VFD or as listed below.
- Hand-off-Auto switch controls located on the door of the VFD enclosure. Provide a Type C dry contact for indication of Hand-Off-Auto switch in "Auto" position.
- Accept a remotely generated contact closure to start the VFD when the Hand-Off-Auto switch is in the "Auto" position.
- Accept a remotely generated contact closure to run the VFD at a preset user-configurable speed when the Hand-Off-Auto switch is in the "Auto" position.

5. Elapsed time meters located on the door of the VFD enclosure.
6. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
7. Provide the control panel enclosure with the following:
   a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
   b. Control Buttons and Selector Switches.
   c. Emergency stop (ESTOP) maintained pushbutton.
   d. LED type indicating lights.
8. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
9. Provide control panels with integral surge protection devices (SPD):
   a. 120VAC, 10kAIC rated.
   b. Visual indication of plug status.
   c. UL listed.
10. Provide RAM memory protected by backup battery.
11. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
12. Provide fully documented ladder logic on a CD-ROM.

13. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide Allen-Bradley PanelView Plus 7 product with a 9 x 14 inch Color display and touch screen that is compatible with Ethernet communication net work. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
14. Provide control a monitoring of the system as shown on the contract drawings.
15. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
16. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
17. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
18. The configured HMI display shall be operator friendly and shall include at a minimum an overview page, cycle start-stop page, parameter page, loop display page, sludge pump control loop page, polymer control page, alarm page and manual operation page.
    a. The OIT shall allow the operator to adjust the following parameters.
        1) Backwash interval and duration.
        2) Sludge waste interval and duration.
        3) Number of backwashes between sludge waste.
        4) Time, date, year.
    b. The OIT shall provide, at minimum, the following information:
        1) Filter waste level.
        2) Time since last backwash.
        3) Time since last sludge wasting.
        4) Backwash time.
        5) Sludge wasting time.
        6) Flapsed time or filter drive motor.
        7) Flapsed time on backwash pumps.
        8) Alarm history, including the time and date of the 25 most recent alarms.
        9) Time between backwashes for the most recent 40 backwashes.
19. The disk filter vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
20. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.

F. Level Sensors and Transmitter

A. The pressure-type level transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal. Unit shall monitor the water level of each filter tank.Transmiter shall be flush mounted to the tank wall and be an IFM Effector PX series or approved equial.

B. A float switch shall be furnished in each tank to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equial. The float shall contain a non-mercury switch, chemical resistent polypropylene casing hermetically sealed and a PVC#18 AWG three conductior cable. Switch rating shall be minimm 4.5 amps non-inductive at 120 VAC.

C. Level measurements shall be available for input to the plant control system from the filter panel.

**2.07 - PAINTING**

A. Painted steel vessels shall be min 10 gauge, finished with interior: near white sandblast (SSPC-SP10) painted with Tnemec N69 polamide epoxy, 2 coats 4-6 mils each for 8-12 DFT. Exterior; SSPC-SP6, painted TnemecN69 Hi-Build Epoxoline, 2 coats 3-4 mils each and 1 coat Tnemec 1075 Endura shield II 2-3 mils for 8-11 mils DFT.

B. All equipment, excluding disk filter tank shall be painted as specified below.

C. Primer and Finish Paint: Shop apply to all extrior ferrous surfaces two part epoxy paint in accordance with the following:

A. Solids by Volume: Minimum 57 percent (percent $\pm$2).

B. Type: Polyamide epoxy, self priming.

C. Dry Film Thickness: 4 to 6 mils per coat.

D. No. of Coats Required: Three.

E. V.O.C. Requirement: 3.06 lbs/gallon.

F. Conform to AWWA D102 Inside Systems No. 1 and No. 2.

G. Use thinners that are acceptable to ANSI NSF Std 61.

H. Color: As specified for piping system of same service or as selected by the Engineer.

D. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions for immersion or non-immersion service as required.

E. Ferrous surfaces which are not to be painted shall be given a ship applied coat of grease or rust resistant coating.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with manufacturer's printed instructions, as specified, and indicated.

B. Manufacturer's representative to perform inspection of all equipment and conduct check-out and training as specified herein.

**3.02 - FIELD TESTING**

A. Perform field testing of all equipment functions and alarms.

B. Make all adjustments necessary to place equipment in specified working order at time of above tests.

C. Remove all replaced equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

**3.03 - PROCESS PERFORMANCE GUARANTEE**

A. The Effluent Disk Filters will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur one (1) year from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the MANUFACTURER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

B. The MANUFACTURER shall be responsible for the process performance of the Effluent Disk Filters and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 - WARRANTY**

A. The MANUFACTURER shall be provide an warranty of the Effluent Disk Filters warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract. The Contractor shall be involved with and contractually tied to performance/process testing during this warranty period and shall address any warranty items during these warranty period should the need arise.

C. It is the MANUFACTURER's responsibility to resolve any and all warranty claims. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 - ACCEPTANCE TESTING**

A. The Acceptance Test shall demonstrate performance of the Effluent Disk Filters under design loading conditions. This might be accomplished through simulating higher loading conditions by operating only one SBR (to increase decant volumes) or storage of SBR effluent through manipulation of SBR decant cycles. Testing of elevated solids concentration may require dosing the SBR effluent with a measured amount of WAS from the WAS storage tank. It is the manufacturer's responsibility to develop a test protocol for approval by the Engineer. The test protocol at a minimum should demonstrate compliance with the filters' performance requirements described herein to include but not be limited to the following with one filter on and one filter in standby mode. Testing should be conducted to prove performance on each filter independently:

| Condition | SBR Effluent TSS, mg/l | Effluent Disk Filter Effluent TSS, mg/l |
|---|---|---|
| Average Conditions (Q = 650 gpm for 75 min) | 30 | 5 |
| Max Day Conditions (Q = 1700 gpm for 75 min) | 50 | 10 |

All results shall be based on grab samples taken at 15 min intervals, which will then be composited at the end of the test to represent average performance during the decant cycle. The average of a minimum of 8 decants/tests shall be used to determine compliance for each filter.

B. Operation of the WWTF to include sampling during the Acceptance Test shall be the responsibility of the owner. The system supplier may provide oversight of the test at its discretion.

C. Should the system pass the Acceptance Test, the Performance Bond or irrevocable Letter of Credit will be released following approval of the Engineer. Should the system fail the Acceptance Test, the manufacturer will be given up to two opportunities to make adjustments and retest. Should the system fail all Acceptance Tests (maximum of three (3)), even if before the three (3) year term expires, the Owner reserves the right to call the Performance Bond or irrevocable Letter of Credit. None of the above releases the system supplier to making such modification as necessary to bring the system into compliance with the performance requirements of this specification.

**3.06 - FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contrator shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 11600**

**SEQUENCING BATCH REACTORS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the SBR System along with all other equipment and accessories as indicated and specified herein.

B. The installation of the equipment furnished by the SBR manufacturer shall be the responsibility of the installing contractor in accordance with all requirements of the contract documents.

C. Provide and test sequencing batch reactor (SBR) process treatment equipment and appurtenances as indicated and specified.

D. The Owner has pre-selected the manufacturer of the Sequencing Batch Reactors. Refer to SECTION 99999, ATTACHMENTS for the Proposal received from Aqua Aerobic Systems, Inc. In the event of a discrepancy between the Proposal and this section, this section shall govern.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

**1.03 - DEFINITIONS**

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. List of operating installations in New England.

1. Provide current (verified) contact information for each installation.
2. Identify commonality with the proposed WWTF processes, design flows and loads, seasonality and other relevant information.

C. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

D. Shop Drawings: Submit the following in accordance as specified.

1. Certified shop and working drawings including complete motor characteristics and performance data for all equipment.
    a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.
    b. Electronic files shall conform to the following minimum requirements:
        (1) Files shall be AutoCad 2013 or Higher.

(2) Files shall be submitted as part of the Shop Drawing submittal.

(3) Submit Files on CD or DVD.

(4) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

(7) Drawings shall be in conformance with all other requirements as specified in this specification.

3. Factory work sheets as specified herein identifying each piece of equipment.
4. System piping schematic.
5. Manufacturer's literature and specifications. Show catalog dates.
6. Manufacturer's process design calculations.
7. For Motors:
   a. Descriptive literature and motor characteristics.
   b. Shop drawings and descriptive data to include:
      (1) Outlines, weights, and wiring diagrams.
      (2) Efficiency and power factory at ½, ¾ and full load.
      (3) Bearing life data and grease requirements.
      (4) NEMA standard nameplate data.
      (5) Shop tests.
      (6) Field acceptance tests.
      (7) Operating and maintenance instructions and parts lists.
      (8) Listing of reference installations as specified with contact names and telephone numbers.
      (9) A written statement on the guaranteed oxygen transfer rate and power usage.
      (10) Certified results of hydrostatic testing.
      (11) Certified results of dynamic balancing.
      (12) List of parts without prices.
      (13) Shop and field inspection reports.
      (14) Bearing Life.
      (15) Control Panels:
         (a) Bill of Materials and annotated catalog sheets on devices in the control panel.
         (b) Front elevations, with and without door showing dimensions and locations in internally and externally mounted components.
         (c) Electrical wiring schematics and wiring diagrams clearly indicating all required field wiring and terminations. Submit wiring diagrams using project specific equipment tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.

(d) Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.

(e) Use NEMA device designations and symbols for electric circuit diagrams. Make contents of elementary connection diagrams in accordance with NEMA ICS 1.

(f) System control description.

(16) Operating and maintenance instructions and parts list.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.
9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.
10. Paint manufacturer's product data and specifications. Provide data to indicate conformance to shop painting requirements specified including statement of compliance for compatibility.
11. Manufacturer's literature as needed to supplement certified data.
12. Shop test results.
13. Motor shop test results.
14. Qualifications of field service technician.
15. Schematic control and power wiring diagrams.
16. Shop and Field inspections reports.
17. Bearing Life: Certified by manufacturer.
18. List of recommended spare parts other than those specified. Provide a list of all parts with unit prices.
19. Recommendations for short and long term storage.
20. Special tools.
21. Bearing temperature operating range for service conditions specified.
22. Equipment grounding requirements and details.
23. Shop and field testing procedures and equipment to be used.
24. Number of service technician days provided and per diem field service rate.
25. Manufacturer's product data, specifications, and color charts for shop painting.
26. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
27. The most recent ISO 9001 series certification or Quality Control Plan.
28. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and similar effluent objectives indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of ten (10) installations in operation for a minimum of ten (10) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

E. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. If deviations and clarifications from the drawing are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

F. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

**1.06 - DESIGN CRITERIA**

A. Sequence Batch Reactor equipment and operating data as specified herein.

B. The MANUFACTURER will design and furnish the following equipment/systems for installation by the CONTRACTOR.

1. SBR process equipment package to be supplied for dual basins as shown of the drawings.

2. Aeration system and retrievable diffused air equipment shall be designed to accommodate Phase 1 conditions and future Phase 2 flows/loads as specified.

3. Diffused air equipment for each SBR basin shall be expandable to accommodate Phase 1 and Phase 2 conditions with the wet installation of additional diffuser racks.

4. Mechanical mixers for each SBR basin, to provide a minimum power density under Phase 2 MWL condition of 25 HP/MG (not including air power).

5. Level instruments and transmitters for each SBR basin.
6. DO instruments and controls for each SBR Basin.
7. Decanter assemblies for each SBR basin to accommodate the range of flow from Phase 1 to Phase 2 without modification, and designed with a mechanism for excluding foam/floatables as well as entrained mixed liquor.
8. SBR system control system with local operator interface panel to interface with the WWTF SCADA system.
9. Cycle configuration/duration shall be operator adjustable.
10. Electric motor operated raw water valves.
11. Two electrically actuated flow control valves to be supplied with a single common magnetic flow meter to regulate decant rates under low influent flow conditions to utilize full duration of decant cycle.
12. All retrievable components (Type 316 stainless steel) shall be supplied with guiderail assembly, lifting chain/cable, hoist, etc.
13. Any other equipment and controls required by the PROPOSER to meet the system performance requirements.
14. The ENGINEER will specify in the project construction documents that the CONTRACTOR will install the SBRs that is to be furnished by the MANUFACTURER.

C. The ENGINEER will design and/or the CONTRACTOR will provide and install the following equipment and systems related to the SBR system

1. Common wall SBR basin design with input from the MANUFACTURER.
2. Administration Building, and all reinforced concrete structures; including all piping to and from the SBR basins, based on the sizing and load criteria provided by the MANUFACTURER.
3. All yard piping and civil site requirements.
4. The chemical make-up facilities as well as storage and feed pumps and piping for chemical dosing upstream of the SBR basins, if required.
5. All power and control wiring including local power disconnect power switches.

D. Influent Conditions

1. Influent wastewater flow and influent design parameters to the SBR system are summarized below.

| Phase 1 | Min Month | Annual Average | Max Month | Max Day | Peak Hour |
|---|---|---|---|---|---|
| Flow, gpd | 224,713 | 264,368 | 374,649 | 689,120 | 792,500 |
| BOD, lbs/d | | 626 | 800 | 1,022 | |
| TSS, lbs/d | | 725 | 948 | 1,359 | |
| TKN, lbs/d | | 136 | 172 | 199 | |
| Design Temp, $^{o}$C | 10 | 15 | 20 | 24 | |

| Phase 2 | Min Month | Annual Average | Max Month | Max Day | Peak Hour |
|---|---|---|---|---|---|
| Flow, gpd | 321,163 | 377,839 | 535,928 | 957,417 | 1,101,000 |
| BOD, lbs/d | | 884 | 1,127 | 1,446 | |
| TSS, lbs/d | | 1,030 | 1,346 | 1,940 | |
| TKN, lbs/d | | 188 | 238 | 276 | |
| Design Temp, $^{o}$C | 10 | 15 | 20 | 24 | |

2. Note that based on the seasonal location and weather conditions, the Max Month loads and Min design temperature will not be coincident.

E. Effluent Conditions

1. Effluent design parameters from the SBRs are summarized below.

| Constituent | SBR Effluent Requirements |
|---|---|
| BOD, mg/L | 20 |
| TSS, mg/L | 20 |
| TN, mg/L | 7 |

2. Note that the Biological process shall be sized to meet effluent requirements under Max Month conditions.

3. Note that the SBR system (i.e. tank size, tank volume, aeration requirements, etc.) shall be sized and controls be programed to be able to achieve a TN of 7 mg/L without the addition of a supplemental carbon source and a TN of 3 mg/L with the addition of a supplemental carbon source that would be provided by others in the future.

F. Equipment

1. The following equipment list is intended to establish a level of quality, not to be an all-inclusive list of equipment to be furnished or not to be furnished. The proposal shall contain an itemized list of all equipment, instrumentation

and controls determined by the proposer to allow the SBR to perform in the manner in which it is intended. The proposal must clearly identify which equipment, instrumentation and controls are part of the Lump Sum Price and which are not part of the Lump Sum Price. All equipment shall be required to meet all OSHA requirements.

2. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.

3. The SBR manufacturer shall provide SBR process equipment package as indicated in the scope of supply and supplemented below:

   a. Valves and Actuators

      1) All system actuated valves shall be supplied.

      2) All actuated valves shall be furnished with motor operators so that the disc filtration filter system can operate automatically.

      3) Valves and Actuators shall meet the minimum requirements specified hereon.

   b. Bolts, Nuts, Jack Studs

      1) Furnish bolts, nuts, jack studs as required for mounting pipe, equipment, and appurtenances.

      2) Material type for bolts, nuts, jack studs to be Type 316L Stainless Steel.

   c. Miscellaneous Equipment - Provide ancillary equipment, controls, etc. required to provide a complete advanced treatment system.

   d. Support Equipment - Support equipment including, but not limited to, gates, valves, weirs, baffles, and appurtenances shall be listed in the submittal proposal as to type, size, quantity, location, and specific requirements

   e. PLC Based Control System

      1) The SBR system is to be designed as an automatic system monitored and controlled using a PLC based control system which is to be compatible and interconnected with the WWTF control system architecture. The control system shall include a local control panel for each SBR. All instrumentation and control required for the SBR system control and monitoring system shall be designed and furnished including all necessary programming.

      2) Furnish interface software that allows the PLC-based controls for the SBR system to communicate with the WWTF main PLC system. The process cycle configuration/duration shall be operator adjustable.

      3) Furnish a PLC based control system designed specifically to control and monitor the SBR treatment system. Each SBR unit shall be provided with a UL-listed local control panel that will have ethernet data communication to a main SBR system control panel. The control system shall be designed to control the following systems, as a minimum:

         a) Floating mixers for each SBR basin. Monitor and control mixers with and without aeration based on cycle mode during SBR process operation.

         b) Aeration Blowers. Monitor and control speed of aeration blowers based on process mode and DO requirements.

         c) Submersible pressure transducers and back-up level float switches to monitor tank level in each tank.

   f. Instrumentation

      1) All instrumentation items and controls required for SBR system to perform in the manner in which it is intended shall be included in the Proposal as part of the Lump Sum Price. Minimum requirements for selected equipment are listed below:

         a) The PLC-based Control panel and instrumentation components shall consist of the following:

- NEMA 4X Wall Mount Control Panel.
- PLC CPU Card
- PLC I/O Racks
- PLC Field Interface Cards
- Operator Interface Display
- Uninterruptable Power supply
- Circuit breakers
- Terminal Strips
- Transient Voltage Surge Suppressors
- Miscellaneous wire

b) The instrumentation and control system equipment will meet the minimum requirements specified herein.

2) The PROPOSER is also responsible for the instrumentation and control system to achieve the effluent requirements as stated herein including level and pressure/vacuum instruments. The general contractor will be responsible for the performance and warranty of the all ancillary items to the SBRs not furnished by the selected manufacturer.

g. Proposal Submittal - The following information is to be submitted with the Proposal.

1) Completed Life-Cycle Cost Data Entry Forms.

2) Complete SBR process design including all calculations and justification for the recommended values for the following:

a) Tank volume sizing including tank dimensions.

b) Design food to Mass ratio (F/M).

c) Actual Oxygen Requirement (AOR), Alpha and Beta for all specified load conditions.

d) Certified Design Standard Oxygen Transfer Efficiency (SOTE) for all load conditions.

e) Decanter sizing calculations; velocity pattern, flow rate as a function of liquid level in the SBRs.

f) Mixer sizing to provide complete mix without the introduction of air.

g) Design calculations stamped by a Professional Engineer in the registered in the State were the project is located.

h) Design Sludge Retention time.

i) Reaction rates for nitrification and denitrification, along with oxygen demand, including kinetic values to support cycle times and motor operation requirements.

j) Complete Mix at High Water Level shall be achievable at 4,500 mg/l minimum MLSS with no introduction of air.

3) Complete process design submittal with support calculations shall be presented showing effluent quality expected under the following conditions for the SBR effluent:

a) Design Year Phase 1 and Phase 2 Annual Average Flow/Loading

b) Design Year Phase 1 and Phase 2 Maximum Month Flow/Loading

c) Design Year Phase 1 and Phase 2 Peak Flow/Loading

4) Provide any ancillary equipment, controls, etc. required to provide a complete SBR system, and to furnish this equipment and controls, not otherwise specifically specified herein.

5) Provide preliminary equipment manufacturer's names covering all process and control equipment items to be supplied as part of the offering. Provide cut sheets of key components along with the model, horsepower, major components, and performance curves.

6) For the following equipment, provide complete design basis including number of units, flow, head or pressure, motor horsepower, equipment sizes, and other information to provide a complete description of the required equipment:

   a) Aeration system including diffusors and appurtenances

   b) Tank Mixing equipment

   c) Decanter system.

   d) Retrieval systems for all equipment

   e) Online analyzer(s).

   f) Control valves (if required).

   g) Instrumentation and control systems.

   h) Supplemental chemical dosing control system (if required).

**1.07 - REFERENCES**

A. American National Standards Institute (ANSI):

   1. B16.1: Standard for Cast-Iron Pipe Flanges and Flanged Fittings, 125 lb.

B. American Society for Testing Materials (ASTM):

   1. A36: Specification for Structural Steel

C. National Electric Code.

D. American Bearing Manufacturers Association (ABMA):

   1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.

   2. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings)

E. American Gear Manufacturers Association (AGMA).

F. National Electrical Manufacturers Association (NEMA).

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - QUALITY ASSURANCE**

A. Provide in accordance as specified herein.

B. Equipment shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

C. Welding: In accordance with American Welding Society Code D1.1.

D. Submit copies of AWS certificates.

E. Provide shop tests as specified.

F. The manufacturer of the SBR system shall provide equipment, panels, and controls regardless of manufacturer, as a complete integrated package to ensure proper coordination, compatibility and operation of the system.

G. The manufacturer of the SBR system shall be responsible for the proper design of their system, including but not limited to; diffused aeration equipment, foam suppressing mixers, decanters, DO instrumentation and controls. All

equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

H. If system proposed is different than specified, provide all structural, architectural, electrical and mechanical revisions at no additional cost to the Owner.

I. Provide Services of Manufacturer's Representative as specified herein.

J. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment specified.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve the Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections: 3 person-days.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 5 person-days.

c. Field Performance Testing: Field performance test equipment specified. 5 person-days.

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 2 person-days.

e. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

f. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

K. Manufacturer of equipment shall have at least ten (10) operating installations with units of the size specified and in the same service as specified operating for not less than ten (10) years. Proposer’s who do not meet the Manufacture’s Experience shall provide with their Technical Proposal a Certified Letter stating that they will provide to the OWNER, with the shop drawing submittal, an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall extend for a period of three years beyond the completion date for the project and shall be retained by the OWNER until the installed equipment has passed the specified performance testing and the equipment has been accepted by the OWNER. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

L. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified herein.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements as indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and as indicated.

**PART 2 – PRODUCTS**

**2.01 - MANUFACTURERS**

A. Aqua Aerobic Systems, Inc.

B. The Owner has pre-selected the Aqua Aerobic Systems, Inc as the manufacturer of the Sequencing Batch Reactors. No Substitutions are allowed.

**2.02 - SYSTEM DESCRIPTION**

A. The following is a general description of the equipment to be supplied and coordinated by the SBR Supplier:

1. SBR process equipment package to be supplied for basins as indicated.
2. Fine bubble diffuser equipment for each SBR basin.
3. Floating foam suppressing mixers for each SBR basin.
4. Level instruments and transmitters for each SBR basin.
5. DO probes and transmitters to be tied to SBR DO control system
6. Decanter assemblies for each SBR basin to accommodate the range of flow from Phase 1 to Phase 2 without modification.
7. SBR process control system.
8. Two electrically actuated flow control valves to be supplied with a single common magnetic flow meter to regulate decant rates under low influent flow conditions to utilize full duration of decant cycle.
9. Cycle configuration/duration shall be operator adjustable.
10. Electric motor operated influent feed plug valve to each basin: (a) Valve to be flanged end connection, ASTM A-126 Class B cast iron with 80 percent port opening, assembled and tested with an electric actuator; and (b) Actuator shall include manual override and limit switch feedback and include local push-button controls, selector switch and lights.
11. Provide all other items as indicated and specified.

B. Provide the system designed for operation in true batch mode.

C. Pertinent Site Conditions

1. Site Elevation: 60 ft. above MSL
2. Intermittent Low Air Temperature: 0 deg. F
3. Intermittent High Air Temperature: 100 deg. F

D. Provide a SBR system with the following characteristics

1. Number of SBR Tanks: 2
2. SBR Tank Inside Dimensions: 45 ft. by 65 ft.
3. SBR Tank Depth: 22.5 ft. overall, 20.0 ft. above grade elevation.
4. SBR Tank Design Low Water Depth: 14.5 ft.
5. SBR Tank Design High Water Depth: 20.5ft.
6. SBR Cycles Per Day at Average Flow: 4
7. SBR Cycles Per Day at Maximum Day Flow: 4
8. SBR Maximum Decant Rate: 1,700 GPM

E. Motors within the SBR Tanks: Rated for temperature code T2A (280 deg. C)

F. Provide a SBR system designed to operate in rectangular tanks with dimensions and sidewater depths as specified and indicated.

G. The wastewater treated in the SBR system will be decanted directly to the disk filter process then continue by gravity into a Post Equalization tank for effluent discharge after UV disinfection.

H. Tank and process design shall be sized to accommodate Phase 2 maximum day flows/loads utilizing normal SBR operating cycle. The use of a compressed cycle (i.e. – "Storm mode") is not allowable unless flows exceed specified Phase 2 Maximum Day flows.

I. Note that based on the seasonal location and weather conditions, the Max Month loads and Min design temperature will not be coincident.

J. Provide a aeration distribution system based on the following minimum requirements.

1. Minimum SOR at Max Day Flows/Loads
    a. Alpha (maximum value allowed): 0.85
    b. Beta (maximum value allowed): 0.95
2. Minimum Standard Oxygen Transfer Efficiency
    a. Annual Average: 2 percent/ft submergence
    b. Max Month: 1.8 percent/ft submergence
    c. Max Day: 1.6 percent/ft submergence
3. Maximum headloss in Aeration System: 1.4 psi
4. The aeration system for the SBR tanks shall be capable of providing mixing such that when operated under any combination of the specified design conditions it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in the basin.
5. Minimum Cycle Times at Maximum Daily Flow.
    a. Minimum Aeration Time: 2.60 hrs/cycle
    b. Minimum Mixing Time: 4.00 hrs/cycle
    c. Minimum Settling Time: 0.75 hrs/cycle
6. Provide a SBR system that will operate with the design conditions indicated below.
    a. SBR mixed Liquor Suspended Solids: 4,500 mg/l at LWL
    b. SBR Sludge Age: 22 – 26 days

**2.03 - SBR EQUIPMENT**

A. SBR Valves

1. SBR Influent Valves: Provide one 8-inch electrically operated plug valve per SBR.
2. SBR Decant Valves: Provide one 10-inch electrically operated butterfly valve per SBR.
3. Provide all valves and electric motor operator.

B. Mixer

1. Provide one mechanical floating mixer and related equipment accessories as indicated and specified for each SBR.
2. Provide each mixer consisting of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute.
3. Performance:
    a. Each mixer shall have a zone of complete mix of the tank inside diameter at the maximum water depth. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids without the introduction of air.
    b. Mixer shall include the ability to reduce foam and scum by providing direct passage to the center intake.

c. Recirculation rate: 253,000 gpm.

d. Mechanical mixer to provide a minimum power density under Phase 2 MWL condition of 25 HP/MG (not including air power).

4. Mixer Drive Motor

a. Horsepower: 10, 900 rpm, 460 V, 60 cycle, three phase.

b. Provide motors in accordance with Specification 16220 – Electric Motors and as specified herein.

c. Vertical P base design, TEFC, and generally rated for severe duty. Submerged motors are not acceptable.

d. The motor shall in all cases equal or exceed standard NEMA specifications.

e. Motor Winding insulation shall equal/exceed NEMA class F design, minimum service factor of 1.15, and be nonhygroscopic.

f. All motor end bells shall be deep registered and Permatex sealed.

g. All through bolts, nuts and screws shall be Type 18-8 SS.

h. Each motor will have a rain cap constructed of cast iron or non-corrosive 304 ss. Painted or plated carbon steel will not be acceptable.

i. Motor shall be Centaur model supplied by Reliance Electric or Endura model supplied by Teco-Westinghouse.

j. Provide a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the impeller.

(1) Shaft 2.25-inch dial: 17-4 PH stainless steel.

k. Motor bearings: Regreasable type, sealed bearings are not acceptable.

(1) Provide the top bearing shielded on the bottom side only.

(2) Bottom bearing: Open.

(3) Top and bottom motor bearings: Combined radial and axial thrust type.

(4) Provide the lower motor bearing inner race locked to the motor shaft via a special washer and locking nut arrangement. Provide the shaft threaded just below the lower bearing and a keyway cut into the motor shaft. Provide the key to accept a tab from the inner diameter of the locking washer, and the locking nut recessed to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers are not acceptable.

5. Motor Mounting Base

a. Provide the motor mounted onto a solid Type 304L stainless steel base integral with the motor base extension. All Submersed wetted motor mounting base components to be Type 304 stainless steel.

b. The motor base shall contain a machined recess to permit the use of a free running, anti-deflection insert. The anti-deflection insert shall not require lubrication. The provision for this insert shall be located in the lower extremity of the motor base extension immediately above the impeller.

c. Provide the upper portion of the motor mounting base, immediately below the lower motor bearing with two independent acting air seals. Provide the two seals capable of sealing off the flow of air from the suction action of the pumped flow, and prevent backflow of liquid during impeller reversal.

d. Provide the lower end of the motor base extension with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

6. Intake/Discharge Volute

a. The center intake/discharge structure of the mixer shall be fabricated of Type 304 stainless steel and shall be designed to support the motor and motor base and align the impeller with the volute. Supports shall be included to connect the entire power section assembly to the deployed float assembly.

b. The center structure shall also contain rigid vertical support gussets that connect the top and bottom alignment flanges that support and connect the motor support base and the submerged impeller volute assembly.

c. All power section connecting bolts shall be Type 316 stainless steel and have drilled heads, and shall be safety wired in place with stainless steel safety wire.

7. Flotation

a. Equip each unit with a separate self-deploying, segmented float support system consisting of four (4) float segments and a center support bracket suitable for installation through a 44-inch opening. The float shall be designed to bring surface scum and foam directly to the mixer center. Solid round floats are not acceptable. Each float segment to be fabricated from 14 gauge, Type 304 stainless steel and shall attach to the center support bracket with a Type 316 stainless steel shoulder bolt. Fiberglass floats are not acceptable.

b. Fill internal void of each float segment with closed cell polyurethane having a minimum density of 2.0 lbs/cu. ft. and seal watertight.

c. The center support bracket shall have a connection for each float segment. It shall have an opening in the center for installation, after full deployment, of the complete power section with intake volute assembly.

d. When deployed, floats to have minimum width of 151-3/4-inch and minimum thickness of 10-1/2-inch, and minimum reserve buoyancy of 650 lbs.

e. Connecting bolts shall be used to secure power section, center support bracket and floats. Provide Type Type 316 stainless steel connecting bolts.

f. Provide electric cable connectors, supports, etc. as indicated on the Drawings.

8. Impeller

a. Provide the impeller designed to pump the liquid from near the surface and direct it down toward the basin bottom.

b. Impeller: Two blade marine type precision casting of Type 316 stainless steel 14.5-inch in diameter. designed for the application specified and indicated.

c. Impeller shall be streamlined to prevent cavitation and reduce drag and shall have 180o trailback blades to insure non-clog operation.

d. The impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings.

e. The impeller shall be securely attached to the motor shaft in such a manner so that reversal operation for liquid backflushing will not loosen its connection; therefore, impellers requiring the threading of the shaft for attachment will not be allowed.

f. The impeller shall be "pitch balanced" to insure equalization of load under full flow operation. Each blade's pitch and rake shall not vary more than 2.0 percent from the other.

g. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed at any time.

9. Intake Volute Assembly

a. Material: Type 304L stainless steel plate, minimum 3/16 inch thick with a minimum volute diameter of 15-inch.

b. No plastic, fiberglass, carbon steel or cast iron materials shall be acceptable.

c. The volute shall be welded to and aligned concentrically with the motor base and float without ships or external adjustment.

10. Vibration

a. Dynamically balance the impeller and rotor unit as a completed assembly and as an integral unit with the motor mounting base to a vibration level not to exceed two mils at the motor rpm.

b. Dynamically balance the entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor rpm. Transducer pickup points shall be at the motor bearings on the motor frame perpendicular to the motor shaft. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

c. Submit certified copies of the balance inspection for each mixer.

11. Cable Mooring System

a. Provide each unit with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors, and extension springs as shown on the drawings.

b. Mooring cable, anchors, and hardware: Type 304 stainless steel.

c. Contractor to field attach the mooring points to the tank.

12. Cable Mooring Electrical Service Cable

a. Each unit shall include #8-4-four conductor power cable wired into the motor conduit box and terminating at the basin wall.

b. Provide the electrical cable with kellems grips at the motor and basin wall terminations. Provide electrical cable floats for flotation of electrical service.

c. Contractor to attach cable and supply of junction box/disconnect at the basin wall.

C. Decanter Assembly

1. Provide one mechanical floating decanter and related equipment accessories as indicated and specified for each basin.

2. Provide each decanter consisting of an integral flotation unit, a stainless steel movable weir assembly, and a hydraulic motor-driven actuator to open and close the weir.

3. Performance

a. Provide each decanter capable of withdrawing decant fluid from 4 to 6 inches beneath the liquid surface, regardless of liquid depth, from the maximum down to the minimum allowable water level specified.

b. Decanter to accommodate the range of flow from Phase 1 to Phase 2 without modification, and designed with a mechanism for excluding foam/floatables as well as entrained mixed liquor.

c. Provide the system to draw decant liquid through an adjustable weir opening of 2 to 6 inches.

d. Provide the weir in a circular configuration to permit liquid to enter the decanter from the entire 360 degrees without obstruction.

e. Locate the centerline of each decant pipe 1.6 ft. below the low water level specified herein or as recommended by the manufacturer.

4. Weir Actuator

a. Weir actuator: Reversible hydraulic motor operated linear actuator.

b. Provide the actuator capable of operating with a closing force of 1500 lbs.

c. 115 volt, single phase, 60 hertz.

d. Provide adjustable limit switches to permit adjustment of the weir opening.

e. Provide a coil spring to provide for travel after the weir has closed and provide desired closure pressure.

f. Provide a corrosion resistant removable cover to protect the actuator and motor during normal operation.

5. Decanter power section

a. Painted steel

b. Provide an aluminum band clamp heater.

c. Provide #14 AWG ten conductor power cable from the NEMA 4X junction box of the unit to the basin wall.

d. Contractor to provide junction box/disconnect at the basin wall.

6. Weir

a. Type 304L stainless steel

b. Circular in shape

c. Provide vortex control baffles permanently affixed to the weir.

d. Attach the weir to the actuator through a removable single shaft which shall also function as the torque restraint.

7. Decanter Discharge Pipe

a. Provide each decanter with a Type 304L stainless steel elbow with 16-inch diameter Schedule 80 PVC discharge pipe complete with 16-inch fiber-loc backing ring and cast iron backing ring and Vanstone flange and Type 304 stainless steel flanged flexible joints.

b. Provide each decanter assembly terminating with a flanged Type 304L stainless steel elbow at the basin wall. All piping, pipe supports, gaskets, and hardware beyond the terminating flange of the elbow shall be provided by the Contractor.

8. Decanter Restrained Mooring System

a. Provide each decanter with a galvanized steel mooring frame attached to the float.

b. Provide one 4-inch diameter Schedule 40 galvanized steel mooring post assembly with base plate to assure consistent location of the decanter in the basin.

c. Contractor to fill mooring post with concrete.

d. Provide galvanized steel dewatering support posts consisting of three 4-inch diameter Schedule 40 vertical pylons with base plates and one 4-inch diameter Schedule 40 pipe dewatering support post with pipe saddle and base plate.

e. Contractor to provide anchors and attach each support with base plate to the basin floor with Type 304 stainless steel anchors field.

f. Provide top and bottom mooring post supports of galvanized steel for attachment to the basin wall by the Contractor.

D. Fine Bubble Diffuser System

1. Performance Requirements

a. Fine bubble aeration system: Provide retrievable air diffuser assemblies in the SBR basins as specified and indicated. The design shall provide for additional aeration assemblies and blower (by others) for Phase 2 conditions as specified herein.

b. Each air diffuser assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. The 4-inch diffuser

manifold shall be stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

2. Design Criteria

   a. Air Supply System: The SBR's will receive air supply from aeration blowers located in the lower level of the Administration Building and will be supplied by others. Three blowers (2 duty/1standby) shall be supplied by others for Phase 1 conditions with a fourth blower supplied by others for Phase 2 conditions.

   b. The diffuser system in each SBR shall be installed with enough capacity to support Phase 1 standard oxygen requirement conditions as outlined below while meeting the minimum SOTE requirements listed.

**Phase 1 Oxygen Requirements (Std Conditions)**

| | Annual Average | Maximum Month | Maximum Day |
|---|---|---|---|
| SOR, lbs/hr-tank | 165 | 212 | 259 |
| Ave Water Depth, ft | 15.8 | 16.1 | 17.0 |
| Minimum Required SOTE at Ave Water Depth, percent | 32 | 29 | 27 |

   c. The diffuser system shall be designed such that with the use of guiderails, retrieval accessories, etc. already installed under Phase 1, the wet installation of additional diffuser racks under Phase 2 will meet the Phase 2 standard oxygen requirement conditions as outlined below while meeting the minimum SOTE requirements listed.

**Phase 2 Oxygen Requirements (Std Conditions)**

| | Annual Average | Maximum Month | Maximum Day |
|---|---|---|---|
| SOR, lbs/hr-tank | 231 | 296 | 362 |
| Ave Water Depth, ft | 16.1 | 16.6 | 17.8 |
| Minimum Required SOTE at Ave Water Depth, percent | 32 | 30 | 28 |

   d. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Each membrane shall be held in place by two Type 304 stainless steel band clamps, and cleanable with a high pressure wash water.

   e. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. The membrane shall include UV inhibitor and be designed for resistance to chemicals, weathering.

   f. Each diffuser assembly shall include a 3-inch diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, a threaded flange, elbow and quick disconnect adapters. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

   g. Each assembly shall include a 3-inch diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor.

E. Pressure Transducer

1. Provide one Keller PSI Model 700 submersible pressure transducer unit (or equal) constructed of stainless steel for each SBR.

2. Transducer to utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.

3. Transducer output: 4-20 mA.
4. Electrical connection: Two wire, 24 gauge polyethylene shielded cable, minimum 35 feet of cable per unit, and as required for installation and servicing connected equipment without splicing.
5. Suspend the transducers using 1/8-inch Type 304 stainless steel suspension cables and bracket. Contractor to attach cables and brackets to the basin with Type 304 stainless steel anchors provided by the con tractor for anchoring the pressure transducer suspension cables and mounting bracket.

F. Level Sensors

1. Provide one level sensor assembly consisting of a polypropylene cased liquid level sensor with a smooth, chemical resistant polypropylene casing, and Type 316 stainless steel mounting bracket for each SBR.
2. Provide each float switch with a three conductor electrical cable.
3. Electrical cable to terminate at a junction box/disconnect located at the basin wall.
4. Contractor to provide field wiring and junction box/disconnect. Contractor to provide adhesive Type 304 stainless steel anchors for anchoring the level sensor, mast and mounting bracket.

**2.04 - MOTORS**

A. Provide in accordance with Specification 16220 – Electric Motors and as specified herein.

B. Enclosure: NEMA 4X. Motors shall be capable of being washed down with a hose stream during operation.

C. Insulation: Minimum “Class F” with “Class “B” temperature rise, 40 deg. C ambient unless otherwise indicated or specified.

D. Service Factor: 1.15.

E. L-10 Bearing Life: 100,000 hours.

F. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

G. Rating: 460V, 3 ph, 60 Hz

**2.05 - SPARE PARTS**

A. Provide as specified herein.

B. Provide the following:

1. One (1) 16 point input card
2. One (1) 16 point output card

C. Provide a list of parts with unit prices.

**2.06 - CONTROL SYSTEM**

A. Provide the control system designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures.

B. Provide the control software program factory tested prior to installation at the jobsite.

C. Control System: Timer based system with level overrides providing control, sequence, monitoring, and alarm annunciation capabilities.

D. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility.

E. Provide the control system designed to automatically accommodate the plant's full range of loads and flows.

F. Provide a complete control system as specified herein.

G. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for all mixers and aeration blowers.

1. SBR Mixers
2. Blowers
3. Influent Valves
4. Decanter Actuators
5. Decanter Valves
6. Sludge Valves
7. 4-20 mA Pressure Transducers
8. Level Sensors
9. Common Alarm

H. In addition, controls as indicated for the following equipment shall be included within the SBR control panel:

1. 4-20 mA D.O. Signals
2. Oxidation Reduction Potential Signal

I. Programmable Logic Controller

1. Automatic controls for operation of Sequencing Batch Reactors (SBRs) and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide each control panel with a panel-mounted Human Machine Interface (HMI):
2. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.
3. Provide NEMA 4X 316 Stainless Steel enclosure.
4. Panel shall be labeled UL 508A.
5. Provide motor starters, and VFDs internal to the control panel as required. Provide VFDs in accordance with Specification 16260 – Low Voltage Variable Frequency Drives.
6. Heaters or AC units required for the control panel shall be powered from the control panel.
7. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC and separate from 480VAC Equipment.
8. Provide the control panel enclosure with the following:
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Control buttons and selector switches as specified herein.
    c. LED type indicating lights.
    d. Emergency stop (ESTOP) maintained pushbutton to shut down the SBR system.
9. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide RAM memory protected by backup battery.
11. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
12. Provide fully documented ladder logic on a CD-Rom.
13. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a 9 x 14 inch color display. Provide Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.

14. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
15. Provide control a monitoring of the system as shown on the contract drawings.
16. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
17. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
18. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
19. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.
20. The SBR vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
21. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.
22. Operation - The PLC shall be configured to provide the following control:
    a. PHASE CONTROL, the regulation of the process cycles of the SBR up to the maximum daily flow of the plant.
    b. AERATION CONTROL, the regulation of the aeration and mixing systems to achieve optimum process control.
    c. COMPONENT MONITORING, the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

**2.07 - PAINTING**

A. All painted equipment shall be painted as specified below.

B. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces two part epoxy paint in accordance with the following:
    1. Solids by Volume: Minimum 57 percent (percent $\pm$2).
    2. Type: Polyamide epoxy, self-priming.
    3. Dry Film Thickness; 4 to 6 mils per coat.
    4. No. of Coats Required: Three.
    5. V.O.C. Requirement: 3.06 lbs/gallon
    6. Conform to AWWA D102 Inside Systems No. 1 and No. 2
    7. Use thinners that are acceptable to ANSI NSF Std 61
    8. Color: As specified for piping system of same service or as selected by the Engineer.

C. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions for immersion or non-immersion service as required.

D. Ferrous surfaces which are not to be painted shall be given a ship applied coat of grease or rust resistant coating.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with manufacturer's printed instructions, as specified, and indicated.

B. Manufacturer's representative to perform inspection of all equipment and conduct check-out and training as specified herein.

**3.02 - FIELD TESTING**

A. Perform field testing of all equipment functions and alarms.

1. Make all adjustments necessary to place equipment in specified working order at time of above tests.

2. Remove all replaced equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

**3.03 - PROCESS PERFORMANCE GUARANTEE**

A. The SBRs will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur one (1) year from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the MANUFACTURER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

B. The MANUFACTURER shall be responsible for the process performance of the SBRs and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 - WARRANTY**

A. The MANUFACTURER shall be provide an warranty of the SBRs warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The MANUFACTURER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the Cost Proposal submitted by the manufacture and therefore, shall be utilized to cover the cost of the discrepancy between the Proposal and this section.

C. It is the MANUFACTURER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 - ACCEPTANCE TESTING**

A. The specified system will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, in order to protect the client's

interests, the MANUFACTURER shall provide to the Owner, through the Contractor, with the shop drawing submittal, a Performance Test Guarantee in the form of an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

B. The Acceptance Test shall demonstrate performance under design loading conditions. This might be accomplished through simulating higher loading conditions by operating only one SBR, or by lowering MLSS levels to simulate design maximum F:M ratios for example. It is the manufacturer's responsibility to develop a test protocol for approval by the Engineer. The test protocol at a minimum should demonstrate compliance with the SBRs performance requirements under Maximum Month or Simulated Maximum Month Loading as follows:

- Average SBR Effluent BOD <= 20 mg/l
- Average SBR Effluent TSS <= 20 mg/l
- Average SBR Effluent TN <= 7 mg/l

C. All sampling will be based on flow weighted 24-h composites.

D. Testing shall be conducted such that compliance with the above requirements is demonstrated for a minimum of (7) consecutive days with the system operating in (or simulating) design process control parameters such as design SBR cycle allocation times, design max MLSS, Design Max SRT, Design Min F:M, etc. Operation of the WWTF to include sampling during the Acceptance Test shall be the responsibility of the owner. The system supplier may provide oversight of the test at its discretion.

E. Should the system pass the Acceptance Test, the Letter of Credit will be released following approval of the Engineer. Should the system fail the Acceptance Test, the manufacturer will be given up to two opportunities to make adjustments and retest. Should the system fail all Acceptance Tests - maximum of three (3), even if before the three (3) year term, the Owner reserves the right to call the letter of credit. None of the above releases the system supplier to making such modification as necessary to bring the system into compliance with the performance requirements of this specification.

**3.06 - FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 12300**

**LABORATORY FURNISHINGS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide the laboratory furnishings as specified and/or as shown on the Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Drawings, including all equipment and components.

2. The equipment contractor shall furnish roughing-in drawings for mechanical and electrical services. In addition, complete master wiring diagrams and elementary or control schematics, including required coordination with other electrical control devices operating in conjunction with the equipment shall be provided. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.

3. Operation and Maintenance Manual.

4. All bidders, upon request, shall be required to submit samples made in accordance with this specification. Samples shall be full size, production type samples, as miniature, or “Show Room” type samples are not acceptable. Samples shall include one combination drawer and cupboard base unit showing complete construction details. In addition, samples of all mechanical service fittings, locks, door pulls, hinges, and interior hardware shall be provided.

5. Installation layout of all equipment showing coordination of electrical and water supplies.

**1.05 -PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Attention is directed to SECTION 01640, SPECIAL MECHANICAL AND ELECTRICAL EQUIPMENT REQUIREMENTS wherein certain Special Mechanical and Electrical Equipment Requirements are specified. These requirements are a part of this section and relate to:

1. Substitution of Equipment
2. Special Requirements for Pumps
3. Electric Motor and Power Factor Correction Capacitor Requirements
4. Noise Specification for Machinery and Equipment

**1.07 - COORDINATION**

A. The supplier shall furnish and install all utility service outlet accessory fittings, electrical receptacles and switches shown on the Drawings. The duplex receptacles shall be coordinated as shown on the Drawings in order to provide the required electrical connections being provided under DIVISION 16 ELECTRICAL.

B. The supplier shall furnish and deliver, packed in boxes for installation by the mechanical contractor, all laboratory sinks, cup sinks or drains, drain troughs, overflows and sink outlets with integral tailpieces, as shown on the Drawings. Integral tailpieces when required shall be in accordance with the manufacturer's standards. All tailpieces shall be furnished with the couplings required to connect them to the drain piping system.

C. Fume hood fan shall be furnished as a part of this section. Fan shall be complete with suitable supports, silencers, motor switches with warning lights and proper overload protection.

**PART 2 - PRODUCTS**

**2.01 - FURNISHINGS**

A. The following list of laboratory furniture, appliances and case work are identified by Kewaunee Scientific Equipment Corporation catalogue numbers and descriptions unless otherwise indicated. Equal products of other manufacturer will be given consideration. All products of the same type shall be the same manufacturer. Item No.'s refer to those shown on the drawings.

B. All furniture and case work shall be fully-welded, heavy gauge steel construction meeting Supply and Equipment Foodservice Alliance (SEFA). Furniture shall be powder coated, lab grade finished with color to be selected by the ENGINEER from submitted manufacturer's charts.

C. All counter tops shall be molded epoxy resin, 24-inch, black, with a back splash. All edges shall be rounded to a 1/4-inch at front top edge, exposed side edge and at vertical corners. Table tops shall be 1-inch thick, with drip grooves provided on the underside at all exposed edges. All exposed edges shall be rounded to a 1/4-inch radius at front top edge and at vertical corners. Integrally molded 4-inch high curbs at the backs and ends of standard 31-inch and 24-inch wide tops shall be 3/4-inch thick, and the juncture between top and curb shall be covered to a 3/4-inch radius. The top of all box curbs (reagent shelf) shall be 4-inch above the countertop. Curbs on special width tops and around special cutouts shall be the same thickness as the tops, bonded to the surface of the top to form a square joint. Sink cutouts shall be smooth and uniform without saw marks and the top edge shall have a uniform radius of approximately 1/8-inch. The bottom edge of the sink opening shall be finished smooth with the edge broken to prevent sharpness. Corner radii of sink cutouts shall not be less than 3/4-inch.

D. MATERIALS

1. General Requirements. Provide a high quality steel cabinet specifically designed for the laboratory environment. The cabinet is to be flush face construction, with doors and drawers in the same plane as the cabinet face frame, without overlap. The door and drawers are to be 3/4-inch thick with square edges, and a bail-type aluminum pull.

2. Sheet Steel: Cold rolled sheet steel shall be prime grade; roller leveled and shall be treated at the mill to be free of scale, ragged edges, deep scratches or other injurious effects. All gauges shall be U.S. Standard.

3. Glass used for framed sliding and swinging doors shall be 1/8-inch float glass. Glass used for unframed sliding doors, shall be 1/4-inch float glass. Glass used in fume hoods or other hazardous locations shall be 7/32-inch laminated safety float glass, except the glass shielding fluorescent lights in fume hoods shall be tempered glass to provide greater resistance to heat and impact.

4. Hardware and Trim:

   a. Drawer and Door Pulls. Drawer and door pulls shall be modern design, offering a comfortable hand grip, and be securely fastened to doors and drawers with screws. All pulls shall be satin finish aluminum, with a clear, lacquer finish. Two pulls shall be required on all drawers over 24-inch long. Use of plastic pulls (molded or extruded), or a design not compatible for usage by the handicapped will not be acceptable.

   b. Sliding Door Pulls. Flush pulls for sliding doors shall be brushed aluminum, providing a recessed finger grip. Finger holes or slots machined into doors will not be acceptable.

   c. Hinges shall be made of Type 304 stainless steel 0.089 thick, 2 1/2-inch high, with brushed satin finish, and shall be the institutional type with a five-knuckle bullet-type barrel. Hinges shall be attached to both door and case with two screws through each leaf. Welding of hinges to door or case will not be accepted. Doors under 36-inch in height shall be hung on one pair of hinges, and doors over 36-inch high shall be hung on 3 hinges.

   d. Locks, where shown or called for, shall be a National Lock, 5-disc tumbler with heavy-duty interchangeable cylinder. Exposed lock noses shall be dull nickel (satin) plated and stamped with identifying numbers. Locks shall have capacity for 225 primary key changes. Master key one level with the potential of 40 different, non-interchangeable master key groups.

   e. Roller Catches for doors shall be nylon roller type, adjustable, with plated strike.

   f. Elbow Catches and strike plates shall be used on left hand doors of double door cases where locks are used, and are to be burnished cast aluminum, with bright brass finish.

   g. Shelf Adjustment Clips shall be nickel-plated steel.

   h. Leg Shoes shall be provided on all table legs, unless otherwise specified, to conceal leveling device. Shoes shall be a pliable, black vinyl material. Use of a leg shoe which does not conceal leveling device will not be acceptable.

   i. Support Rods, Upright Rod Assemblies and Rod Sockets. Upright rods, cross rods and ring support rods, where specified, shall be anodized Duralumin (2-inch or 3/4-inch diameter, as required). Rod sockets shall be chrome plated brass, secured through table tops with lock nut and spring washer. Rod clamps shall be heavy duty, designed to securely hold rod assembly in any position. Use of wood rod assemblies will not be accepted.

   j. Sink Supports shall be the hanger type, suspended from top front and top rear horizontal rails of sink cabinet by four 1/4-inch diameter rods, threaded at bottom end and offset at top to hang from two full length reinforcements welded to the front and rear top rails. Two 3/4-inch by 1-1/2-inch by 12 gauge channels shall be hung on the threaded rods to provide an adjustable sink cradle for supporting sinks. When sink capacity exceeds 3,750 cu. in., the sink supports shall be suspended from full-length reinforcements welded to the two end rails. Two 1-inch by 2-inch by 10 gauge full-length channels shall be hung from the four 1/4-inch diameter rods to provide an alternate sink cradle.

k. Support Struts shall consist of two 16 gauge channel uprights fastened top and bottom by two adjustable u-shaped spreaders, each 12 gauge, 1-1/2-inch by length required. Struts shall be furnished to support drain troughs, and to support worktop at plumbing space under fume hood superstructures or other heavy loads. Support struts can be furnished with hangers at extra cost when specified, to support mechanical service piping and drain lines.

E. CONSTRUCTION

1. General

a. The steel furniture shall be of modern design and shall be constructed in accordance with the best practices of the Scientific Laboratory Equipment Industry. First class quality casework shall be insured by the use of proper machinery, tools, dies, fixtures and skilled workmanship to meet the intended quality and quantity for the project.

b. All cabinets shall be flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.

c. Each cabinet shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts.

d. Case openings shall be rabbetted on all four sides for both hinged and sliding doors to provide a dust resistant case.

e. All cabinets shall have a cleanable smooth interior. Bottom shall be the pan type with both sides and back formed up for easy cleaning. Bottoms with pans turned down must be caulked around inside perimeter.

2. Steel Gauges - Gauges of steel used in construction of cases shall be 18 gauge, except as follows:

a. Corner gussets for leveling bolts and apron corner braces, 12 gauge.

b. Hinge reinforcements, case and drawer suspension channels, 14 gauge.

c. Top and intermediate front horizontal rails, table aprons and reinforcement gussets, 16 gauge.

d. Drawer assemblies, door assemblies and adjustable shelves, 20 gauge.

3. Cabinets

a. End uprights shall be formed into not less than a channel formation at top, bottom, back and front. The front edge shall further offset to form a strike for doors and drawers, and shall be perforated for the support of drawer channels, intermediate rails and hinge screws. An upright filler shall be screwed in place in all cupboard units to close the back of the channel at front of the upright and to provide a smooth interior for the cupboard to facilitate cleaning. The upright filler shall be perforated with shelf adjustment holes at not more than 2-inch centers painted prior to assembly. The inside front of the upright shall be further reinforced with a full height 14 gauge hinge reinforcement angle.

b. Top horizontal rail on base cabinets shall interlock within the flange at top of end panels for strength, but shall be flush as face of unit. Top rail shall have a full width rabbet for swinging doors and drawers. Reinforcements shall be provided at all front corners for additional welded strength between vertical and horizontal case members.

c. Intermediate rails shall be provided between doors and drawers, but shall not be provided between drawers unless made necessary by locks in drawers. When required, intermediate rails shall be recessed behind doors and drawer fronts, and designed so that security panels may be added as required.

d. Intermediate vertical uprights shall be furnished to enclose cupboards when used in a unit in combination with a half width bank of drawers. However, to allow storage of large or bulky objects, no upright of any type shall be used at the center of double door cupboard units.

e. Cabinet bottom, and bottom rail shall be formed of one piece of steel except in corner units and shall have both sides and back formed up with a radius between flange and bottom to provide for ease of cleaning, and shall be offset in front to provide a door and drawer recess rabbet.

f. Toe space rail shall extend up and forward to engage bottom rail to form a smooth surfaced fully enclosed toe space, 3-inch deep by 5-inch high. Whenever toe space base is omitted for units to set on building bases on separate steel bases, then the toe space rail shall extend back 4-1/2-inch.

g. Back construction shall consist of a top and bottom rail, channel formed for maximum strength and welded to back and top flange of end uprights, open for access to plumbing lines. Cupboard units only shall be provided with removable back panels.

h. Die formed gussets shall be furnished in each bottom corner of base units to insure rigidity, and a 3/8-inch, 16 leveling bolt, 3-inch long, shall engage a clinch nut in each gusset. Access to the leveling bolts shall be through plug buttons in the bottom pan. Each leveling bolt and gusset shall be capable of supporting 500 lbs. (Each unit shall support 2000 lbs. uniformly distributed on a worktop). Access to leveling bolts through toe space or leveling bolts requiring special tools to adjust are not acceptable.

i. Adjustable shelves shall be formed down 3/4-inch, returned back 7/8-inch and up 1/4-inch into a channel formation front and rear; formed down 3/4-inch at each end, shelves over 42-inch long shall be further reinforced with a channel formation welded to underside of shelf.

j. Drawer assembly shall consist of an outer head and a drawer body. The outer head shall have a channel formation on all four sides to eliminate sharp raw edges of steel and the top front corners shall be welded and ground smooth. Drawer bodies shall be made in one-piece construction including the bottom, two sides, back and front. They shall be fully coved at interior bottom on all four sides for easy cleaning. The top front of the inner drawer body shall be offset to interlock with the channel formation at the top of the outer drawer head providing a 3/4-inch thick drawer head. All drawer heads shall contain a sound deadening material.

k. Drawer/door assemblies shall be painted prior to assembly. Both shall be punched for attaching drawer pulls. Likewise, inner pan formation of door and drawer body shall be indented for in-field installation of locks when required. Door and drawer outer pans to be textured steel.

l. Drawer suspension assembly shall consist of two sections providing a quiet, smooth operation on ball bearing nylon rollers. All drawers shall be self-closing from a point 5-inch open. Cabinet channels shall maintain alignment of drawer and provide an integral drawer stop, but the drawer shall be removable without the use of tools. Drawers shall provide 13-5/8-inch front to back clearance when fully extended. Drawers shall rise when opened thus avoiding friction with lower drawers and/or doors. Drawer suspension system shall incorporate a double stop, lock open feature.

m. Doors shall be readily removable and hinges easily replaceable. Hinges shall be applied to the cabinet and door with screws. Welding of hinges to either cabinet or door will not be acceptable.

n. Knee space panels, where shown or specified, shall be 18 gauge, finished same as casework cabinets, and easily removable for access to mechanical service areas.

4. Special Purpose Storage Cabinets

a. Acid Storage Cabinets

(1) Acid storage cabinets shall utilize the same gauges of steel and construction features as other base cabinets except they shall be completely lined with a one piece Polyethylene corrosion resistant liner. The liner shall be 1/4-inch thick, molded into a seamless tub, including top, sides and bottom, with a 1-inch lip at the bottom front to contain spills. Each door shall have a set of louvers at the top and bottom and have a 1/8-inch sheet polyethylene liner.

(2) Where specified, each cabinet shall be vented into the fume hood with a 1-1/2-inch vent pipe. It should provide a positive airflow directly into the fume hood exhaust system.

b. Steel Sliding Door Cabinets

(1) Sliding door storage cabinets shall have a completely finished interior same as exterior. Doors shall be suspended from the top by nylon rollers in a roll formed steel track welded to top of cabinet. Track shall be so designed to prevent accidental removal of doors in operation position.

(2) End uprights shall be formed at front, bottom and back to provide maximum strength and rigidity. Front fascia of upright shall be 1-inch wide with inside edge formed in channel 2-inch by 1/4-inch. A full height box reinforcement shall be fitted to the channel, formed to provide a recessed strike for door and to reinforce the case. The back side of the reinforcement shall be perforated with shelf adjustment holes spaced at not more than 1-inch centers. The back of upright shall be formed to a 2-1/2-inch formation. A 14-gauge hinge reinforcement same as specified for base units shall be welded to inner side of front uprights.

(3) Cabinet tops shall be formed with a 1-1/2-inch wide front fascia, and a 2-inch by 2-inch channel formation at front edge flanged down and back. Door suspension roll formed steel track shall be welded to cabinet top.

(4) Cabinet flush bottoms shall be formed with a 1-inch wide front fascia, and a channel formation at front edge flanged back and up to create a door recess rabbet for dust stop.

(5) Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for shelf adjustment holes on not more than 1-inch centers. Holes shall be set in a channel formation in cabinet back and enclosed by end uprights.

(6) Adjustable shelves shall be formed down 3/4-inch, returned back 7/8-inch and up 1/4-inch into a channel formation front and rear, formed down 3/4-inch at each end, shelves over 42-inch long shall be further reinforced with a channel formation welded to underside of shelf.

(7) Glazed sliding doors shall be suspended from the top in a roll formed steel track welded to cabinet top and shall glide on nylon rollers. Track shall be so designed to prevent accidental removal of doors. Doors shall be 3/4-inch thick and consist of an inner and outer door pan welded together to form a single unit. Outer door pan shall be 18 gauge steel, formed into a channel or flanged shape at all four sides. It shall be pierced and formed to create a 3-inch wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 18 gauge steel, flanged at all four sides, and pierced for a glass opening in center of the door. Doors shall be glazed with 1/8-inch float glass, held in place by a rubber or vinyl gasket around the entire edge of the glass.

(8) Solid panel sliding doors shall be suspended same as glazed sliding doors. Door assembly (two-piece) shall consist of inner and outer pan formations, mechanically assembled after painting (electrodeposition). All doors shall be 3/4-inch thick and contain a structural foam sound deadening material.

(9) Sliding plate glass doors shall be available for 48-inch high cases and under. The plate glass doors shall operate on an extruded aluminum track at the bottom of the cabinet, and in an extruded aluminum channel at the top. The bottom of each glass door shall be furnished with a continuous aluminum shoe the full length of the door, which shall be equipped with two nylon rollers that operate on the extruded aluminum track. The aluminum shoes on the bottom of the plate glass doors shall be equipped with pulls for operation of the doors, and also to prevent bypassing of the doors. Plate glass doors shall close against rubber bumpers.

c. Steel Swinging Door Full Height Cabinet Construction

(1) Swinging door full height storage cabinets shall have a completely finished interior same as exterior.

(2) End uprights shall be formed at the front in a 1-inch channel formation with the inside flange formed to provide a 31/32-inch by 1/2-inch door recess. The back of the upright shall be formed to a 2-1/2-inch formation. A 14 gauge hinge reinforcement, same as specified for Base Cabinets, shall be welded to inner side of front uprights.

(3) Cabinet tops shall be formed into a 1-inch by 1-3/16-inch channel shape at front, with a 31/32-inch

by 1/2-inch offset for door recess, and with flange at rear and sides for electro-welding cabinet top to cabinet back and ends.

(4) Cabinet bottoms for storage cabinets shall have both sides and back formed up with a radius between flange and bottom to provide ease of cleaning, and shall be offset in front to provide a door recess rabbet for dust stop. Cabinet bottoms shall be formed to provide a flush 1-inch face rail with a return flange to give a 9/16-inch deep by 5-inch high toe space.

(5) Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for shelf adjustment holes on not more than 1-inch centers. Holes shall be set in a channel formation in cabinet back and enclosed by end uprights.

(6) Adjustable shelves shall be formed down 3/4-inch, returned back 7/8-inch and up 1/4-inch into a channel formation front and rear, formed down 3/4-inch at each end, shelves over 42-inch long shall be further reinforced with a channel formation welded to underside of shelf.

(7) Toe space rails shall interlock in back of bottom rail and with end panel to provide a welding plate, and shall extend to the floor with a flange turned back 1-1/2-inch and turned up 3/8-inch for support.

(8) Glazed swinging doors shall be 3/4-inch thick and consist of an inner and outer door pan welded to form a single unit. Outer door pan shall be 18 gauge steel, formed into a channel or flanged shape at all four sides. It shall be pierced and formed to create a 3-inch wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 18 gauge steel, flanged at all four sides, pierced for a glass opening in center of the door, with a 14 gauge hinge reinforcements welded in place. Doors shall be glazed with 1/8-inch float glass, held in place by a rubber or vinyl gasket around the entire edge of the glass. Outer door pan shall be pierced for a recessed flush pull, as described under Hardware.

d. Fume Hoods

(1) Fume Hoods shall be in accordance with the Laboratory Room Accessory Schedule on DRAWING 10 A-402, ENLARGED PLANS, ELEVATIONS SCHED. – LAB ROOM.

(2) A 4 foot long, 2 tube fluorescent light fixture shall be provided at the top of the hood and shall be isolated from the hood interior by a 1/4-inch thick tempered glass panel sealed from the hood cavity. Fixture shall be UL labeled.

(3) A vertical rising sash of 1/4-inch laminated safety float glass shall be provided. The sash shall have a neutral colored polyvinyl chloride horizontal member at the top and a full length metal handle at the bottom. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The sash track shall be a neutral colored polyvinyl chloride set flush with the interior liner panels.

(4) Hood work surface shall be 1-1/4-inch thick molded epoxy resin made in the form of a watertight pan, not less than 3/8-inch deep to contain spillage with a 6-inch wide safety ledge across the front edge. A cup drain flush with the recessed work surface shall be provided.

(5) Back- and side-splashes shall be provided for both fume hoods to protect furniture and equipment near to the hoods.

5. Duplex Receptacles

a. Furnish and install duplex receptacles and pedestals as shown on the Drawings. The duplex receptacles shall be rated 20 ampere, 125 volts, 3 pole, 2 wire grounding type, or 240 volt, 2 pole, 3 wire as appropriate as manufactured by Arrow-Hart Company, Hubbell, Incorporated, Bryant Electric Company or equal.

b. Plates for flush mounted curb receptacles shall be of Type 302 high nickel stainless steel and of the number of gangs as required for installation. The plates shall be of the same manufacturer as the receptacle device.

F. Equipment supplier shall be responsible for providing all equipment listed including all hangers, supports, ends, transition panels, and other items required for a complete installation.

G. Fluorescent lighting shall be furnished and mounted on the underside of each wall mounted storage case.

H. Each wall mounted storage case shall be mounted at an elevation determined by the ENGINEER in the field.

**2.02 - IDENTIFICATION OF MANUFACTURERS**

A. Manufacturers:

1. Kewaunee Scientific, Research Collection Steel Laboratory Furniture
2. Or equal.

**2.03 – FURNISHINGS**

A. Refer to Contract Drawings for a list of furnishings for Laboratory (Room 115).

B. Refer to Contract Drawings for a list of furnishings for Control Room (Room 116).

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the beginning the Work described in this Section, verify that the project is ready.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify and coordinate with subcontractors involved or affected by this work.

**3.02 - INSTALLATION**

A. All materials and equipment including tops, ledges, supporting structures, fume hoods, filler panels, knee space panels and miscellaneous items of equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16 - ELECTRICAL.

C. Installation of the equipment shall be in accordance with written instructions provided by the manufacturer and as approved.

D. The packing of the individual items for shipment, their shipment, movement and storage within the building, and unpacking shall be accomplished under the supervision of a manufacturer's representative.

E. Coordinate and provide necessary wall reinforcement and fasteners to support all wall mounted equipment.

**3.03 - PAINTING**

A. Steel Paint System Finish:

1. After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.
2. After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a corrosion-resistant finish anywhere moisture can accumulate using an –"Electrodeposition" dip tank. Surfaces to be coated include the inside of cabinet doors and drawer heads, behind all cross rails, all inside surfaces underneath the cabinet interior bottom panel, inside front and rear posts, inside of sub-base members, and behind adjustable shelf front and back edges. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.

3. Finishes specified to be a color other than Light Neutral shall then receive an additional sprayed and heat cured color coat, of the color specified, on all surfaces exposed to view after installation except as follows: drawer bodies, case channels, removable backs in cupboards and removable shelves (other than those in open front units or glazed units with swinging or sliding doors).

B. Shop painting and surface preparation shall be performed with strict accordance to the requirements listed in this section and those listed in SECTION 09940, SHOP PAINTING.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the case work, furniture, and equipment. Spillage of lubricants or materials used during installation shall be cleaned and replaced.

**3.05 - MANUFACTURER'S SERVICES**

A. The Manufacturer shall provide the services of a factory service technician for a period of not less than one day to verify that all equipment is assembled and installed according to the manufacturer's requirements, and to train the water pollution control facility staff in the operation of all equipment listed in this section.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with the DOCUMENT 00700, GENERAL CONDITIONS.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 12500**

**FURNITURE**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide furniture as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide furniture and storage units as specified. Assemble and install where indicated for a complete installation.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. Measurement and payment for the Work of this section related to the Equipment Storage Facility shall be included under Alternative A1. Measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the furnishings in the Equipment Storage Facility.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Product Data: Submit complete catalog cuts including manufacturer’s material descriptions and finish for each item of office furniture and storage unit specified. Manufacturer's statement substantiating that the materials comply with the requirements shall be included.

2. Samples: Three samples of baked enamel finishes, fabrics and plastic laminates shall be submitted for color selection and approval.

3. Color and finish selection shall be by Engineer.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Furniture and storage units shall be properly protected in accordance with the manufacturer’s requirements so that no damage or deterioration will occur from the time of shipment until installation is completed.

E. Delivery of Materials:

a. Materials shall not be delivered to the project site before the time of installation.

b. Materials shall be delivered in sufficient quantities to allow continuity of the Work.

c. Factory assembled parts and components shall not be dismantled for shipment.

F. Storage of Materials:

a. Materials shall be stored in original, undamaged containers with manufacturer's labels and seals intact.

b. Materials shall be stored in a dry, enclosed area, off the ground and away from all possible contact with water, ice or snow.

c. Damage to materials during storage shall be prevented primarily by minimizing the amount of time they are stored at the site before being incorporated into construction systems.

G. Handling of Materials:

a. Materials shall be handled carefully in order to avoid damage or breakage.

b. Materials shall not be exposed to detrimental conditions or physical damage. Materials which are so exposed shall be permanently removed from the site and shall not be incorporated into the Work.

c. Packages or containers shall not be opened until all necessary preparatory Work is complete and installation is to begin immediately. Materials shall not be allowed to become wet or soiled or covered with ice or snow.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**PART 2 – PRODUCTS**

**2.01 - MANUFACTURERS**

A. Owner has standardized furniture as manufactured by HON Office Furniture, Muscatine, IA.

B. Refer to Furniture Schedule on drawings.

1. HON furniture is the proprietary manufacturer for all office furniture unless another manufacturer is identified. All other listed items which show a different manufacturer are to be ‘basis of design’ products in order to establish a minimum standard of quality.

**2.02 - MATERIALS**

A. Office furniture shall be of contemporary design with rectilinear lines.

B. Refer to Furniture Schedule on drawings.

1. Furniture and accessories specified in this Section are keyed to the products of HON Office Furniture to establish a minimum standard of quality.

PART 3 – **EXECUTION**

**3.01 - EXAMINATION**

A. Verify that areas to receive furniture and storage units are properly prepared and completed. The rooms in which furniture is to be installed shall have all work of all other trades completed so as to minimize the possibility of soil or damage occurring to the furniture.

**3.02 - INSTALLATION**

A. Office furniture and storage units shall be uncrated, assembled and placed where indicated on the drawings and as directed. All crating and shipping materials shall promptly be removed and properly discarded.

**3.03 - PROTECTION**

A. All furniture items and storage units shall be protected from soil, damage, and abuse until final acceptance by the Owner.

**3.04 - ADJUSTMENT**

A. Furniture and storage unit components which are dislodged, damaged, expanded, broken, penetrated or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced, at no additional cost to Owner, with new and undamaged material in compliance with the specifications and properly protected as specified.

**3.05 - CLEANING**

A. After installation, furniture shall be cleaned and left in a neat condition. Units shall be cleaned using materials and processes as recommended by the manufacturer.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 13300**

**INSTRUMENTATION AND CONTROL SYSTEM – GENERAL**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide a complete, functional control system as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide and test the instrumentation and controls systems as specified and indicated on the Contract Drawings.

D. Provide all equipment, installation, services, and appurtenances required to achieve a complete, integrated, and fully operational system.

E. Contractor shall retain the services of a System Integrator (SI). The SI shall be responsible for the system integration, programming and making all components of the system operate as a whole. The SI shall be responsible for providing instrumentation, control system hardware, control system programming and instrument calibration services for this contract as well as for Contract 2019-02: Downtown Area Collection System and Pumping Stations. Instrumentation drawings for this contract are included as an appendix to this section.

F. Contractor shall install in place all instruments and control system hardware.

G. Provide and calibrate instruments as specified in SECTION 13330 PROCES INSTSRUMENTS.

H. Provide programming and integration services as specified in SECTION 13331, CONTROL SYSTEM INTEGRATION.

I. Provide PLC control panels as specified in SECTION 13340, PLC CONTROL PANELS.

J. Provide data network equipment as specified in SECTION 13345, DATA NETWORK.

K. Provide SCADA equipment as specified in SECTION 13350, SCADA EQUIPMENT.

L. Test all components individually as well as in a system as specified.

M. The Contractor shall be responsible with the assistance of the SI for the coordination of other equipment furnished in this contract with overall control system requirements.

N. Preconstruction Meeting: The Contractor shall arrange a Preconstruction Meeting. The meeting shall be held prior to the submission of shop drawings. The meeting shall be held at the job site. The meeting shall be attended by the Contractor, the Owner, a technical representative of the SI and the Engineer. The purpose of the meeting shall be to review the scope of work, submittal procedures, project documentation, proposed instruments and control systems, contacts and communications and other issues that the Contractor, Owner or the SI may wish to discuss.

O. All equipment shall comply with the electrical area classification indicated in the electrical drawings.

P. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

Q. Provide UL approved materials and equipment.

R. Ambient Conditions for control panels

1. Minimum Temperature: 50 degrees F
2. Maximum Temperature: 90 degrees F
3. Relative Humidity: 95% Non-condensing

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Field Instrumentation

2. PLC Control Panels Hardware and Software

3. Servers and Network Equipment

4. SCADA HMI Screens

C. Provide submittals for all instrumentation and control systems equipment as indicated under the referenced specification sections.

1. All submittals related to the instrumentation and control system, including vendor-supplied PLC control panels, provided by the Contractor shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed and all SI comments have been addressed.

2. Operation and Maintenance Manuals.

3. Submit "record copy" of all drawings previously submitted for review within 30 days after completion of system installation as part of operating and maintenance instructions. Show all changes and modifications made during installation. Define special maintenance requirements particular to system along with special calibration and test procedures.

4. Submit brief description of calibration procedures listing actual calibration and test equipment. Include typical calibration sheet and description of loop check procedures, provide typical loop check sheet.

5. Provide manufacturer's certified statement of installation approval.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. References:

1. Federal Specifications: WW-T-799F; Tube, Copper, Seamless, Water, (For Use with Solder-Flared-Or Compression Type Fittings).

2. National Fire Protection Association: NFPA 70.

3. The International Society of Automation (ISA) PR7.1, Pneumatic Control Circuit Pressure Test, Tentative Recommendation Practice.

4. American Petroleum Institute (API) RP-550 Manual of Installation of Refinery Instruments and Control Systems.

5. The International Society of Automation (ISA) S5.2, S5.3 and S5.4, Instrument Loop Diagrams, standard.

6. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS1 and Industrial Controls and Systems ICS2.

**1.07 - QUALITY ASSURANCE**

A. Work of SI service personnel shall be coordinated by the Contractor.

B. Coordinate with instrumentation, mechanical and electrical systems suppliers to identify any signal isolation, signal boosting devices or auxiliary relays that may be required to complete the system.

C. Provide auxiliary devices for proper operation, such as transducers, relays, current/current isolators, and signal boosters for interfacing with equipment provided under this and other sections of this specification.

D. Provide a qualified manufacturer representative to oversee the installation, the placing and location of system components, the location of sleeves, methods of installing conduits and special cables, mounting, piping, and wiring of one of each type of device, and methods of protecting all equipment prior to being placed into service, their connections to the process equipment panels, cabinets and devices, subject to the Owner's approval. Provide on-site services for a minimum period of three 8-hour days, excluding travel time. Certify that all field wiring for power and signal circuits are correctly installed and terminated in accordance with best industry practice and provide for all system grounding to insure a satisfactory functioning installation. Schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of Division 16.

E. Upon completion of installation, provide service personnel, for field check-out of the System.

F. Instrument Calibration: Calibrate electronic and pneumatic test equipment within 6 months prior to use. Accuracies of test equipment shall be traceable to Bureau of Standards.

G. Provide calibration tag to all calibrated instruments. The calibration tag shall have the name and phone number of the SI who performed the calibrations with the date of calibration and the date of the next calibration. The tag shall be signed by the individual that performed the calibration. Linkage or range adjustments sealed by colored lacquer immediately following calibration. Provide calibration records to the Engineer prior to substantial completion.

H. System energizing not allowed prior to receipt of certified statement from Contractor and supplier approving system and authorizing energizing of system.

I. Protect materials and equipment against damage in storage and during construction.

J. Replace damaged materials or equipment as determined by the Engineer at no additional cost to the Owner.

K. Engineer and/or Owner shall inspect and observe the testing of the equipment at its site of manufacture, fabrication or assembly. Equipment shall include cabinets, control devices, computerized equipment, panel equipment and field equipment. No equipment shall be shipped without Engineer's approval. Provide 21 days written notice for Engineer's inspection.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. Equipment Manufacturer – Not Used

C. Contractor

1. The Contractor shall provide a warranty that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply. The Warranty, obtained by the Contractor, shall be secured by a Performance Bond issued jointly to the Contractor and the Owner. The Contractor agrees to furnish a Warranty in the sum of the full amount of the equipment price and duly executed by the said Contactor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract.

3. The Contractor shall be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor's and Equipment Manufacturer's responsibility to resolve any and all warranty claims.

E. The Warranties shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bonds will be summarily rejected and returned to the Contractor without further review and consideration.

## PART 2 - PRODUCTS

### 2.01 - GENERAL

A. Equipment, cabinets and other devices furnished hereunder shall be rated for continuous use in the intended application.

B. The system shall consist of current production products.

C. Equipment shall be UL listed (or approved equivalent listing where UL listing is not available).

D. Refer to equipment specification sections as referenced.

### 2.02 - SPARE PARTS

A. Spare Parts:

1. Provide spare parts specified in the products specifications.

### 2.03 - SHOP TESTING

A. Provide shop testing for individual equipment as specified under Division 13.

B. Coordinate with the S.I. to provide a shop, factory and field test plan outlining the proposed procedures for testing all field primary devices, final control elements, local control panels, the control system, and termination cabinets at the factory prior to shipment. This plan shall demonstrate the system performs as specified and as indicated. Submit the shop test plan with the shop drawings as specified. Submit results of test to Engineer.

C. Conduct a Witness Factory Test (WFT) that will be attended by the Engineer and/or Owner. The WFT shall include:

1. The entire system, except for primary elements, final control elements, and field-mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of monitoring devices/functions and control devices/functions.

2. All panels, consoles and assemblies shall be inspected and tested to verify that they are in conformance with related shop drawing submittal, and these specifications and contract documents.

    a. During the tests all digital system hardware shall be operated for at least five days continuously trouble free to verify the system is capable of continuous operation.

3. Provide all temporary cables including fiber optic and CAT 5, necessary to connect all control system components including PLC control system communication cables for use during factory testing.

    a. Perform a 100 percent check of all I/O to the interface terminal blocks and verification of all communications networks. I/O verification includes testing each analog signal at zero, fifty, and one hundred percent, and each digital signal at its zero and one state. Where remote I/O (RIO) panels alone are part of the test (where the corresponding master PLC-based panel is existing in the field), tests shall confirm the wiring between terminals and the module I/O points.

    b. Test the functionality of each selector switch and push-button.

    c. Test the functionality of each indicator light and annunciator point.

    d. Confirm accurate signaling at each analog indicator, recorder, and controller at zero, ten, fifty, ninety, and one hundred percent of range.

    e. Test each computer to ensure system boots correctly, allows access to all system components including hard drives, disk drives, CD-ROM drives, and communications networks.

f. Test each communications network link using an Engineer-approved SI test configuration to verify successful completion of required communications paths including: sending data to and receiving data from a PLC, (PC to PLC communications), sending data to and receiving data from another PLC or control system (PLC or control system to PLC communications), sending data to and receiving data from another PC (PC to PC communications), and sending data to all printers.

4. Notify the Owner in writing that the system is ready for the WFT and allow the Owner to schedule a test date within 21 days of receipt of the "Ready To Test" letter. At the time of notification, the SI shall submit any revisions to the detailed test procedure previously approved by the Owner/Engineer in the project system plan.

5. All control panels shall be included in these tests.

6. All deficiencies identified during these tests shall be corrected and retested prior to completion of the WFT as determined by the Owner and/or Engineer.

7. The following documentation shall be made available to the Owner and/or Engineer at the test site both before and during the WFT:

   a. All drawings and specifications, addenda and change orders and approved shop drawings.

   b. Master copy of the test procedure.

   c. List of the equipment to be tested including make, model and serial number.

   d. Design related hardware and software submittal applicable to the equipment being tested.

   e. Approved test procedure.

8. All test data and procedure followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

D. All "punch list" items or deficiencies shall be corrected by the SI prior to starting the Field Test.

E. Test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the SI shall be tested at the factory.

F. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Engineer.

G. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

H. Copies of these sign off test procedures prepared by SI, forms and checklists will constitute the required test documentation.

I. The SI shall provide all special testing materials and equipment, including all interconnecting wires and cables between equipment to be tested, required to conduct the test in accordance with these specifications. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide an approved means of simulation. Define these simulation techniques in the test procedures.

J. Coordinate all testing with the Engineer and Owner.

K. The Engineer and Owner reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures without additional cost.

L. The Owner’s decision shall be final regarding the acceptability and completeness of all testing.

M. No equipment shall be shipped until the Owner has received all test results and approved the system is ready for shipment.

## PART 3 - EXECUTION

### 3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

### 3.02 - INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16 - ELECTRICAL.

C. Provide proper installation of the equipment in accordance with manufacturer’s written instructions and/or as approved by the Engineer. Coordinate the proper installation of equipment with the Work of all other trades.

### 3.03 - PAINTING

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09900, PAINTING.

### 3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

### 3.05 - MANUFACTURER'S FIELD SERVICES

A. Provide field services for the instrumentations and control systems as specified under their the respective section.

### 3.06 - MANUFACTURER'S TRAINING

A. Provide training for the instrumentations and control systems as specified under their the respective section.

### 3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

### 3.08 - SPARE PARTS

A. Provide spare parts for the instrumentations and control systems as specified under their the respective section.

### 3.09 - SHOP TESTING

A. Provide shop testing for the instrumentations and control systems as specified under their the respective section.

### 3.10 - FIELD TESTING

A. Provide field testing for the instrumentations and control systems as specified under their the respective section.

### 3.11 - GENERAL INSTALLATION

A. Install instrumentations and control systems as specified under equipment sections and in accordance with manufacturer’s instructions.

**3.12 - CONTROL PANEL INSTALLATION**

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's printed instructions and approved shop drawings. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be determined by the SI during development and fabrication of systems. Obtain in the field, all information relevant to the placing of the process equipment and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials to complete the work in an approved manner at no additional cost to the Owner.

B. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.

C. For installation of fiber optic cable within control panels or control assemblies, follow cable manufacturer’s specification for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief to meet manufacturer’s strain requirements.

**3.13 - TRAINING**

A. Upon completion of the start-up, provide competent training personnel for a period of not less than three, 8-hour working days, excluding travel time, for training of personnel in the use, operation and maintenance of the instrumentation and control system. Training to utilize the submitted operation and maintenance manuals and record copy drawings as reference materials. Training to be for 6 personnel in each class. Each class to be of a 4 hour duration.

**3.14 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 13330**

**PROCESS INSTRUMENTS**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide process instruments as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) shall furnish process instruments as specified and in accordance with the Contract Documents.

D. Instrument Product Sheets are in Attachment A.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Field Instrumentation

C. Submit the following shop drawings in accordance with Section 01300.

D. All submittals provided by the Contractor under this specification section shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments has been addressed and that the submittal is reviewed by the SI.

E. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

F. Submit Product Data Sheets, in accordance with ISA-S20 with the information noted below and other data pertinent to the equipment and the application.

1. Initial submission for review to accompany Shop Drawings:

a. The product manufacturer and the supplier or representative.

b. The complete model or catalogue number(s) including any special options.

c. The available adjustment range(s) and the operating range(s).

2. Second Submission during pre-commissioning, testing and calibration period:

a. Serial numbers, part numbers, dates of installation and calibration.

b. Calibration and programming procedure.

c. Calibration and programming documentation.

d. Provide linkage or range adjustments sealed by colored lacquer following calibration.

e. This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

3. Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

a. All of the above information.

b. Phone number and email address of contact person for product support/service.

G. Submit Shop Drawings for all instruments. Manufacturers' catalog cuts and product specifications shall be accepted only if the following information is clearly indicated and highlighted for the equipment proposed:

1. Submit information on each instrument to demonstrate compliance with the data sheet.

2. Tag names, quantities, options provided, full description and performance data.

3. Installation details depicting mounting assemblies, physical dimensions.

4. Termination details, clearly indicating the type and lengths of external wiring required and electrical connections.

5. Power supply rating, input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements.

6. Specific catalog model numbers for each piece of equipment and its accessory options, clearly referenced by the respective instrument or equipment tag name. Improperly tagged items shall be rejected.

7. Sales bulletins and other general publications are not acceptable as submittals except where necessary to provide supplemental technical data.

H. Submit a separate document with manufacturers' recommended list of spare parts, including individual pricing with the shop drawings.

I. Drawing submissions shall clearly show the enclosures proposed for each instrument.

J. Submit completed Calibration forms and Instrument Installation Checklist forms.

K. Submit schedule of proposed instrument nametag inscriptions.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Where possible, all equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings and on the data sheets.

D. References:

1. American Petroleum Institute (API):

   a. RP 551: Process Measurement Instrumentation

2. International Society of Automation (ISA):

   a. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

3. National Electrical Manufacturers Association (NEMA):

   a. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.07 - QUALITY ASSURANCE**

A. All instruments shall be UL listed or equivalent listing system when UL listing is not available.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. Equipment Manufacturer

1. The Equipment Manufacturer shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. In addition, the Equipment Manufacturer shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein. The Warranty, obtained by the Equipment Manufacturer, shall be secured by a Performance Bond issued jointly to the Equipment Manufacturer and the Owner. The Equipment Manufacturer agrees to furnish a Warranty in the sum of 100 percent of the equipment price and duly executed by the said Equipment Manufacturer as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety,

for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract.

3. The Equipment Manufacturer shall be responsible for execution of warranties during the warranty period should the need arise.

C. Contractor

1. The Contractor shall provide a warranty that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply. The Warranty, obtained by the Contractor, shall be secured by a Performance Bond issued jointly to the Contractor and the Owner. The Contractor agrees to furnish a Warranty in the sum of the full amount of the equipment price and duly executed by the said Contactor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract.

3. The Contractor shall be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor's and Equipment Manufacturer's responsibility to resolve any and all warranty claims.

E. The Warranties shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bonds will be summarily rejected and returned to the Contractor without further review and consideration.

## PART 2 - PRODUCTS

### 2.01 - GENERAL REQUIREMENTS

A. Provide instruments with enclosure rating indicated on electrical drawings or in instrument Product Sheet - whichever is more stringent.

B. Instruments shall have an integral indicator to display the current process measurement, calibrated in engineering units. Blind instruments shall be provided with a separate digital indicator mounted adjacent to the instrument as specified.

C. Provide electronic instruments with linear 4-20 mA DC isolated output signals capable of driving a maximum load of 750 ohms.

D. Electronic instruments shall have integral configuration capability. Instruments without integral configuration capability shall be provided with a wireless remote handheld terminal. One handheld terminal shall be provided for each type of device in the Contract Documents.

E. Provide standard instrument process connections of 1/2 inch (12.7 mm) NPT female, other than pressure gauges which shall be 1/2-inch (12.7 mm) NPT male.

F. Instruments shall be of current manufacturer design. Obsolete equipment or equipment that has been identified for withdrawal from the market by the manufacturer before date of shop drawing submittal shall not be accepted.

G. Field measure lengths for transducer cables and similar items prior to ordering and supply adequate cable length for application.

**2.02 - MATERIALS**

A. Provide manufacturer's written certificate that the materials of construction are suitable for the service and process fluids.

**2.03 - EQUIPMENT**

A. Provide instruments in accordance with the Product Sheets, Schedules, and Special Construction notes in the attachments to this Section.

**2.04 - ACCESSORIES**

A. Provide the necessary mounting brackets and mechanical shields to secure and protect transducers and other instrumentation devices.

B. Provide all electrical connections, transducer junction boxes, power supplies, and accessory items or options required to satisfy each application.

C. Provide cable between transducers and transmitter units with adequate length based on the location of the devices as shown on the Contract Drawings. Cables shall be continuous run with no splices.

D. Mounting brackets shall be AISI 316 Stainless Steel, and design to securely fasten the devices.

E. Provide shields for outdoor mounted electronic instrument with integral displays, to provide protection against rain, ice and snow and shade from the sun.

F. Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joints or couplings in accordance with the Manufacturer's written instructions.

G. Provide identification nametags for instruments, engraved stainless steel, 3 inch x 1.5 inch x 1/16 inch. Affix to component with minimum 18 AWG minimum stainless steel wire or stainless steel screws. Provide inscription in block letters with following lines, text height as indicated:

1. Line 1: Device Tag and Name, ¼ inch.
2. Line 4: Power Source, 1/6 inch.

**PART 3 – EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - INSTALLATION**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16 - ELECTRICAL.

C. Provide proper installation of the equipment in accordance with manufacturer's written instructions and/or as approved by the Engineer. Coordinate the proper installation of equipment with the Work of all other trades.

**3.03 - PAINTING**

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09900, PAINTING.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided for installation, startup and training for the equipment as follows:

1. 3 working days (via 2 separate trips to project site).

**3.06 – NOT USED**

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Provide spare parts as indicated on the instruments' data sheets.

**3.09 - SHOP TESTING – Not Used**

**3.10 - INSTALLATION**

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer's written instructions.
2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.
3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless Steel.
4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.
2. Orient instrument displays to be easily viewed from a standing position.
3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.
4. Unless otherwise indicated in the Contract Documents, mount instruments 55 inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.
5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.
7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.
8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless Steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.
2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.
3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.
4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.
5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

**3.11 - PRE-COMMISSIONING**

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer’s written instructions.
2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.
3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless Steel.
4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.
2. Orient instrument displays to be easily viewed from a standing position.
3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.
4. Unless otherwise indicated in the Contract Documents, mount instruments 55 inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.
5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.
7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.
8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless Steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.

2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.

3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.

4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.

5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

**3.12 - COMMISSIONING**

A. Demonstrate instrument calibration and loop checks. Each loop check shall be witnessed by, and successfully demonstrated to the Engineer for sign-off.

**3.13 - MANUFACTURER SERVICES AND CERTIFICATION OF INSTALLATION**

A. Provide the services of a trained, qualified manufacturer's representative to test, program and start the instruments to ensure correctness of installation, calibration, testing, start-up, commissioning and training.

B. Manufacturer field services shall be split into three stages: inspection during installation, start up and commissioning, plant operation personnel training.

C. The qualified representative shall:

1. Provide on-site supervision of installation, commissioning and testing for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as required by the Engineer. The Engineer may order additional supervision at no additional cost to the Contract if, in their opinion, procedures are compromised.

2. Provide operation and maintenance instruction to the plant operation personnel.

D. Provide all materials, labor and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer.

E. On completion of installation and testing, provide written certification from the manufacturer confirming that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.

**3.14 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**ATTACHMENT A**
**INSTRUMENTS PRODUCT SHEETS**

| | |
|---|---|
| DATA SHEET 1.1 | pH/ORP SYSTEM SPECIFICATION |
| DATA SHEET 2.1 | DO SYSTEM SPECIFICATION |
| DATA SHEET 3.1 | pH AND DISSOLVED OXYGEN SYSTEM SPECIFICATION ADDITIONAL REQUIREMENTS |
| DATA SHEET 6.1 | PERISTALTIC TYPE AUTOMATIC SAMPLER SPECIFICATION |
| DATA SHEET 10.1 | TURBIDITY/TOTAL SUSPENDED SOLIDS ANALYZER SPECIFICATION |
| DATA SHEET 48.1 | GAS SENSOR TRANSMITTER SPECIFICATION |
| DATA SHEET 50.1 | CONTINUOUS ON-LINE MULTI-PARAMETER ANALYZER SPECIFICATION |
| DATA SHEET 416.1 | MAGNETIC FLOW METER SPECIFICATION |
| DATA SHEET 426.1 | THERMAL DISPERSION FLOW METER SPECIFICATION |
| DATA SHEET 442.1 | FLOW SWITCH (PADDLE TYPE) SPECIFICATION |
| DATA SHEET 443.1 | ROTAMETER SPECIFICATION |
| DATA SHEET 853.1 | LEVEL SWITCH (FLOAT TYPE) SPECIFICATION |
| DATA SHEET 859.1 | LEVEL TRANSMITTER (ULTRASONIC TYPE) SPECIFICATION |
| DATA SHEET 864.1 | LEVEL SWITCH MINIATURE FLOAT TYPE) SPECIFICATION |
| DATA SHEET 873.1 | SUBMERSIBLE WATER LEVEL SENSOR/TRANSMITTER SPECIFICATION |
| DATA SHEET 1451.1 | GAUGE PRESSURE TRANSMITTER SPECIFICATION |
| DATA SHEET 1452.1 | PRESSURE SWITCH SPECIFICATION |
| DATA SHEET 1454.1 | PRESSURE GAUGE SPECIFICATION |
| DATA SHEET 1457.1 | PRESSURE ISOLATOR RING SPECIFICATION |
| DATA SHEET 1662.1 | ROOM/OUTSIDE AIR TEMPERATURE SENSOR SPECIFICATION |

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**pH/ORP SYSTEM SPECIFICATION**

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**DATA SHEET 1.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | See Table Below |
| 2. | Service | : | See Table Below |
| 3. | P&ID No. | : | See Table Below |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

ELECTRODE STATION

| | | | |
|---|---|---|---|
| 5. | Type | : | SUBMERSIBLE |
| 6. | Electrodes | : | GLASS Ph, PLATINUM ORP AND DOUBLE JUNCTION REFERENCE |
| 7. | Temperature Comp. | : | AUTOMATIC |
| 8. | Range Measured | : | 0 TO 14 Ph OR ± 2000mV ORP |
| 9. | Sensitivity | : | ±0.02 pH |
| 10. | Repeatability | : | pH ±0.05 pH, ORP ±3 mV |
| 11. | Enclosure | : | SUBMERSIBLE |
| 12. | Material | : | EPOXY RESIN PLASTIC |

TRANSMITTER

| | | | |
|---|---|---|---|
| 13. | Type | : | ELECTRONIC |
| 14. | Input Power Source | : | 120VAC |
| 15. | Output Signal | : | 4 - 20 mADC, FOR PH TRANSMITTER, PROVIDE ADDITIONAL OUTPUT SIGNAL FOR TEMPERATURE |
| 16. | Local Indicator | : | LCD DISPLAY |
| 17. | Diagnostics | : | BROKEN GLASS, LIQUID LEAK, RTD-SHORT/OPEN, FAILED PREAMP, FOULED REFERANCE |
| 18. | Enclosure | : | IN ACCORDANCE WITH AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 19. | Accuracy | : | ±0.04% OF FULL SCALE |
| 20. | Repeatability | : | SAME AS ACCURACY+/-0.1 pH UNIT |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 21. | Fluid | : | SEE TABLE |
| 22. | Solution Temp. | : | -20 TO +40°C (-4 TO 100°F) |
| 23. | Operating Pressure | : | 2 TO 10 FEET WATER |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 24. | Interconn. Cable | : | 50 FEET WITH QUICK DISCONNECT |
| 25. | Manufacturer(s) | : | E+H, CERLIC, FOXBORO OR EQUAL TRANSMITTER |
| 26. | Model No.(s) | : | CPF 81/82 & CPM 153 OR 223, PHx & BB2, pH10 & 870ITP OR EQUAL |

| TAG NO. | SERVICE | FLUID | P.&I.D |
|---|---|---|---|
| AE/AIT-1005A | PRE-EQUALIZATION TANK 1 pH | INF | 10 DI-602 |
| AE/AIT-1005B | PRE-EQUALIZATION TANK 1 ORP | INF | 10 DI-602 |
| AE/AIT-1006A | PRE-EQUALIZATION TANK 2 pH | INF | 10 DI-602 |
| AE/AIT-1006B | PRE-EQUALIZATION TANK 2 ORP | INF | 10 DI-602 |
| AE/AIT-1130 | SEPTAGE RECEIVING pH | SEP | 10 DI-611 |
| AE/AIT-1021A | SBR 1 pH | SBI | 15 DI-601 |
| AE/AIT-1021B | SBR 1 ORP | SBI | 15 DI-601 |
| AE/AIT-1032A | SBR 2 pH | SBI | 15 DI-601 |
| AE/AIT-1032B | SBR 2 ORP | SBI | 15 DI-601 |

NOTES.

a. See Data Sheet 3.1 for additional requirements.

**DISSOLVED OXYGEN SYSTEM SPECIFICATION**

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**DATA SHEET 2.11**

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| | | | |
|---|---|---|---|
| GENERAL | | | |
| 1. | Tag Number | : | SEE TABLE NEXT PAGE |
| 2. | Service | : | SEE TABLE NEXT PAGE |
| 3. | P&ID No. | : | SEE TABLE NEXT PAGE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |
| ELEMENT - PROBE | | | |
| 6. | Type | : | SUBMERSIBLE LUMINESCENT TECHNOLOGY SENSOR |
| 7. | Range Measured | : | 0-20 mg/l |
| 8. | Compensation | : | AUTOMATIC FOR PRESSURE, TEMPERATURE & HUMIDITY |
| 9. | Enclosure | : | SUBMERSIBLE |
| 10. | Mounting | : | SUSPENSION ASSEMBLY HOLDER. |
| 11. | Material | : | STAINLESS |
| TRANSMITTER | | | |
| 12. | Type | : | ELECTRONIC |
| 13. | Input Power Source | : | 120 VAC |
| 14. | Output Signal | : | 4 - 20 mADC |
| 15. | Display | : | DIGITAL PPM, 0-100%, TEMPERATURE AND ALARM TRIP SETTINGS |
| 16. | Key Pad | : | MEMBRANE TYPE FOR CONFIGURATION, CALIBRATION, AND PROCESS INFORMATION |
| 17. | Contacts | : | WHEN REQUIRED BY LOOP, SPDT 3 APMS AT 120 VAC |
| 18. | Accuracy | : | ±1.0% MEASURING RANGE AT CALIBRATION TEMPERATURE |
| 19. | Enclosure | : | NEMA 4X (IP65) WITH SUN SHIELD |
| 20. | Mounting | : | WALL OR STRUT |
| PROCESS CONDITIONS | | | |
| 21. | Fluid | : | SEWAGE AERATION TANKS |
| 22. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 23. | Operating Pressure | : | 2 TO 10 FEET WATER |
| MISCELLANEOUS | | | |
| 24. | Interconn. Cable | : | 50 FEET WITH WATER TIGHT IP66 QUICK DISCONNECT FITTINGS |
| 25. | Manufacturer(s) | : | HACH, E+H, CERLIC, ROSEMOUNT OR EQUAL |

NOTES.

a. See Data Sheet No. 3.1 for additional requirements.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AE/AIT 1021F | SBR 1 DISSOLVED OXYGEN | 15 DI-601 |
| AE/AIT 1031F | SBR 2 DISSOLVED OXYGEN | 15 DI-601 |

**pH, ORP AND DISSOLVED OXYGEN SYSTEM SPECIFICATION**
**ADDITIONAL REQUIREMENTS**

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**DATA SHEET 3.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE DATA SHEETS 1.1 AND 2.1 |
| 2. | Service | : | SEE DATA SHEET 1.1 AND 2.1 |
| 3. | P&ID No. | : | SEE DATA SHEET 1.1 AND 2.1 |
| 4. | Location | : | SEE DATA SHEET 1.1 AND 2.1 |

OTHER REQUIREMENTS:

5. All wetted parts must be suitable for the intended service conditions.
6. Provide field replaceable sensor, Salt Bridge, Standard Cell Solution, ORP reference solution (500mL Bottles)
7. Supply each probe with 50 feet of cable, with a weatherproof plug on each end for connection to the transmitter. Provide a cover permanently attached to protect the probe when not in use.

FOR SUBMERSIBLE SENSORS

8. Provide a suspension assembly to mount transmitter and sensor. Provide upright 316 Stainless Steel post to mount transmitter and support transverse pipe assembly with easily removed clamps. Provide transverse pipe to hold sensor assembly. Provide weather shield to protect transmitter. Provide complete assembly like E+H CYY 101 w/ immersion assembly or tube. Do not mount transmitter and or analyzer to the railings.
9. Provide each probe with a 316 stainless steel mounting brackets.

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**PERISTALTIC TYPE AUTOMATIC SAMPLER SPECIFICATION**

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**DATA SHEET 6.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SAMPLER

| | | | |
|---|---|---|---|
| 5. | Type | : | SELF CONTAINED REFRIDGERATED SAMPLER |
| 6. | Discrete/Composite | : | PROGRAMMABLE, DISCREET AND COMPOSITE |
| 7. | Fixed/Portable | : | FIXED |
| 8. | Refrigeration | : | REQUIRED, SAMPLE TEMPERATURE STABILITY MAINTAINED 39°F/4°C FOR OPERATING TEMP RANGE 5°F TO 104°F/-15°C TO 40°C |
| 9. | Bottle Type/Size | : | ONE 2.5 GAL BOTTLE |
| 10. | Bottle Quantity | : | SEE NOTES |
| 11. | Sample Volume | : | VACUUM PUMP - 20ml to 350ml/0.7fl oz to 12fl oz |
| 12. | Sample Frequency | : | PROGRAMABLE, USER-DEFINED TEXT, MULTIPLE SAMPLING MODES RUNNING SIMULTANEOUSLY TO ALLOW AUTOMATIC MODE CHANGE WITHOUT OPERATOR PARTICIPATION |
| 13. | Sample Mode | : | VACUUM PUMP - CONSTANT TIME/CONSTANT VOLUME, VARIABLE TIME/CONSTANT VOLUME; EVENT SAMPLING. PERISTALIC PUMP - CONSTANT TIME/CONSTANT VOLUME; VARIABLE TIME/ CONSTANT VOLUME; CONSTANT TIME/VARIABLE VOLUME; EVENT SAMPLING |
| 14. | Sample Height | : | 26 FEET |
| 15. | Power Requirement | : | 120 VAC, 60 HZ 10AMP MAXIMUM |
| 16. | Communication | : | 4-20mA |
| 17. | Sample Line Size | : | 10 mm (3/8"), 98 FT MAX LENGTH, PVC/EPDM W/ CORROSION RESISTANT STRAINER |
| 18. | Wetted Materials | : | CORROSION RESISTANT |
| 19. | Enclosure Class | : | PER AREA CLASSIFICATION SCHEDULE ON SHEET 00 E-601. |
| 21. | Exterior Finish | : | ASA-PC V0 LURAN TO UL508 , UL60950-1 |
| 22. | Battery Back-up | : | REQUIRED, EXTERNAL 24V, RECHARGEABLE; INTERNAL LITHIUM |

SAMPLING RANGE

| | | | |
|---|---|---|---|
| 22. | Flow Proportional | : | PROCESS FLOW, PROGRAMABLE W/ AUTOMATIC MODE CHANGE |
| 23. | Time Proportional | : | PROGRAMABLE W/ AUTOMATIC MODE CHANGE, MINUTES AND HOURS |

ENCLOSURE

| | | | |
|---|---|---|---|
| 24. | Installation | : | INDOORS |
| 25. | Material | : | ASA-PC V0 LURAN, UL94, UL60950-1, UL508 |
| 26. | Insulation | : | EPS NEOPOR, ASTM E96, C203, D2126, EXCEED ASTM C518; 2-INCH |
| 27. | Gasket | : | UPPER AND LOWER COMPARTMENTS, FRONT/REAR, WATERTIGHT |
| 28. | Doors | : | ASA-PC V0 TO MAINTAIN NEMA 4X ENCLOSURE W/ INTEGRAL KEYED LOCKS |

| | | |
|---|---|---|
| 29. | Temp Control | : THERMOSTATICALLY CONTROLLED TO 39°F IN 210 MIN, COMPRESSOR WITH BAKED ENAMEL FINIS, PROVIDE COPPER REFRIGERANT LINES W/ CONFORMAL COATING TO PROTECT AGAINST H2S ATTACK |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 30. | Fluid | : WASTEWATER |
| 31. | Sample Temperature | : 2° TO 50° C (36° TO 120° F) |
| 32. | Pressure Range | : 11 PSIG MAXIMUM FOR SAMPLING IN PRESSURIZED LINES |
| 33. | Ambient Temp. | : -15° TO 40° C (5° TO 104° F) |

OTHER REQUIREMENTS

34. Provide sample pump to sustained sample velocity of 1.9ft/s in a 3/8" line. Pump shall automatically purge the sample line after each sample is drawn. Peristaltic pump tubing shall be silicon. Where peristaltic pumps are specified, provide 4 spare pump tubing kits
35. Provide sampler with a flow assembly for sampling from pressurized lines, pressure not to exceed 11 psig. Inlet connection shall be ¾" hose barb with union coupling. Outlet connection shall be 1 ¼" hose barb with union coupling. Outlet shall vent to drain at atmosphere. Sampler connection shall be 3/8" NPT
36. Provide electronics and refrigeration located in upper compartment of the NEMA 4X sampler, and shall be accessible to the operator
37. Provide sampler with a distribution arm to allow change of sample mode from composite to discreet without field retrofit
38. Provide sampler with industrial flash drive to maintain up to eight data-logs simultaneously. The data shall be visible on the operator interface screen and capable of download without interruption of process
39. Provide inputs for up-to 2 analog and 2 discrete inputs for flow paced and event triggered sampling
40. Provide the ability to run multiple programs simultaneously, and the ability to change sampling modes without operator interface. Sampler shall allow manual override

MISCELLANEOUS

| | | |
|---|---|---|
| 41. | Manufacturer(s) | : ENDRESS+HAUSER, HACH, MANNING OR EQUAL |

NOTES.

a. Provide 2 complete sample line replacement kits including; 10M sample line ferrules, clamps and strainer.
b. Provide sampler who has local representation within 100 miles of the project site. Sample manufacturers without local representation will not be considered.
c. Provide a minimum of two (2)site visit(s) not to exceed 10 hours per visit by the sampler manufacturer's authorized technician to commission the sampler(s). Commissioning shall include inspection of installation, wiring verification, initial programming, function check, loop check, operator field and classroom training, written report
d. Contractor shall install the sampler mechanically and electrically prior to the commencement of commissioning services
e. Provide warranty from the sample such that the sampler(s) shall be free from manufacturing defects for a period of thirty six (36) months from date of commissioning and submission of written commissioning report as specified in paragraph "c" above

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AN-1002 | INFLUENT SCREENING | 10 DI-601 |
| AN-1094 | PLANT EFFLUENT | 10 DI-607 |

**TURBIDITY/TOTAL SUSPENDED SOLIDS (TSS) ANALYZER SPECIFICATION**

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**DATA SHEET 10.11**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE BELOW |
| 2. | Service | : SEE TABLE BELOW |
| 3. | P&ID No. | : SEE TABLE BELOW |
| 4. | Location | : SEE MECHANICAL DRAWINGS |

PROBE ELEMENT

| | | |
|---|---|---|
| 5. | Type | : SUBMERSIBLE INFRARED COLOR INDEPENDENT |
| 6. | Cleaning Type | : SELF CLEANING, WIPER |
| 7. | Range (TSS) | : 0.001 mg/L to 50 g/L TSS OR 0.001 mg/L to 500 g/L |
| 8. | Range (Turbidity) | : .001 to 4000 NTU |
| 9. | Body Material | : STAINLESS STEEL |
| 10. | Meas.Chamber Mat. | : STAINLESS STEEL |
| 11. | Mounting | : IMMERSION OR INLINE |

TRANSMITTER

| | | |
|---|---|---|
| 12. | Type | : ELECTRONIC |
| 13. | Input Power Source | : 120 VAC |
| 14. | Output Signal | : 4 - 20 mADC |
| 15. | Indicator | : 4 1/2 INCH DIAL OR 2 1/2 DIGIT LCD |
| 16. | Accuracy (TSS) | : <5% OF MEASURED VALUE |
| 17. | Accuracy (Turbidity) | : <1% OF THE MEASURED VALUE +/- 0301 NTU (WITH CALIBRATION) |
| 18. | Repeatability (TSS) | : <3% |
| 19. | Repeatability (Turbidity) | : <1% |
| 20. | Elec. Clas'tion | : CLASS 1 DIVISON 1 OR NEMA 4X BASED ON AREA CLASSIFICATION ON SHEET 00 E-601 |

PROCESS CONDITIONS

| | | |
|---|---|---|
| 21. | Fluid | : SEE TABLE |
| 22. | Operating Temp | : 40 TO 75 DEG. F. |

MISCELLANEOUS

| | | |
|---|---|---|
| 24. | Interconn. Cable | : 50 FEET WITH QUICK DISCONNECT FITTINGS |
| 25. | Manufacturer(s) | : HACH OR EQUAL |
| 26. | Model No.(s) | : SOLITAX SC PROBE WITH SC200 CONTROLLER, OR EQUAL. |

NOTES.

27. For open channel or tank mounted sensors, the probe lengths shall be as specified elsewhere. Furnish probe with sufficient number of swivel clamps to attach the sensor to the rail or vertical post and hold it rigidly in place. Design clamps specifically for the intended application and fit them with stainless steel set screws, dowel pins, bolts, nuts and washers.
28. Design transmitter to permit the entire electronics assembly to be removed from the enclosure as a single unit for prompt replacement from spare parts inventory in case of electronics failure or other damage.
29. Furnish one complete spare analyzer of each model, to cover the range herein specified.

30. Furnish a one year supply of spare parts, as recommended by the manufacturer, for each different model used.
31. The manufacturer of the analyzer shall furnish initial start-up and calibration services when notified by the Contractor that all units are installed, powered and ready for operation.
32. Services shall be furnished by the manufacturer to provide instruction to the operating personnel in the operation and maintenance of the analyzer.

| TAG NO. | SERVICE | FLUID | P&ID |
|---|---|---|---|
| AE/AIT 1050 | DISK FILTER 1 INFLUENT TURBIDITY | DEC | 10 DI-604 |
| AE/AIT 1060 | DISK FILTER 2 INFLUENT TURBIDTY | DEC | 10 DI-604 |
| AE/AIT 1056 | DISK FILTER 1 EFFLUENT TURBIDITY | FE | 10 DI-604 |
| AE/AIT 1066 | DISK FILTER 2 EFFLUENT TURBIDITY | FE | 10 DI-604 |
| AE/AIT 1084 | EFFLUENT TURBIDITY | EFF | 10 DI-606 |
| AE/AIT-1021E | SBR 1 TURBIDITY | SBI | 15 DI-601 |
| AE/AIT-1032E | SBR 2 TURBIDITY | SBI | 15 DI-601 |

**GAS SENSOR TRANSMITTER SPECIFICATION**

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**DATA SHEET 48.1**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE |
| 2. | Service | : SEE TABLE |
| 3. | P&ID No. | : SEE TABLE |
| 4. | Location | : SEE TABLE AND ELECTRICAL PLANS |

SENSOR

| | | |
|---|---|---|
| 5. | Type | : LEL – IR SENSOR, OXYGEN AND H2S - ELECTROCHEMICAL. SEE TABLE |
| 6. | Op Temp Range | : LEL - -40℃ TO 50℃, OXYGEN AND H2S -40℃ TO 40℃ |
| 7. | Response Time | : LESS THEN 35 SECONDS |
| 8. | Repeatability | : +/- 5% @ TEMP OF CALIBRATION |
| 9. | Sensor Life | : 2 YEARS MINIMUM |
| 10. | Filter | : AS REQUIRED FOR DUST |

ANALYZER/TRANSMITTER

| | | |
|---|---|---|
| 11. | Range | : 0 - 100% LEL, 0-50ppm H2S, 0-25% O2 |
| 12. | Repeatability | : +/- 2.0% |
| 13. | Channels | : ONE PER ANALYZER |
| 14. | Output Signal | : 4-20 mADC |
| 15. | Indicator lights | : WARNING AND ALARM |
| 16. | Alarm Contacts | : TWO SPDT REQUIRED |
| 17. | Contact Rating | : 3 AMPS 30 VDC |
| 18. | Input Power | : 120VAC |
| 19. | Indicator | : LCD |
| 20. | Mounting | : REMOTE WALL OR PEDESTAL. MOUNT 5.5 FEET ABOVE FINISHED FLOOR. |
| 21. | Adjustments | : SET POINTS, ALARM AND CALIBRATION |
| 22. | Enclosure | : EXPLOSION PROOF FOR SENSORS AND TRANSMITTER |
| 23. | Cable Package | : AS REQUIRED |

MISCELLANEOUS

| | | |
|---|---|---|
| 24. | Manufacturer | : MSA, VULCAIN, DETECTOR OR APPROVED EQUAL |

NOTES.

a. Provide one year's supply of calibration gas. Assume each unit is calibrated once per week.

b. Provide analyzers and sensors which require only a single 3 conductor 16 AWG shielded cable per sensor between analyzer and sensor for distances up to 1000 feet between analyzer and sensor.

c. Design sensor to operate in an atmosphere of 100 ppm of hydrogen sulfide for up to 24 hours with no more than 5% reduction in sensor response time.

d. Provide system that shall be connected to controller over a multidrop 4-wire loop

e. Calibration shall be by means of a non-intrusive hand held infrared calibration controller. Sensor/transmitter LCD display shall instruct user when to apply span and zero gas during calibration. Sensor/transmitter shall automatically adjust internal settings to proper calibration values and provide "replace sensor" indication when sensor nears its end-of-life. Time and date stamp of last successful calibration shall be retained in sensor/transmitter internal memory along with minimum, maximum and average gas values.

f. Provide a total of two (2) hand held calibrator/controllers for all sensor transmitters.

**GAS DETECTION LOCATION GUIDELINES**

| GAS | LOCATION | TYPE SENSOR | PROPERTIES |
|---|---|---|---|
| LEL-GASOLINE | 18" ABOVE FF | CATALYTIC BEAD | Heavier then air |
| LEL-METHANE | CEILING | CATALYTIC BEAD | |
| H2S | 18" ABOVE FF | ELECTROCHEMICAL | Heavier then air |
| O2 | 5-6' ABOVE FF | ELECTROCHEMICAL | |

**SET-POINT VALUES**

| GAS/VAPOR | CAUTION | WARNING | ALARM |
|---|---|---|---|
| LEL | 10.0% | 20.0% | 25.0% |
| H2S | 3 ppm | 5 ppm | 6 ppm |
| O2 | 19.0% | 18.5% | 17.0% |

| TAG NO. | SERVICE | LEL | H2S | O2 | P&ID |
|---|---|---|---|---|---|
| AE/AIT-1311A | HEADWORKS | X | | | 99 DI-601 |
| AE/AIT-1311B | HEADWORKS | | X | | 99 DI-601 |
| AE/AIT-1311C | HEADWORKS | | | X | 99 DI-601 |
| AE/AIT-1312A | TRUCK BAY WEST | X | | | 99 DI-601 |
| AE/AIT-1312B | TRUCK BAY WEST | | X | | 99 DI-601 |
| AE/AIT-1312C | TRUCK BAY WEST | | | X | 99 DI-601 |
| AE/AIT-1312D | TRUCK BAY EAST | X | | | 99 DI-601 |
| AE/AIT-1312E | TRUCK BAY EAST | | X | | 99 DI-601 |
| AE/AIT-1312F | TRUCK BAY EAST | | | X | 99 DI-601 |
| AE/AIT 1313 | BASEMENT | X | | | 99 DI-601 |

**CONTINUOUS ON-LINE MULTI-PARAMETER ANALYZER SPECIFICATION**

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**DATA SHEET 50.14**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

INTEGRATED CONTROL UNIT ANALYZER (TRANSMITTER)

| | | | | |
|---|---|---|---|---|
| 5. | Type | : | MICROPROCESSOR BASED. | |
| 6. | Range | : | PARAMETER | RANGE |
| | | : | AMMONIA-NITROGEN | 0.1-1000 mg/l |
| | | : | NITRATE-NITROGEN | 0.1-1000 mg/l |

USER INTERFACE (Separate Transmitter for Nitrate and Ammonia Probe)

| | | | |
|---|---|---|---|
| 7. | Display | : | GRAPHIC DISPLAY W 320X240 PIXEL RESOLUTION. |
| 8. | Key Pad | : | 5 OPERATING KEYS FOR MEASUREMENT, CALIBRATION SET, SYSTEM SETTINGS, SWITCHING MENU AND ESCAPE. |
| 9. | Input Power | : | 120-230 VAC, 50/60 HZ |
| 10. | Output Signal | : | 4 - 20 mADC |
| 11. | Protection | : | EMI/RFI, LIGHTENING SURGE |
| 12. | Enclosure | : | SEE AREA CLASSICIATION SCHEDULE ON 00 E-601. |
| 13. | Operating Temp | : | -20~55℃ |

NITRATE ($NO_3$) PROBE

| | | | |
|---|---|---|---|
| 14. | Type | : | IN-SITU NITRATE SENSOR WITHOUT SAMPLE PREPARATION. LIGHT ABSORPTION IN PROPORTION TO CONCENTRATION |
| 15. | Measuring Principle | : | SPECTRAL MEASUREMENT IN THE UV/VIS RANGE (190 TO 230nm). |
| 16. | Probe | : | OPTICAL NITRATE PROBE, PATH LENGTH 1mm. |
| 17. | Range | : | 0.01 TO 25 mg/l, 0.1 TO 100mg/l |
| 18. | Flow Velocity | : | LESS THAN 3 m/s. |
| 19. | Operating Tem. | : | 0~45℃. |
| 20. | PH Range | : | 4~9 |
| 21. | Salt Content | : | LESS THAN 5000mg/l IN MEDIUM. |
| 22. | Automatic Cleaning | : | VALVE MODULE FOR AUTOMATIC COMPRESSED AIR CLEANING, 3~7 BAR. |
| 23. | UV/VIS Module | : | CONNECTION MODULE FOR UV/VIS SENSOR. |
| 24. | Accuracy | : | < ±3% OF MEASURED VALUE |

AMMONIA PROBE

| | | | |
|---|---|---|---|
| 25. | Type | : | IN-SITU AMMONIA SENSOR WITH OUT SAMPLE PREPARATION |
| 26. | Electrodes | : | INTEGRATED MEASURING AND COMPENSATION ELECTRODE |
| 27. | Temperature Compensation | : | REQUIRED |

| | | | |
|---|---|---|---|
| 28. | Matrix Adjustment | : | YES |
| 29. | pH Range | : | 4-9 |
| 30. | Measuring Range | : | 0.2-1290 mg/l |
| 31. | Accuracy | : | < ±5% OF MEASURED VALUE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 32. | Fluid | : | WASTEWATER MIX LIQUOR |
| 33. | Operating Temp. | : | 5 TO 100° C (40 TO 100° F) |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 34. | Manufacturer | : | WTW, ENDRESS + HAUSER, HACH OR APPROVED EQUAL |
| 35. | Model | : | VARION PLUS SET WITH IQ SENSOR NET; STAMOSENS; AISE/NITRAX WITH SC200 CONTROLLER |

NOTES.

a. All wetted parts shall be suitable for the intended service conditions.

b. Provide initial calibration and commissioning. Commissioning shall require as a minimum 3−days of operation w/ factory trained technician to operate and maintain system. MTTR greater then 30 minutes shall restart the commissioning time.

c. Provide training for staff during commissioning period in addition to training specified in other sections of specifications.

d. The Manufacturer of the analyzer(s) shall furnish one year's service starting from the completion of the initial commissioning and calibration. This service shall be rendered in a maximum of three site visits and shall include replacement parts as needed to keep the analyzer in proper operation. The start-up, calibration, spare parts and extended service shall be included in the Contractor's price.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| AE/AIT 1021C | SBR 1 Ammonia | 15 DI-601 |
| AE/AIT 1021D | SBR 1 Nitrate | 15 DI-601 |
| AE/AIT 1031C | SBR 2 Ammonia | 15 DI-601 |
| AE/AIT 1031D | SBR 2 Nitrate | 15 DI-601 |

**MAGNETIC FLOW METER SPECIFICATION**

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**DATA SHEET 416.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag No. | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

CONNECTIONS

| | | | |
|---|---|---|---|
| 5. | Line Size | : | SEE TABLE |
| 6. | Line Material | : | DUCTILE IRON |
| 7. | Conn. Type | : | FLANGED |
| 8. | Conn. Materials | : | CARBON STEEL |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 9. | Fluid | : | WATER WITH ~40% PROPYLENE GLYCOL |
| 10. | Maximum Flow | : | SEE TABLE |
| 11. | Max. Flow Velocity | : | SEE TABLE |
| 12. | Minimum Flow | : | SEE TABLE |
| 13. | Min. Flow Velocity | : | SEE TABLE |
| 14. | Operating Temp. | : | 40 TO 250 °F. |
| 15. | Operating Pressure | : | 57 PSI |

METER

| | | | |
|---|---|---|---|
| 16. | Meter Size | : | SEE TABLE |
| 17. | Tube Material | : | 304 STAINLESS |
| 18. | Housing | : | WELDED STEEL |
| 19. | Liner Material | : | INJECTION MOLDED HARD RUBBER OR EQUIVALENT |
| 20. | Electrode Type | : | FLUSH MOUNT |
| 21. | Electrode Material | : | 316 STAINLESS OR EQUIVALENT |
| 22. | Terminal Box | : | DIE CAST ALUMINUM |
| 23. | Enclosure Class | : | NEMA 4X OR CLASS 1 DIV 1 – SEE AREA CLASSICIATION SCHEDULE ON 00 E-601 |
| 24. | Power Supply | : | 120 VAC, 60 HZ |
| 25. | Grounding Type | : | STRAP AND RING |

TRANSMITTER

| | | | |
|---|---|---|---|
| 26. | Type | : | INTELLIGENT, MICROPROCESSOR BASED |
| 27. | Mounting | : | WALL MOUNTED |
| 28. | Transmitter Range | : | SEE TABLE BASED ON INSTRUMENT SPAN |
| 29. | Power Supply | : | 120 VAC, 60 HZ |

| | | | |
|---|---|---|---|
| 30. | Analog Output | : | 4 - 20 mADC |
| 31. | Elect. Class | : | SEE AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 32. | System Accuracy | : | +/- 0.5% OF FLOW RATE AT VELOCITIES ABOVE 1 FOOT PER SECOND |
| 33. | Sys. Repeatability | : | +/- 0.1% OF FULL SCALE |
| 34. | Empty Pipe Detect. | : | REQUIRED |
| 35. | Local Display | : | MULTI-LINE LC FOR MEASURED VARIABLE, DIAGNOSTICS PLUS BAR GRAPH AND KEY PAD |
| 36. | Local Totalizer | : | REQUIRED, 6 DIGIT, NON RESET |
| 37. | Cable Length | : | APPROX. 50 FEET PROVIDED BY METER MANUFACTURER |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 39. | Manufacturer(s) | : | FOXBORO, E+H, KROHNE OR SIEMENS |
| 40. | Model No. | : | 2000 SERIES, PROMAG W, ENVIROMAG OR MAG 5100 |

NOTES.

a. Provide grounding ring from meter manufacturer. Fabricated grounding rings from a third party shall not be accepted.

b. Provide meter manufacturers cable between the meter and the transmitter.

c. Wet calibrate all meters (at 3 points over the specified flow range) by gravimetric or volumetric methods that are traceable to NIST (National Institute Standard Testing).

d. Deleted. Add 6.

e. Provide, by the meter manufacturer, insitu calibration of all meters prior to system acceptance. Submit written calibration report from the manufacturer to the engineer.

f. PROVIDE 316 STAINLESS STEEL MOUNTING HARDWARE including all nuts and bolts connecting the meter to the process pipe.

g. Contractor to provide all power and signal cable in rigid conduit or liquid-tight conduit. See electrical specification for product specifications.

h. Contractor to provide grounding from ground rings to meter and meter to ground, using green size 10 AWG (6mm) ground wire. The Contractor shall install ground as directed by the meter manufacturer or to nearest water pipe. Contractor is responsible for all connections.

i. Remote communication must not interfere with the analog output signal. Use frequency shift keying (FSK) technique for communication.

| TAG NO. | SERVICE | LINE SIZE (in) | FLUID | MAX FLOW (gpm) | MAX VEL (fps) | Min FLOW (gpm) | Min VEL (fps) | METER SIZE (in) | P&I D |
|---|---|---|---|---|---|---|---|---|---|
| FE/FIT-1015 | SBR INFLUENT FLOW | 6 | SBI | | | | | 6 | 10 DI-603 |
| FE/FIT 1060 | DISK FILTER 1 INFLUENT FLOW | 14 | DEC | | | | | 14 | 10 DI-604 |
| FE/FIT 1070 | DISK FILTER 2 INFLUENT FLOW | 14 | DEC | | | | | 14 | 10 DI-604 |
| FE/FIT 1085 | EFFLUNT FLOW TO UV | 8 | EFF | | | | | 8 | 10 DI-606 |
| FE/FIT 1105 | PLANT WATER FLOW TO DISTRIBUTION | 6 | PW | | | | | 6 | 10 DI-608 |
| FE/FIT 1107 | FOAM SPRAY WATER TO SBRS | 6 | FSW | | | | | 6 | 10 DI-608 |
| FE/FIT 1130 | SEPTAGE RECEIVING INFLUENT* | 4 | SEP | | | | | 4 | 10 DI-611 |
| FE/FIT 1140 | WAS FLOW TO WASTE SLUDGE STORAGE TANKS | 4 | WAS | | | | | 4 | 10 DI-612 |
| FE/FIT 1160 | RDT-1 INFLUENT | 3 | SL | | | | | 3 | 10 DI-614 |
| FE/FIT 1170 | RDT-2 INFLUENT | 3 | SL | | | | | 3 | 10 DI-614 |
| FE/FIT 1173 | THICKENED SLUDGE TO OFF SITE DISPOSAL | 6 | TSL | | | | | 6 | 10 DI-615 |
| FE/FIT 3001 | FLOW TO WICK WELL 1. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3002 | FLOW TO WICK WELL 2. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3003 | FLOW TO WICK WELL 3. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3004 | FLOW TO WICK WELL 4. | 6 | EFF | | | | | 6 | 30 DI-601 |
| FE/FIT 3005 | FLOW TO WICK WELL 5. | 6 | EFF | | | | | 6 | 30 DI-601 |

*FURNISHED BY MANFACTURER

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**THERMAL DISPERSION FLOW METER SPECIFICATION**

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**DATA SHEET 426.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | THERMAL DISPERSION PRINCIPLE WITH AUTOMATIC REAL-TIME TEMPERATURE COMPENSATION |
| 6. | Material | : | 316 STAINLESS STEEL |
| 7. | Oper Press | : | 0 TO 17 BAR 0 TO 250 PSIG |
| 8. | Oper Temp | : | -40° TO 177°C (-40°F TO 350°F) |
| 9. | Process Conn | : | 50mm (2-INCH ) FULL PORTED 316 SS BALL VALVE W/ 1.25-INCH MNPT PROBE W/ RETRACTABLE PACKING GLAND |
| 10. | Insert Length | : | BASED ON PROCESS PIPE SIZE |
| 11. | Line Size | : | SEE TABLE |
| 12. | Enclosure | : | NEMA 4X FOR NON HAZARDOUS LOCATIONS |

TRANSMITTER

| | | | |
|---|---|---|---|
| 13. | Mounting | : | WALL MOUNT |
| 14. | Output Range | : | SEE TABLE |
| 15. | Power Requirement | : | 120 VAC |
| 16. | Digital Comm | : | NONE REQUIRED. |
| 17. | Output | : | 4 - 20 mADC |
| 18. | Accuracy | : | +/- 1% FLOW + 0.5% FULL SCALE |
| 19. | Repeatability | : | +/- 0.5% READING |
| 20. | Turndown | : | 10:1 to 100:1 WITHIN CALIBRATED FLOW RANGE |
| 21. | Enclosure | : | NEMA 4X FOR NON-HAZARDOUS,<br>NEMA 7 (XP) FOR HAZARDOUS AREA. |
| 22. | Indicator | : | REQUIRED, 2 LINES 16 CHARACTERS / LINE LCD |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 23. | Fluid | : | SEE TABLE |
| 24. | Operating Temp. | : | 40 TO 150°C (100 TO 300°F). |
| 25. | Operating Pressure | : | UPTO 1.5 BAR (20 PSIG) |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 26. | Manufacturer(s) | : | FCI, FOX, SAGE, SIERRA OR EQUAL |
| 27. | Model No.(s) | : | ST98, 10A, SI, 640S OR EQUAL |

NOTES.

a. Provide a minimum of two [2] hand held calibrators.

b. Provide meter calibration curves for three [3] points of the flow curve. Calibration shall be NIST traceable.

| TAG NO | SERVICE | RANGE | P&ID |
|---|---|---|---|
| FE/FIT 1125 | AIR FLOW TO SBRS | | 10 DI-610 |

**FLOW SWITCH (PADDLE TYPE) SPECIFICATION**

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**DATA SHEET 442.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | PADDLE TYPE FLOW ACTUATED ELECTRIC SWITCH |
| 6. | Materials | : | ALL WETTED PARTS 316 STAINLESS UNLESS OTHERWISE SPECIFIED. |
| 7. | Body | : | 316 STAINLESS STEEL |
| 8. | Bellows | : | SEAMLESS 321 STAINLESS STEEL |
| 9. | Flex Tube | : | (EXPLOSION PROOF APPLICATIONS) 316 SS |
| 10. | Stem-Paddle | : | 316 SS |
| 11. | Bearings | : | 440C SS MICRO BALL |
| 12. | Enclosure | : | MEET ELECTRICAL CLASSIFICATION IN PROCESS AREA. NEMA 4X MINIMUM. |

CONTACTS

| | | | |
|---|---|---|---|
| 13. | Form | : | SPDT |
| 14. | Open/Close | : | CLOSE |
| 15. | On Flow Incr/Decr | : | INCREASING |
| 16. | Rating | : | 10 AMPS AT 120 VAC |
| 17. | Input Power | : | 120 VAC, 60 HZ |
| 18. | Switch Setting | : | NO FLOW |
| 19. | Output Signal for | : | PUMP CONTROL AND ALARM |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 20. | Fluid | : | WATER |
| 21. | Flow Rate | : | 0-3 GPM |
| 22. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 23. | Operating Pressure | : | 10 TO 50 PSIG |
| 24. | Line Size | : | ½” |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 25. | Mounting | : | TEE OR WAFER MOUNT |
| 26. | Elec. Class. | : | SEE AREA CLASSICIATION SCHEDULE ON 00 E-601. ELECTRICAL DRAWINGS |
| 27. | Manufacturer(s) | : | PEECO, HONSBERG, KOBOLD OR EQUAL |

| TAG NO | SERVICE | P&I D |
|---|---|---|
| FSH 1011 | SBR.TP-1 SEAL WATER | 99 DI-601 |
| FSH 1012 | SBR.TP-2 SEAL WATER | 99 DI-601 |
| FSH 1013 | SBR.TP-3 SEAL WATER | 99 DI-601 |
| FSH 1171 | TSL.P-1 SEAL WATER | 99 DI-601 |
| FSH 1172 | TSL.P -2 SEAL WATER | 99 DI-601 |

**ROTAMETER SPECIFICATION**

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**DATA SHEET 443.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL |
| 5. | Line No./Size | : | SEE MECHANICAL OR AS REQUIRED FOR EQUIPMENT PROVIDED BY OTHERS |

METER

| | | | |
|---|---|---|---|
| 6. | Type | : | VARIABLE AREA |
| 7. | Size | : | SEE TABLE |
| 8. | Scale Length | : | BASED ON METER SIZE |
| 9. | Scale Type | : | GRADUATED |
| 10. | Scale Range | : | SEE TABLE |
| 11. | Accuracy | : | ±2% OF FULL SCALE |
| 12. | End Conn. Type | : | UNION W/O-RING OF EPDM, VITON OR FEP BASED ON FLUID |
| 13. | End Conn. Orient. | : | UPWARD FLOW |

MATERIALS OF CONSTRUCTION

| | | | |
|---|---|---|---|
| 14. | Tube Material | : | NON-METALLIC POLYSULFONE OR AS REQUIRED FOR FLUID |
| 15. | Float Material | : | 316 SS AS REQUIRED FOR FLUID |

SERVICE CONDITIONS

| | | | |
|---|---|---|---|
| 16. | Fluid | : | SEE TABLE |
| 17. | Max. Flow Rate | : | SEE TABLE |
| 18. | Min. Flow Rate | : | SEE TABLE |
| 19. | Normal Flow Rate | : | SEE TABLE |
| 20. | Oper. Pressure | : | SEE TABLE |
| 21. | Oper. Temperature | : | 40° TO 75° F |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Flow Adj Valve | : | REQUIRED; EXTERNAL NEEDLE TYPE |
| 23. | Manufacturer(s) | : | BLUE-WHITE, CHEMLINE, KING OR APPROVED EQUAL |

| TAG NO | SERVICE | FLUID | SIZE (in) | RANGE (GPM) | PRESS (PSIG) | P&I D |
|---|---|---|---|---|---|---|
| FI 1183 | SODIUM HYPOCHLORITE CARRIER WATER | W3 | ¾ | 1-10 | | 10 DI-616 |
| FI 1193 | PACL CARRIER WATER | W3 | ¾ | 1-10 | | 10 DI-617 |
| FI 1011C | SBR.TP-1 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1012C | SBR.TP-2 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1013C | SBR.TP-3 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1171C | TSL.P-1 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |
| FI 1172C | TSL.P -2 SEAL WATER | Seal Water | ½ | 0-3 | | 99 DI-601 |

**LEVEL SWITCH (FLOAT TYPE) SPECIFICATION**

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**DATA SHEET 853.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE ELECTRICAL DRAWINGS |

FLOAT

| | | | |
|---|---|---|---|
| 5. | Dimensions | : | APPROX. 6 INCH DIAMETER |
| 6. | Material | : | POLYPROPYLENE |

SWITCH

| | | | |
|---|---|---|---|
| 7. | Type | : | MICRO SWITCH STEEL BALL ACTIVATED |
| 8. | Contact | : | SPDT |
| 9. | Rating | : | 5 AMPS AT 120 VAC |
| 10. | Enclosure | : | ENCAPSULATED |
| 11. | Open/Close | : | CLOSE ON INCREASING, OPEN ON DECREASING |
| 12. | Mounting | : | ADJUSTABLE CLAMP ON 1 INCH STAINLESS PIPE |
| 13. | Elec. Classification | : | SEE ELECTRICAL DRAWING 00 E-601 FOR AREA CLASSIFICATION SCHEDULE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 14. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 15. | Operating Pressure | : | ATMOSPHERIC |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 16. | Interconn. Cable | : | REQUIRED APPROX. 50 FEET |
| 17. | Manufacturer(s) | : | COX OR KARI NO OR EQUAL |
| 18. | Model No.(s) | : | OPTI-FLOAT OR KA SERIES NO OR EQUAL |

NOTES

a. Provide 1-inch diameter SCH 40 316L SS pipe to mount the float switch(s).
b. Provide COX or KARI level switches as specified. Other manufacturers shall not be accepted based on performance.
c. Provide detailed instructions for proper installation of switches, enclosures and mounting hardware.
d. Provide 316 SS brackets and hardware to attach pipe to side of well or tank.
e. Provide a minimum of 3 brackets spaced a maximum of 10'-0" OC.
f. Provide all 316 SS mounting hardware to mount float switch(s) to 1-inch pipe. Mounting hardware shall allow for float level adjustment with hand tools.
g. Provide single sealed well/tank penetration for float switch(s) cables.
h. Provide 316 SS NEMA 4X or cast aluminum termination enclosure (based on area electrical classification). The enclosure shall provide termination for the float(s) and include isolation relays and intrinsic safety barriers.
i. Provide termination enclosure mounted on 316 SS UNISTRUT® supports for wall or floor mounting.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LSHH 1070 | POST EQUALIZATION TANK HIGH-HIGH LEVEL | 10 DI-605 |
| LSLL 1070 | POST EQUALIZATION TANK LOW-LOW LEVEL | 10 DI-605 |
| LSHH 1100 | PLANT WATER TANK HIGH-HIGH LEVEL | 10 DI-608 |
| LSLL 1100 | PLANT WATER TANK LOW-LOW LEVEL | 10 DI-608 |

**LEVEL TRANSMITTER (ULTRASONIC TYPE) SPECIFICATION**

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**DATA SHEET 859.1**

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : SEE TABLE |
| 2. | Service | : SEE TABLE |
| 3. | P&ID No. | : SEE TABLE |
| 4. | Location | : SEE MECHANICAL DRAWINGS |
| 5. | Type | : ULTRASONIC, TRANSDUCER |

TRANSMITTER

| | | |
|---|---|---|
| 6. | Type | : ELECTRONIC |
| 7. | Display | : REMOTE LCD IP65 NEMA 4X |
| 8. | Display Units | : 4 DIGIT W/ DECIMAL POINT |
| 9. | Measuring Range: | SEE MECHANICAL, BASED ON TANK DIMENSION. |
| 10. | Agitator Filters | : REQUIRED |
| 11. | Input Power | : 120 VAC |
| 12. | Output | : 4 - 20 mADC ISOLATED |
| 13. | Resolution | : 2.5mm (0.1 INCH) |
| 14. | Accuracy | : +/- 0.5% OF SPAN |
| 15. | Adjustments | : DIRECT SETTING BCD IN INCHES |
| 16. | Alarms | : LOSS OF ECHO AND NEAR ZONE USER CONFIGURABLE FOR HIGH OR LOW LEVEL CURRENT |
| 17. | Material : | CAST ALUMINUM |
| 18. | Mounting | : REMOTE – SEE INSTRUMENTATION DRAWINGS |
| 19. | Temp | : -40° TO 70°C (-40° TO 160°F) |
| 20. | Enclosure | : PER AREA CLASSIFICATION ON 00 E-601. |

TRANSDUCER

| | | |
|---|---|---|
| 21. | Enclosure | : RATED APPROPRIATELY AS PER AREA CLASSIFICATION SCHEDULE ON DRAWING 00 E-601. |
| 22. | Material | : CPVC, PFA |
| 23. | Mounting | : 50mm (2-INCH) NPT CONDUIT CONNECTION OR FLANGE |
| 24. | Beam Angle | : 10° AT -3dB |
| 25. | Frequency | : 53 KHz |
| 26. | Temperature Comp | : INTEGRAL WITH TRANSDUCER |
| 27. | Oper Temp Limits | : -40° TO 70°C (-40° TO 160°F) FOR CPVC AND -40° TO 95°C (-40° TO 200°F) FOR PFA. |
| 28. | Protection | : FM APPROVAL FOR CLASSIFIED AREA |

PROCESS CONDITIONS

| | | |
|---|---|---|
| 29. | Operating Temp. : | -30° TO 50°C (-20° TO 125°F). |
| 30. | Operating Pressure | : ATMOSPHERIC |

MISCELLANEOUS

31. Intercon Cable : 30M (100 FEET) OR GREATER SO THE TRANSMITTER CAN BE MOUNTED FOR OPERATOR ACCESS

32. Manufacturer(s) : FLOWLINE, DREXELBROOK, KROHNE, SIEMENS OR EQUAL

NOTES.

a. Provide all mounting hardware.

b. Provide detailed instructions for installation of sensor, transmitter and mounting hardware.

c. Provide 316 SS wall sleeve w/ 150mm (6-inch) flange for mounting in top of tanks or wells.

d. Provide barrier for intrinsically safe applications

e. Provide lightning and surge protection

f. Provide detailed installation wiring diagrams specific to the installation application.

g. Provide 316 SS (fiberglass for chemical applications) UNISTRUT® floor or wall bracket for indicator or remote mount transmitter.

h. Provide linearization functions to measure flow in open channels or weirs. Provide linearization calculations to determine tank volumes.

i. Other transmitter housing material may be considered for non-hazardous area application.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LE/LIT-1011A | RWW.SCR-1 UPSTREAM * | 10 DI-601 |
| LE/LIT-1011B | RWW.SCR-1 DOWNSTREAM * | 10 DI-601 |
| | (*) PROVIDED BY SCREEN MFG | |
| LE/LIT-1005A | PRE-EQUALIZATION TANK 1 | 10 DI-602 |
| LE/LIT-1005B | PRE-EQUALIZATION TANK 1 | 10 DI-602 |
| LE/LIT-1006A | PRE-EQUALIZATION TANK 2 | 10 DI-602 |
| LE/LIT-1006B | PRE-EQUALIZATION TANK 2 | 10 DI-602 |
| LE/LIT 1070 | POST EQUALIZATION TANK | 10 DI-605 |
| LE/LIT 1100 | PLANT WATER STORAGE TANK | 10 DI-608 |
| LE/LIT 1141A | WASTE SLUDGE TANK NO. 1 | 10 DI-612 |
| LE/LIT 1141B | WASTE SLUDGE TANK NO. 1 | 10 DI-612 |
| LE/LIT 1142A | WASTE SLUDGE TANK NO. 2 | 10 DI-612 |
| LE/LIT 1142B | WASTE SLUDGE TANK NO. 2 | 10 DI-612 |
| LE/LIT 1170A | THICKENED SLUDGE STORAGE TANK | 10 DI-615 |
| LE/LIT 1170B | THICKENED SLUDGE STORAGE TANK | 10 DI-615 |

**LEVEL SWITCH (MINIATURE FLOAT TYPE) SPECIFICATION**

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**DATA SHEET 864.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

FLOAT

| | | | |
|---|---|---|---|
| 5. | Dimensions | : | APPROX. 13/16 INCH DIAMETER |
| 6. | Material | : | POLYPROPYLENE |
| 7. | No. of Floats/Disp. | : | ONE |

SWITCH

| | | | |
|---|---|---|---|
| 8. | Contact | : | SPST |
| 9. | Rating | : | 0.07 AMPS AT 120 VAC |
| 10. | Enclosure | : | ENCAPSULATED |
| 11. | Open/Close | : | CLOSE |
| 12. | On Level Incr/Decr | : | INCREASING |
| 13. | Mounting | : | STEM MOUNT |
| 14. | Tank Connection | : | ½" NPT PIPE THREAD |
| 15. | Elec. Class'tion | : | GENERAL PURPOSE |
| 16. | Conduit Connection | : | ½ INCH NPT |

MOUNTING STEM

| | | | |
|---|---|---|---|
| 17. | Material | : | POLYPROPOLENE |
| 18. | Length | : | APPROX. 2IN |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 19. | Fluid | : | SEE TABLE |
| 20. | Specific Gravity | : | APPROXIMATELY |
| 21. | Operating Temp. | : | 40 TO 75 DEG. F. |
| 22. | Operating Pressure | : | ATMOSPHERIC |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 23. | Manufacturer(s) | : | MADISON OR EQUAL |
| 24. | Model No.(s) | : | M8700 OR EQUAL |

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LSH 1317A | CHEMICAL ROOM 1 SUMP | 99 DI-601 |
| LSH 1317B | CHEMICAL ROOM 2 SUMP | 99 DI-601 |
| LSH 1317C | CHEMICAL ROOM 3 SUMP | 99 DI-601 |

**SUBMERSIBLE WATER-LEVEL SENSOR/TRANSMITTER SPECIFICATION**

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**DATA SHEET 873.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE TABLE |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | HYDROSTATIC HEAD-PRESSURE TRANSDUCER |
| 6. | Wetted Parts | : | 316 STAINLESS STEEL, VITON OR TITANIUM BASED ON CORROSIVE FLUID |
| 7. | Diaphragm | : | 316 STAINLESS STEEL OR HASTELLOY OR PLATINUM BASED ON CORROSIVE FLUID |
| 8. | Analog Coms | : | 4 - 20 mADC / 10-30 VDC |
| 9. | Digital Coms | : | NONE REQUIRED. |
| 10. | Cable | : | PROVIDED BY SENSOR MANUFACTURE |
| 11. | Cable Connection | : | WATERTIGHT |
| 12. | Cable Type | : | POLYURETHANE |
| 13. | Cable Length | : | AS REQUIRED FOR INSTALLATION |
| 14. | Pressure Range | : | BASED ON TANK OR VESSEL DIMENSIONS W/ 200% OVER RANGE PROTECTION |
| 15. | Oper. Temperature | : | -20 TO 190 DEG. F. |
| 16. | Zero Point Shift | : | 90% OF MEASURING RANGE |

INDICATING DISPLAY.

| | | | |
|---|---|---|---|
| 17. | Type | : | BLIND |
| 18. | Display | : | LCD |
| 19. | Power | : | LOOP POWERED |
| 20. | Housing | : | CAST ALUMINUM |
| 21. | Calibration | : | FIELD |
| 22. | Enclosure | : | IP66 NEMA 4X MINIMUM AND AS REQUIRED FOR ELECTRICAL AREA CLASSIFICATION ON 00 E-601. |

MISCELLANEOUS

23. Elec. Class : SEE ELECTRICAL DRAWING 00 E-601.

24. Manufacturer(s) : ENDRESS HAUSER (E+H) AMERICAN SENSOR TECHNOLOGIES (AST) OR APPROVED EQUAL

NOTES.

a. Provide lighting and surge protection

b. Provide manufacturers mounting hardware for transmitter and level transducer mounting. Submit mounting details with shop drawings.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| LE/LT 3011 | WICK VAULT 1 LEVEL | 30 DI-602 |
| LE/LT 3012 | WICK VAULT 2 LEVEL | 30 DI-602 |
| LE/LT 3013 | WICK VAULT 3 LEVEL | 30 DI-602 |
| LE/LT 3014 | WICK VAULT 4 LEVEL | 30 DI-602 |
| LE/LT 3015 | WICK VAULT 5 LEVEL | 30 DI-602 |

**GAUGE PRESSURE TRANSMITTER SPECIFICATION**

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**DATA SHEET 1451.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

TRANSMITTER

| | | | |
|---|---|---|---|
| 5. | Type | : | INTELLIGENT, MICROPROCESSOR BASED |
| 6. | Element | : | CAPACITANCE CELL, RESONANT WIRE OR PIEZORESISTIVE SENSOR |
| 7. | Remote Calibration | : | ZERO AND SPAN VIA HANDHELD TERMINAL, WITHOUT ADDITIONAL HARDWARE, AT ANY TERMINATION POINT IN LOOP |
| 8. | Trans/Term | : | TWO WAY COMMUNICATION VIA LOOP WIRING SEE NOTE a |
| 9. | Self-Diagnostics | : | CONTINUOUS |
| 10. | Amb Temp. Comp. | : | AUTOMATIC |
| 11. | Power Supply | : | 24 VDC, LOOP POWERED |
| 12. | Output Signal | : | 4 - 20 mADC OR DIGITAL |
| 13. | Dir/Rev Acting | : | DIRECT |
| 14. | Turn Down | : | 6: 1 |
| 15. | Span | : | SEE TABLE |
| 16. | Accuracy | : | +/- 0.1% OF CALIBRATED SPAN |
| 17. | Repeatability | : | +/- 0.05% |
| 18. | Local Indicator | : | REQUIRED |
| 19. | Indicator Display | : | DIGITAL; ENGINEERING UNITS, SIGNAL OUTPUT AND DIAGNOSTICS |
| 20. | Bypass Manifold | : | REQUIRED, 2 VALVE TYPE, 316 SS SEE NOTE b |
| 21. | Span (Elev/Suppr) | : | UP TO 500% OF CALIBRATED SPAN |
| 22. | Enclosure | : | NEMA 4X/IP65/NEMA 7 CLASS I DIV 1 GROUPS A, B, C, D LOCATIONS, AND NONINCENDIVE FOR CLASS I DIV 2, GROUPS A, B, C, D LOCATIONS |
| 23. | Elec. Class | : | SEE ELCTRICAL DRAWING 00 E-601 FOR AREA CLASSICIATION SCHEDULE |
| 24. | Mounting | : | WALL OR PEDESTAL |
| 25. | Process Connections | : | ½ INCH NPT |

MATERIALS OF CONSTRUCTION

| | | | |
|---|---|---|---|
| 26. | Body | : | LOW COPPER ALUMINUM |
| 27. | Wetted Parts | : | 316 SS. FOR CORROSIVE CHEMICALS PROVIDE TANTALUM DIAPHRAGM AND TEFLON GASKETS AND HASTELLOY BODY, PROCESS FLANGE AND SENSOR WITH TEFLON GASKETS. |
| 28. | Fill | : | SILICON OIL. FOR OXYGEN SERVICE USE FLUORINERT. |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 29. | Fluid | : SEE TABLE |
| 30. | Specific Gravity | : APPROX. 1.0 |
| 31. | Max. Static Pressure | : SEE TABLE |
| 32. | Operating Temp. | : -20 TO 180 DEG. F. SEE NOTE d |
| 33. | Ambient Temp. | : 0 TO 100 DEG. F. |

MISCELLANEOUS

| | | |
|---|---|---|
| 34. | Manifold | : ANDERSON GREENWOOD, NOSHOK, PGI OR APPROVED EQUAL |
| 35. | Manufacturer(s) | : E+H, FOXBORO, SIEMENS OR APPROVED EQUAL |
| 36. | Model No.(s) | : CERABAR, IGP25, SITRANS OR APPROVED EQUAL |

NOTES.

a. Provide standard manifold mounting bracket. Mount the manifold not the transmitter such that the transmitter may be removed for service by removing the four transmitter bolts and disconnecting the signal leads. Provide block/bleed/vent/drain and equal to AGCO M4TP.

b. Provide block/bleed/vent/drain equal to AGCO M4TP SS body, AMS SS mount and H5VIS-22 drain valve.

c. Provide 316 SS ½-inch rigid tubing for connection between process measurement primary and process transmitter/manifold. All tubing shall be cut and bent with tube manufacturer approved tools

NOTES

e. Provide SS tubing connectors

f. Provide cleaning and preparation for oxygen service as required based on process application.

| TAG NO. | SERVICE | RANGE (psig) | FLUID | P&ID |
|---|---|---|---|---|
| PE/PIT 1093 | EFFLUENT PRESSURE | | EFF | 10 DI-607 |
| PIT 1104 | PLANT WATER EFFLUENT PRESSURE*<br>*by skid manufacturer | | PW | 10 DI-608 |

**PRESSURE SWITCH SPECIFICATION**

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**DATA SHEET 1452.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE BELOW |
| 2. | Service | : | SEE TABLE BELOW |
| 3. | P&ID No. | : | SEE TABLE BELOW |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

SWITCH

| | | | |
|---|---|---|---|
| 5. | Actuation Element | : | BASED ON PRESSURE ACTUATION REQUIREMENTS |
| 6. | Wetted Parts | : | 316L MINIMUM OR AS REQUIRED FOR CORROSIVE FLUIDS |
| 7. | Output | : | DUAL OUTPUT SPDT |
| 8. | Rating | : | 5 AMPS AT 120 VAC |
| 9. | Set Point | : | INTERNAL LOCKING SCREW SET POINT AND DEAD BAND |
| 10. | Manual Reset | : | REQUIRED EXCEPT FOR CLASSIFIED ELECTRICAL AREAS |
| 11. | Range SP | : | SEE TABLE BELOW |
| 12. | Repeatability | : | +/- 1.0% RANGE SET-POINT |
| 13. | Proof Pressure | : | 400% OF RANGE PROOF |
| 14. | Deadband | : | BASED ON SWITCH RANGE |
| 15. | Material | : | BASED ON PROCESS FLUID |
| 16. | Process Connection | : | 1/4 INCH NPT MINIMUM |
| 17. | Enclosure | : | NEMA 4X (IP66) MINIMUM AND AS REQUIRED FOR ELECTRICAL AREA CLASSIFICATION |
| 18. | Housing | : | CAST ALUMINUM OR STAINLESS STEEL BASED ON ELECTRICAL AREA CLASSIFICATION AND ENVIRONMENTAL REQUIREMENTS |

SERVICE CONDITIONS

| | | | |
|---|---|---|---|
| 19. | Fluid | : | SEE TABLE BELOW |
| 20. | Operating Temp. | : | 40 TO 100 DEG F. |
| 21. | Ambient Temp. | : | 45 TO 90 DEG. F |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Pressure Seals | : | REQUIRED |
| 23. | Manufacturer(s) | : | ASHCROFT BARKSDALE OR EQUAL |

NOTES.

a. Provide pressure switch assembly with type 316L SS pipe and fittings, and a tee with ball valve with female outlet and arranged to allow field checking with a 4½-inch test gauge.

b. Provide pressure switch complete with factory-mounted protective diaphragm attachment which shall allow cleaning of lower diaphragm assembly without breaking seal or refilling and requiring no calibration of gauge.

c. Provide diaphragm of 316 SS with 316 SS upper and lower housing for non-corrosive or solids bearing fluids.

d. Provide alternate diaphragm or isolation ring solution and materials for corrosive or solids bearing fluid.

e. Provide 316L SCH 40 SS pipe and fittings

f. Provide 316 SS ball valves
g. Provide SS ID tag
h. Set Point shall be determined during startup and testing

| TAG NO. | SERVICE/FLUID | RANGE (psig) | P&ID |
|---|---|---|---|
| PSH 1081 | EFF.P-1 DISCHARGE | | 10 DI-606 |
| PSH 1082 | EFF.P-2 DISCHARGE | | 10 DI-606 |
| PSH 1083 | EFF.P-3 DISCHARGE | | 10 DI-606 |
| PSH 1181 | SH.MP-1 DISCHARGE | | 10 DI-616 |
| PSH 1182 | SH.MP-2 DISCHARGE | | 10 DI-616 |
| PSH 1191 | PACL.MP-1 DISCHARGE | | 10 DI-617 |
| PSH 1192 | PACL.MP-2 DISCHARGE | | 10 DI-617 |

**PRESSURE GAUGE SPECIFICATION**

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**DATA SHEET 1454.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE CONTRACT MECHANICAL PROCESS DRAWINGS. |

GAUGE

| | | | |
|---|---|---|---|
| 5. | Type | : | GEARLESS DIRECT-DRIVE NON-LIQUID FILLED |
| 6. | Element | : | HELICALLY WOUND BOURDON TUBE |
| 7. | Element Material | : | INCONEL X-750 |
| 8. | Range | : | SEE TABLE |
| 9. | Overpress. Limit | : | FULL VACUUM AND/OR 150% OF MAX RANGE |
| 10. | Accuracy | : | ± 0.5% AT MID SCALE |
| 11. | Repeatability | : | ± 0.025% FULL SCALE |
| 12. | Zero Adjustment | : | EXTERNAL |
| 13. | Span | : | FACTORY SET |
| 14. | Linearity | : | FACTORY SET |
| 15. | Shaft Attachment | : | DIRECT SENSING COIL AND POINTER |
| 16. | Shaft Bearing | : | SYNTHETIC SAPPHIRE BOTH ENDS |
| 17. | Fittings | : | 316 SS OR AS REQUIRED BY PROCESS |
| 18. | Joints | : | NICRO-BRAZED OR T.I.G. HELIARC WELDED |
| 19. | Case Type | : | SWIVEL FITTING WITH MOVEABLE FLANGE |
| 20. | Case Material | : | ABS PLASTIC |
| 21. | Case Front | : | REAR BLOWOUT |
| 22. | Dial Diameter | : | 4-1/2 INCHES |
| 23. | Socket Material | : | 316 STAINLESS STEEL |
| 24. | Process Connection | : | ½ INCH NPT |
| 25. | Lens | : | ACRYLIC |
| 26. | Mounting | : | BACK SWIVEL FLANGE |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 27. | Fluid | : | SEE TABLE |
| 28. | Operating Temp. | : | SEE TABLE |
| 29. | Operating Pressure | : | SEE TABLE |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 30. | Diaphragm | : | PROVIDE EXTERNAL ISOLATION RING, PIPING AND VALVES, AS INDICATED ON THE CONTRACT MECHANICAL PROCESS DRAWINGS AND DETAILS. SEE DATA SHEET 1457. |
| 31. | Snubber | : | PROVIDE INTERNAL TO STEM |
| 32. | Pulsation Damper | : | INTERNAL TO STEM |
| 33. | Manufacturer(s) | : | 3D, PERMA-CAL OR EQUAL |

| TAG NO. | SERVICE | RANGE | FLUID | P&ID |
|---|---|---|---|---|
| PI 1011A | SBR.TP-1 SUCTION | | SBI | 10 DI-603 |
| PI 1011B | SBR.TP-1 DISCHARGE | | SBI | 10 DI-603 |
| PI 1012A | SBR.TP-2 SUCTION | | SBI | 10 DI-603 |
| PI 1012B | SBR.TP-2 DISCHARGE | | SBI | 10 DI-603 |
| PI 1013A | SBR.TP-3 SUCTION | | SBI | 10 DI-603 |
| PI 1013B | SBR.TP-3 DISCHARGE | | SBI | 10 DI-603 |
| PI 1081A | EFF.P-1 SUCTION | | EFF | 10 DI-606 |
| PI 1081B | EFF.P-1 DISCHARGE | | EFF | 10 DI-606 |
| PI 1082A | EFF.P-2 SUCTION | | EFF | 10 DI-606 |
| PI 1082B | EFF.P-2 DISCHARGE | | EFF | 10 DI-606 |
| PI 1083A | EFF.P-3 SUCTION | | EFF | 10 DI-606 |
| PI 1083B | EFF.P-3 DISCHARGE | | EFF | 10 DI-606 |
| PI 1101A | W3.P-1 SUCTION* | | W3 | 10 DI-608 |
| PI 1101B | W3.P-1 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1102A | W3.P-2 SUCTION* | | W3 | 10 DI-608 |
| PI 1102B | W3.P-2 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1103A | W3.P-3 SUCTION* | | W3 | 10 DI-608 |
| PI 1103B | W3.P-3 DISCHARGE* | | W3 | 10 DI-608 |
| PI 1151A | SL.TP-1 SUCTION | | SL | 10 DI-613 |
| PI 1151B | SL.TP-1 DISCHARGE | | SL | 10 DI-613 |
| PI 1152A | SL.TP-2 SUCTION | | SL | 10 DI-613 |

| TAG NO. | SERVICE | RANGE | FLUID | P&ID |
|---|---|---|---|---|
| PI 1152B | SL.TP-2 DISCHARGE | | SL | 10 DI-613 |
| PI 1171A | TSL.P-1 SUCTION | | TSL | 10 DI-615 |
| PI 1171B | TSL.P-1 DISCHARGE | | TSL | 10 DI-615 |
| PI 1172A | TSL.P-2 SUCTION | | TSL | 10 DI-615 |
| PI 1172B | TSL.P-2 DISCHARGE | | TSL | 10 DI-615 |
| PI 1181 | SH.MP-1 DISCHARGE | | SH | 10 DI-616 |
| PI 1182 | SH.MP-2 DISCHARGE | | SH | 10 DI-616 |
| PI 1191 | PACL.MP-1 DISCHARGE | | PACL | 10 DI-617 |
| PI 1192 | PACL.MP-2 DISCHARGE | | PACL | 10 DI-617 |
| PI 1011C | SBR.TP-1 SEAL WATER | | SBI | 99 DI-602 |
| PI 1012C | SBR.TP-2 SEAL WATER | | SBI | 99 DI-602 |
| PI 1013C | SBR.TP-3 SEAL WATER | | SBI | 99 DI-602 |
| PI 1171C | TSL.P-1 SEAL WATER | | TSL | 99 DI-602 |
| PI 1172C | TSL.P -2 SEAL WATER | | TSL | 99 DI-602 |

*Furnished By Vendor

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**PRESSURE ISOLATOR RING SPECIFICATION**

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**DATA SHEET 1457.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE DATA SHEET 1454 |
| 2. | Service | : | SEE DATA SHEET 1454 |
| 3. | P&ID No. | : | SEE DATA SHEET 1454 |
| 4. | Location | : | SEE MECHANICAL DRAWINGS |

A. Pressure Sensor Rings:

1. Manufacturers:
   a. Onyx
   b. Or an acceptable equivalent product.
2. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-lb (Class 150).
3. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated. For chemical system provide full flange, threaded connections are not acceptable.
4. Face to face length of the sensor: Conform to Specification MSS-SP67.
5. Type: Flow through design with flexible sleeve around full circumference. The centersection shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.
6. Rigidly support all pressure instruments by a post at least 7/8-inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum. 1/4-inch NPT fittings are not acceptable.
7. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
8. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
9. Provide the needle fitting with both 1/4-inch NPTF threads and 1/2-inch NPTM threads.
10. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
11. Attach pressure instruments to the isolator with a hand tightened lock ring.
12. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
13. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
14. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum per lines tested above 150 psi.

15. Materials:
    a. Process water:
        (1) Center – 316 stainless
        (2) End Plates – 316 stainless
        (3) Elastomer – EPDM
        (4) Fluid – silicone
        (5) Stinger – 316 stainless
        (6) Pipe – 316L stainless
    b. 15% sodium hypochlorite (sg 1.20)
        (1) Center – Kynar coated carbon steel
        (2) End Plates – Kynar
        (3) Elastomer – Viton
        (4) Fluid – silicone
        (5) Stinger – 316 stainless
        (6) Pipe – 316L stainless

**ROOM/OUTSIDE AIR TEMPERATURE SENSOR SPECIFICATION**

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**DATA SHEET 1662.1**

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag Number | : | SEE TABLE |
| 2. | Service | : | SEE TABLE |
| 3. | P&ID No. | : | SEE TABLE |
| 4. | Location | : | SEE ELECTRICAL DRAWINGS |

SENSOR

| | | | |
|---|---|---|---|
| 5. | Type | : | RTD SENSOR WALL MOUNT INTEGRAL TO TRANSMITTER |
| 6. | Housing | : | NEMA 4X AND 7 — CLASS I DIV 1 AND CLASS II DIV 2. SEE AREA CLASSIFICATION SCHEDULE ON 00 E-601 |
| 7. | Material | : | CAST ALUMINUM |

TRANSMITTER

| | | | |
|---|---|---|---|
| 8. | Type | : | ELECTRONIC |
| 9. | Power | : | 24 VDC, LOOP POWERED |
| 10. | Output Signal | : | 4 - 20 mADC INTO 550 OHMS |
| 11. | Range | : | -45° TO 135°C (-50° TO 275°F) |
| 12. | Linearity | : | +/- 0.1% WITH SPAN |
| 13. | Calibration | : | MATCH RTD |
| 14. | Indicator | : | 1-INCH HIGH LCD ±999.9 |

PROCESS CONDITIONS

| | | | |
|---|---|---|---|
| 21. | Fluid | : | AIR |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 22. | Manufacturer(s) | : | MICON, WEED, DEVAR OR EQUAL |

NOTES.

a. Provide complete temperature monitor assembly w/ all hardware for wall mounting.

b. Provide outside temperature monitor w/ all hardware and sun shields.

| TAG NO. | SERVICE | P&ID |
|---|---|---|
| TIT 1316A | BASEMENT | 99 DI-601 |
| TIT 1316B | ELECTRICAL ROOM | 99 DI-601 |
| TIT 1316C | SODIUM HYPORHCLORITE AND POLYALUMINUM CHLORIDE ROOM | 99 DI-601 |
| TIT 1316D | POLYMER ROOM | 99 DI-601 |
| TIT 1316E | SODA ASH ROOM | 99 DI-601 |

**SECTION 13331**

**CONTROL SYSTEM INTEGRATION**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Control System Integration as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) is responsible for making all components of the system operate as a whole. This includes but is not limited to:

1. Configuring equipment software provided under SECTION 13350, SCADA EQUIPMENT.
2. Program all network hardware provided under SECTION 13345, DATA NETWORK.
3. Program the SCADA system to display and control the WWTF operation system.

4. Program the WWTF and Collection System PLCs provided under SECTION 13340, PLC CONTROL PANELS to implement the controls and the WWTF operation system.
5. Provide coordination and support the installation and programming of the instruments, provided under SECTION 13330, PROCESS INSTRUMENTS.
6. Provide witness testing for equipment shop testing and performing field testing as specified.
7. Review of shop drawings submittals of process equipment and PLC based control panels provided under other divisions.
8. Provide configuration direction to the Contractor for all process equipment control panels supplied with equipment.
9. Create HMI screens to replicate screens of the process equipment control panels supplied under other divisions.
10. Provide coordination and support, including control panel shop drawing review, for the instrumentation and control systems for all OEM packages.
11. Provide classroom and hands-on training to the owner's staff on operation of the system.

D. The Contractor shall be responsible for the assistance of the SI with the coordination of equipment furnished in this contract with the overall control system requirements.

E. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Detailed network architecture drawings howing all network components.

2. Submit print outs of all SCADA screens for Owner and Engineer’s review and comment.

3. Submit red-line markup of P&ID that reflects all changes to the design throughout the construction process.

4. Table of IP addresses for all devices.

5. Submit PLC program.

6. Submit Network switch, firewall, and gateway configuration files.

7. Record and submit the configuration of each networked devices.

8. Project narrative.

9. Test Results

10. Test Plans.

C. All submittals provided by the Contractor shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments have been addressed and that the submittal is reviewed by the SI.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in resection of the entire submittal with no further review and consideration.

E. Operation and Maintenance Manuals:

1. Submit operating and maintenance instructions. Incorporate functional description of entire system.

F. Submit "record copy" of all drawings previously submitted for review within 30 days after completion of system installation as part of operating and maintenance instructions. Show all changes and modifications made during installation. Define special maintenance requirements particular to system along with special calibration and test procedures.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Where possible, all equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Work of SI service personnel shall be coordinated by the Contractor.

B. Coordinate with mechanical and electrical systems suppliers to identify any signal isolation, signal boosting devices or auxiliary relays that may be required to complete the system.

C. System energizing not allowed prior to receipt of certified statement from Contractor and SI approving system and authorizing energizing of system.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**1.09 - REFERENCES**

A. American Petroleum Institute (API):

1. RP 551: Process Measurement Instrumentation

B. International Society of Automation (ISA):

1. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided for installation and startup for the equipment as follows:

1. 7 calendar days (via ## separate trips to project site).

**3.03 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided for training of Owner's personnel for the equipment at the project site as follows:

1. 3 calendar days (via ## separate trips to project site).

**3.04 - SPARE PARTS – Not Used**

**3.05 - GENERAL INSTALLATION**

A. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be coordinated by the contractor and the SI during development and fabrication of systems.

B. Provide PLC programming services and control system integration as specified and indicated.

**3.06 - SHOP TESTING**

A. The SI shall attend, witness and coordinate shop testing activities of instrumentation and control system equipment as referenced in their respective specification sections.

**3.07 - FIELD TESTING**

A. All field testing activities shall be coordinated and led by the SI with the Contractor support.

B. Calibration and loop testing.

1. The SI shall provide supervision of all calibration and loop testing by the contractor.

2. Instrument calibration shall be provided by the instrument manufacturer. The field calibration shall be provided with a NIST traceable calibrator. The calibration report shall include;

a. Factory calibration sheet

b. Field (not hand written) calibration sheet

c. Picture of installed instrument

3. The calibration records shall include the instrument serial number and the project instrument tag on all documents. The calibration records shall be submitted electronically so they may be incorporated into the Owners asset data base.

4. The SI shall provide supervision for continuous loop testing. Loop testing shall occur following instrument calibration. The test shall check Continuity of all wiring from devices in the field to the control system IO terminations. Next send and receive inputs and outputs from the field to the HMI (this does not mean simulate w/ a signal generator). Valves should be opened and closed, analyzers should be placed in known solution strengths and discrete devices cycled on and off. Note - before chemical tanks are filled w/ chemicals their levels should be check with water - this can be completed during the leak testing process.
5. The Loop Diagrams will be included in the loop testing. The loop diagrams will checked against field conditions to confirm:
    a. Analog range
    b. Terminal numbers
    c. All control wiring
    d. Power source, grounding, isolation and lightning protection
    e. Signal ground shield showing cutting and taping in field

C. As a minimum, the control system testing shall include the following:
1. Operational Readiness Test (ORT).
2. Application Software Operational Readiness Test (ASORT).
3. Field Acceptance Test (FAT).

D. The test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Engineer.

E. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist. Each specific test to be performed and shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

F. Signed copies of the test procedures prepared by SI, forms and checklists will constitute the required test documentation.

G. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

H. The SI shall coordinate all testing with the Owner and Engineer.

I. The Owner and Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures with no additional cost.

J. The Owner's and Engineer’s decision shall be final regarding the acceptability and completeness of all testing.

K. The SI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

L. Operational Readiness Test (ORT):
1. General: Prior to the Field Acceptance Test, the entire system shall be certified (inspected, tested and documented) that it is READY for operation.
2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop by loop and component by component basis by the SI following field installation, to demonstrate and document the system is in conformance with related submittals and these specifications. The Contractor is required to confirm that the system is properly wired, terminated and tagged from the field wiring nearest to the primary elements or equipment to the PLC I/O.
3. The SI shall maintain the Loop Status Reports and Components Calibration sheets at the jobsite and make them available to the Owner and/or Engineer at all times.

4. The Engineer reserves the right to witness and sign off all tests conducted by the SI. The Engineer shall review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries periodically and upon completion of the tests. Any deficiencies found shall be corrected. Final versions of these test sheets shall be submitted to the Owner and/or Engineer at all times.

M. Application Software Operational Readiness Test (ASORT):

1. During the entire ASORT, all panels and HMI equipment shall be powered, fully interconnected per the approved control system architecture drawing, and ready for testing.

2. The SI shall be responsible for testing all control and monitoring loops by simulation of field inputs and outputs. These inputs/outputs shall be simulated at the point nearest to the field element or equipment after conduit and wire have been installed and tagged as specified and indicated, but prior to transition of the wiring of field devices from the existing control system to the new control system. Field I/O will be simulated as follows:

   a. Discrete Input: Jumper at field input to simulate contact closure.

   b. Discrete Output: Relay and plug-in mounting base with matching coil voltage and indicating light to confirm output signal.

   c. Analog Input: 4-20mADC current source to simulate field analog transmitters.

   d. Analog Output: Multi-meter with mA range to confirm analog output from source.

3. Working with the Contractor's assistance to provide simulated field inputs/outputs as described above, the SI will confirm the PLC programming and HMI configurations and controls for each loop. Closed loop controls, such as wetwell level control, shall be simulated by manual simulation of feedback signal to confirm expected response.

4. The SI shall provide, or coordinate with the Contractor to provide, copies of all approved shop drawings; copies of all as-built drawings; PLC and HMI manufacturer's literature.

N. Field Acceptance Test:

1. Prior to the Field Acceptance Test, the entire installed instrument and control system shall be certified by the SI that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete. The intent of the FAT is for all responsible parties, working together, to prove the installed system operates in accordance with the Specifications. Each party is responsible for verifying the completeness of all system components furnished, installed, and configured by their respective firm or subcontractors.

2. A witnessed Field Acceptance Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop, and site by site basis.

3. Loop specific and non loop specific tests shall be the same as specified under factory testing, WFT and AST.

4. In the event of rejection of any part or function of a SI furnished system, the Contractor and SI shall perform repairs or replacement within 10 days and at no additional cost to Owner.

5. Updated versions of the documentation specified to be provided for during the field acceptance tests shall be made available to the Owner and Engineer at the job sites both before and during the tests. In addition, one copy of all O & M Manuals shall be made available to the Owner and Engineer at the job sites both before and during testing.

**3.08 - FUNCTIONAL START-UP TESTING**

A. After completion of the Field Acceptance Test, the Instrumentation and Control System shall be tested as a component of the Functional Start-up Testing. All furnished hardware and software shall operate for a period of 14 consecutive days, under conditions of full plant process operation, without a single non field repairable malfunction.

B. During this test, Owner operations personnel and SI personnel shall be present as required. The Contractor and the SI are expected to provide personnel for this test who have an intimate knowledge of the hardware and the SI provided software of the system. Coordinate staffing requirements during the test to coincide with normal shift operations as much as possible. Off-shift emergencies shall be fully supported by Contractor and SI staff. Provide staff with cell phones and/or pagers to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

C. While the start-up testing is proceeding, the Owner shall have full use of the system.

D. Any malfunction to the system during the tests shall be analyzed and corrected. The Owner shall determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction during the Start-up Testing which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non field repairable malfunction.

F. Upon completion of repairs, the associated test shall be repeated as specified herein.

G. In the event of rejection of any part or function, perform repairs or replacement within 10 days and at no additional cost to the Owner.

H. The total availability of the system shall be greater than 90% during this test period. Availability shall be defined as:

AVAILABILITY = (TOTAL TIME – DOWN TIME)/(TOTAL TIME) * 100%

I. Upon successful completion of the startup operation test and subsequent review and approval of complete system final documentation, the system shall be considered Substantially Complete, after approval by the Owner and Engineer.

**3.09 - TRAINING**

A. Upon completion of the start-up, provide competent training personnel for a period of not less than three, 8-hour working days, excluding travel time, for training of personnel in the use, operation and maintenance of the instrumentation and control system. Training to utilize the submitted operation and maintenance manuals and record copy drawings as reference materials. Training to be for 6 personnel in each class. Each class to be of a 4 hour duration.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 13340**

**PLC CONTROL PANELS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide PLC Control Panels as specified herein and/or as shown on the Contract Drawings. PLC Control panels shall be provided for this contract as well as for Contract No. 2019-02: Downtown Area Collection System and Pumping Stations, drawings for which are included as an Appendix to DOCUMENT 13300, INSTRUMENTATION AND CONTROL SYSTEM.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide all equipment, installation, services, and appurtenances to achieve a complete, integrated, and fully operational system.

D. Test all components individually as well as in a system as specified and recommended by the manufacturer.

E. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

F. Ambient Conditions for control panels:

1. Minimum Temperature: 50 degrees F
2. Maximum Temperature: 90 degrees F
3. Relative Humidity: 95% Non-condensing

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

C. Include with the submittal a copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections with result in rejection of the entire submittal with no further review and consideration.

D. The submittal shall include:

1. Table of contents
2. Loop diagrams on 11 inch by 17 inch sheets.
3. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, surfaces continuing instruments, internal panel wiring and internal panel layout.
4. Complete Bill of Materials indicating manufacturer’s part numbers.

5. Power and control schematics including external connections. Show wire and terminal numbers and color coding.
6. Panel electrical load data used with UPS sizing.
7. Catalog sheets for each piece of equipment to be included in the equipment.
8. Panel temperature control documentations.
9. Shop test plan as specified herein.

E. Submit the following prior to equipment shipment:

1. Certified shop test reports.

F. Submit the following prior to field start-up and testing:

1. As-built drawings incorporating all changes made during the manufacturing process.
2. Installation information including equipment anchorage provisions.
3. Any additional information required for equipment installation.

G. Submit the following after installation:

1. Field tests and inspection reports.
2. Certified statement from Contractor and equipment supplier approving system and authorizing energizing of system.

H. Submit and include the following in the operations and maintenance (O&M) manuals:

1. Submit "record copy" of all drawings previously submitted. Show all changes and modifications made during installation.
2. Define special maintenance requirements particular to system along with special calibration and test procedures.
3. Data sheet describing each element in detail, including manufacturer, part number, calibration values, and all information pertaining to the element. Include a brief description of each device.
4. Manufacturer catalog sheets for each element. All specification sheets shall be properly annotated to indicate particular device supplied.
5. Complete spare parts list.
6. All information shall be in one submittal.
7. Provide manufacturer's certified statement of installation approval.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE:**

A. Provide UL listed materials and equipment.

B. All panels shall be UL 508A listed.

C. System energizing not allowed prior to receipt of certified statement from Contractor and supplier approving system and authorizing energizing of system.

D. Replace damaged materials or equipment as determined by the Engineer at no additional cost to the Owner.

E. Engineer and/or Owner shall inspect and observe the testing of the equipment at its site of manufacture, fabrication or assembly. Equipment shall include cabinets, control devices, computerized equipment, panel equipment and field equipment. No equipment shall be shipped without Engineer's approval. Provide 21 days written notice for Engineer's inspection.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall be provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**1.09 - REFERENCES**

A. National Fire Protection Association: NFPA 70.

B. The International Society of Automation (ISA) S5.2, S5.3 and S5.4, Instrument Loop Diagrams, standard.

C. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS1 and Industrial Controls and Systems ICS2.

D. UL Standard for Industrial Control Panels: UL 508A

**1.10 - FACTORY-TRAINED SERVICE TECHNICIAN**

A. Provide services of factory-trained Service Technician, specifically trained on the type of equipment specified:

1. Service Technician must be present on site for all items listed below and shall be available during the entire installation of the equipment to assist in placing the load break switch in operation and to correct deficiencies in installation, equipment, or material. Person-day requirements listed are minimum values, exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

a. Installation: Provide support during equipment installation:

(1) 2 person-days per panel

b. Startup: Provide support during equipment startup:

(1) 2 person-days per panel

c. Functional Testing: Perform a functional test. Tests to include all items specified.

(1) 2 person-days per panel

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

(1) 2 person-days.

2. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

3. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Equipment, cabinets and other devices furnished hereunder shall be for continuous use in the intended application.

B. The system shall consist of current production products.

**2.02 - CONTROL PANELS**

A. Control Panel Enclosure

1. Size enclosures to fit all required equipment, run all field wires and provide adequate working space.

2. Panels shall be in accordance with the Electrical Area Classification Schedule.

3. Provide panels doors:

a. Extending the full width for full access to panel-rear mounted components

b. With adequate internal bracing for structural rigidity and strength

c. Formed of sheet metal

d. With 180° stainless steel hinges,

e. Gasketed to preserve NEMA rating

f. With a drawing pocket to hold as-built and service documentation.

4. Provide Latching:
    a. Flush Type, 3 point locking latches with keys.
    b. Fabricated from Type 304 stainless steel.
    c. That maintains NEMA rating.

B. Surge Protection
1. Provide UL508 Surge Protection Devices (SPDs) for Panel as follows:
    a. For each power feed into the control panel.
    b. Rated a minimum of 10 kilo amps (kA)
    c. With light indicating fault
    d. Mount SPD inside control panel
    e. Minimize lead length of SPD
    f. SPD manufactured by Dehn or equal.
2. Provide UL508 surge protection for analog signals as follows:
    a. For signals originating in a structure outside the one housing the control panel or greater than 200 feet from the control panel.
    b. Surge protection shall be: two-stage common-mode protection by means of arrestor reactor and varistor in combination and differential mode protection by means of gas arrestor, reactor and zener diode in combination.
    c. Rated a minimum of 10 kilo amps (kA)
    d. Manufactured by Dehn or equal.

C. Power Supplies
1. Provide panel with 120 VAC to DC redundant power supplies with automatic redundancy switchover module to provide power to DC fed equipment, including DC powered field instruments.

D. Courtesy Equipment
1. Provide in each panel section with:
    a. A 1600 lumen LED fixture powered from120 VAC and activated by switch that closes when enclosure door opens.
    b. External panel mounted programming port directly connected to the PLC hardware allowing panel external access to the PLC programming without the need to open the panel enclosure doors.

E. Power to Remote Instruments
1. Provide all instrument power from the instrument panel or termination panel for the control system unless otherwise indicated or specified.
2. Provide power to the instruments from the same panel that receives the instrument’s signal.
3. Provide each instrument requiring 120 VAC power or DC power with an individual fused disconnect or circuit breaker.

F. Mounting

1. Mount all panel components to allow easy access for servicing, calibration, adjustments, testing and removal, without the removal of other equipment.

2. Provide internal panel components mounted directly on removable plates made of the same material and finish as the panel, of a thickness to provide rigid support for mounted components.

3. Mount all equipment on wall of panel enclosure. Loose equipment on the floor of enclosure is not acceptable.

G. Labeling

1. Attach identification labels to all internal components.

2. Provide lamicoid nameplates, white with black background engraved legends. Provide nameplates attached with clear pressure sensitive tape for continuous bond equal to 3M VHB tapes.

3. Provide identification for all wiring to panel components powered externally from the panel power circuit breaker inside the panel.

4. Label all disconnects and fused disconnect or circuit breaker for instrument power with circuit numbers or device tag names.

5. Number wiring in accordance with the numbering system used on the instrument submittal drawings.

6. Provide wire numbers on wires at terminal blocks and all connections.

7. Any component identification on the wire trough covers shall be repeated on the sub-panel to allow component identification with snap-on cover not in place.

8. Provide terminal strips numbered with the signal termination number plus additional characters to identify each individual conductor.

   a. Analog inputs and outputs: Provide the character + appended to the terminal number for the positive signal wire. Provide the character – appended to the terminal number for the negative signal wire. Provide the character S appended to the terminal number for the signal shield.

   b. Digital inputs: Provide the character C appended to the terminal number for the unpowered (common) conductor. For inputs identified as having a CONTACT TYPE of OPEN, provide the character NC appended to the terminal number for the conductor to be powered. For inputs identified as having a CONTACT TYPE of CLOSED, provide the character NO appended to the terminal number for the conductor to be powered.

   c. Digital outputs: Digital outputs have 1 to 4 contacts per signal point. Provide the character C appended to the common terminal for single contact outputs. Provide the character C followed by a number 1 thru 4 appended to the common terminal for each contact output of multiple contact outputs. Provide the character P appended to the powered terminal for single contact outputs. Provide the character P followed by a number 1 thru 4 appended to the powered terminal for each contact output of multiple contact outputs.

H. Switching

1. Unless specified otherwise, pushbuttons shall be of oil-tight, heavy-duty momentary contact pushbuttons, rated for 10 amperes at 120 volts ac unless specified otherwise. Supply with the quantity of poles required for the application.

2. Unless specified otherwise, rotary selector switches used for controlling 120 volts ac, shall be oil-tight, heavy-duty, maintained contact type rated for 10 amperes at 120 volts ac. Rotary switches used for low level control signals shall have gold or other precious metal contacts rated for "dry contact" duty.

I. Indicating Lights

1. Provide oil-tight, heavy-duty, LED cluster type pilot lights, with average life of 40,000 hours, minimum, unless otherwise specified.
2. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.
3. 1/4" (6.4 mm) diameter, colored as selected by the Engineer
4. Lamps to be replaceable from panel front; 10% spares for LED type.

J. Control Relays

1. Provide sealed relays DIN rail mounted with indicating light to indicate its operation. Contacts shall be rated for 10 amperes at 120 volts, ac. Life expectancy shall be 50 million operations, minimum.
2. Provide electronic timer delay of the plug-in, digital type with output contacts rated for 10 amperes @ 120 volts ac. Life expectancy shall be 20 million operations.
3. Provide all relays from a single manufacturer.

K. Termination Points

1. Provide terminal blocks for every input/output wire. Include terminals for signal cable shields.
2. Provide 25% spare terminal blocks for each type of signal.
3. Terminal numbers will be sequential on the terminal blocks.
4. Arrange the terminal blocks into functional groups
5. Use only one side of each terminal block row for internal wiring. Use the other side for field wiring. Do not locate terminal blocks within 6 inches (150 mm) of any right angle panel surface.
6. Provide terminal blocks of corrosion proof material such as nickel plated copper. Provide AC and DC control terminals suitable for 12 AWG (4 mm) or larger wire. Provide terminals for DC analog signals suitable for 16 AWG (1.5 mm) wire.

L. Wires

1. Provide shielded cable pairs for all analog signals internal and external to the panels. Provide minimum conductor size of 16 AWG (1.5 mm) for analog wiring internal to the panel.
2. Provide 16 AWG (1.5 mm), panel wire, type THHN/THWN stranded, and insulated for 600 volts minimum unless otherwise specified.

M. Wiring Methods

1. Grounding
   a. Individually connect ground wires for all surge protectors to a common ground.
   b. Run grounding wires with special care to provide the least possible resistance.
2. Wire Troughs
   a. Provide internal wiring troughs of the plastic, open-side type with snap-on covers.
   b. Wiring troughs shall not be filled to greater than 60% capacity. Provide snap-on covers marked to identify their locations.
3. Wire Path
   a. Group wiring within the panel according to function, and harness together, or place within ducts and secured to the panel structure.
   b. Remote instrument power shall not be commingled with panel power for other panel devices.

c. Power and low-level signal wires shall be routed in separate wireways or harnesses. Crossings of the two system's wires shall be at right angles. Parallel runs of the two system's wires shall be separated by a minimum of 12 inches.

d. Partition intrinsically safe wiring separately from all other wiring. Provide a protective cover with labeling to cover the intrinsically safe wires.

4. Wire colors shall be assigned as follows:

| | | |
|---|---|---|
| a. | AC Power | Black |
| b. | AC Neutral or Common | White |
| c. | AC Control | Red |
| d. | DC Control | Blue |
| e. | Equipment or Panel Ground | Green |
| f. | Externally Powered Circuits | Yellow |

5. Wire connectors shall be the hook-fork type, with non-insulated barrel to allow easy inspection of crimp integrity.

N. Signal Management

1. Design all instrumentation equipment to operate on 24VDC, except as specifically noted. Provide power supplies, regulators, and constant-voltage transformers to allow compliance with the above.

2. Provide electronic type solid-state instrumentation utilizing linear transmission signals of 4-20mADC, (milliampere direct current), except as specifically noted.

3. Provide 4-20mADC outputs capable of driving a 750 ohm load from all transmitters, controllers, and signal processing devices. Inputs to controllers, recorders, indicators, signal processing devices shall be 4-20mADC.

4. Convert nonstandard signals into compatible standard signals at their source. Zero based signals are not acceptable.

5. Direct interlock of equipment without auxiliary relaying shall not be allowed.

6. For all signals to be transferred to/from another panel, provide current isolators (analog) or dry relay contacts (discrete) wired out to terminal blocks.

O. Human Machine Interface (HMI)

1. The HMI is a thin client node specified in SECTION 13350, SCADA EQUIPMENT.

2. Provide space and all necessary connections for thin client node equipment and screen to be mounted on enclosure door.

3. HMI shall be UL508 listed.

P. Programmable Logic Controller (PLC)

1. The PLC is specified in the data sheet in Attachment A (13340-A).

Q. Uninterruptible Power Supply (PLC)

1. The UPS is specified in SECTION 13350. SCADA EQUIPMENT.

2. Provide space and all necessary connections for UPS to be located within PLC cabinet/server rack.

**2.03 - NETWORK COMPONENTS**

A. Ethernet network switches to be provided under specification SECTION 13345, DATA NETWORK.

B. Provide all other networking equipment to create networks indicated and specified.

**2.04 - SPARE PARTS AND TEST EQUIPMENT**

A. Spare Parts:

1. Provide spare parts of the type and quantity as specified herein or as specified with the equipment in Attachment A.

2. Spare parts equal to at least 25% of the field replaceable system components (minimum of two) shall be supplied.

3. Provide the following as at a minimum:

a. 1 - PLC processor unit

b. 1 – Redundancy unit

c. 1 – Analog input card of each type provided

d. 1 – Analog output cards of each type provided

e. 1 – Digital input cards of each type provided

f. 1 – Digital output cards of each type provided

g. 1 - PLC power supplies

h. 1 – 24VDC power supplies of each type provided

4. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and suitable for prolonged storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which part is to be used shall be supplied with the required parts. The spare parts shall be delivered and stored in a location by the Owner.

5. Provide an itemized price list of the delivered spares for the purchase of additional components. Prices shall be honored for a period of one year from substantial completion of the system.

**2.05 - SHOP TESTING**

A. Conduct a Witnessed Shop Test (WST) that will be attended by the System Integrator and may be attended by the Engineer and/or Owner.

B. The equipment supplier, prior to the WST, shall make the completed control panel and a work space available to the System Integrator to upload and test the programming, configuration files and SCADA system operation. Coordinate time requirements with the System Integrator.

C. Coordinate the shop testing with the Contractor, System Integrator, Owner and Engineer.

1. Notify the Owner in writing that the system is ready for the WFT and allow the Owner to schedule a test date within 21 days of receipt of the "Ready To Test" letter.

2. At the time of notification, submit any revisions to the detailed test procedure previously approved by the Owner/Engineer.

D. The following documentation shall be made available to the Owner and/or Engineer at the test site both before and during the WST:

1. All drawings and specifications, addenda and change orders and approved shop drawings.

2. Master copy of the test procedure.

E. Test Procedure:

1. Provide a shop test plan outlining the procedures for testing all the panels at the factory prior to shipment. This plan shall demonstrate the system performs as specified and as indicated.

2. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist.

3. Test procedure shall include a checklist of items to be confirmed by the testing.
4. Submit the shop test plan prior to the shop testing for review as specified.
5. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.
6. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.
7. Copies of these signed off test procedures forms and checklists will constitute the required test documentation.

F. The WST shall include:

1. All panels, consoles and assemblies shall be inspected and tested to verify that they are in conformance with related shop drawing submittal, and these specifications and contract documents.
2. Prior to the WST all equipment shall be set up and allowed to operate for at least five days continuously trouble free to verify the system is capable of continuous operation.
3. To perform the shop test, the entire PLC and SCADA network shall be assembled in the shop. All panels shall be networked with the network switches to be used in the field. In addition, to demonstrate its operation with the control panels, the SCADA system shall be set up including the SCADA server, thin client server and historian.
4. For each type of networked discrete instrument provide an example transmitter, wire it into the appropriate PLC panel to demonstrate its operation.
5. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of monitoring devices/functions and control devices/functions.
6. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide an approved means of simulation. Define these simulation techniques in the test procedures.
7. Provide all special testing materials and equipment including all temporary cables including fiber optic and copper network cable, necessary to connect all control system components including communication components for use during factory testing.
8. Perform a check of all I/O to the interface terminal blocks and verification of all communications networks.
    a. Test the functionality of each selector switch and push-button.
    b. Test the functionality of each indicator light and annunciator point.
    c. I/O verification includes confirming accurate signaling at each analog indicator, recorder controller and PLC at zero, ten, fifty, ninety, and one hundred percent of range.
    d. I/O verification includes testing each digital signal at its zero and one state.
    e. Each test shall be in the cause and effect format. Initiate an input (cause) upon the system or subsystem producing the correct result (effect). When the correct effect is observed the specific test requirement will have been satisfied.
    f. The System Integrator shall test each communications network link using an Engineer-approved test configuration to verify successful completion of required communications paths including: sending data to and receiving data from a PLC, (PC to PLC communications), sending data to and receiving data from another PLC or control system (PLC or control system to PLC communications), sending data to and receiving data from another PC (PC to PC communications), and sending data to all printers.

G. WST Identified Deficiencies:

1. All deficiencies identified during these tests shall be corrected and retested prior to completion of the WST as determined by the Owner and/or Engineer.
2. The Engineer and Owner reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures without additional cost.
3. The Owner's decision shall be final regarding the acceptability and completeness of all testing.
4. No equipment shall be shipped until the Owner has received all test results and approved the system is ready for shipment.

## PART 3 - EXECUTION

### 3.01 - GENERAL INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's printed instructions and approved shop drawings.

B. All work shall be executed in full accordance with codes and these contract documents. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and at no additional cost to the Owner.

C. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as indicated on the Electrical Drawings for the locations.

### 3.02 - CONTROL PANEL INSTALLATION

A. As part of the installation process the equipment manufacturer shall provide a field technician to support this activity and as necessary to successfully complete the installation.

B. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.

C. For installation of fiber optic cable within control panels or control assemblies, follow cable manufacturer's specification for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief to meet manufacturer's strain requirements.

### 3.03 - FIELD TESTING

A. Provide field start up and testing in accordance with Specification SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL.

B. As part of the start-up and testing process described in Specification SECTION 13331, CONTROL SYSTEM INTEGRATION, the equipment manufacturer shall provide a field technician to support this activity and as necessary to successfully complete the specified testing.

C. The Owner's and/or Engineer's decision shall be final regarding the acceptability and completeness of all testing.

### 3.04 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, QUALITY ASSURANCE.

**END OF TEXT**

See Attachment A

# ATTACHMENT A

## PRODUCT SHEETS

| | |
|---|---|
| DATA SHEET 567.1 | PROGRAMMABLE LOGIC CONTROLLER |
| DATA SHEET 567.2 | POLLING PROGRAMMABLE LOGIC CONTROLLER |
| DATA SHEET 569.1 | AUTOMATIC DIALER |

PROGRAMMABLE LOGIC CONTROLLER

---

DATA SHEET NO. 567.1

---

GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : WWTF-PLC, |
| 2. | P & I D No. | : 00 DI-601, 00 DI-601 (PUMP STATION CONTRACT) |
| 3. | Location | : SEE ELECTRICAL DRAWING |

CONTROLLER

| | | |
|---|---|---|
| 4. | Processor | : ALLEN BRADLEY CONTROLLOGIX (WWTF), COMPACTLOGIX (PUMP STATIONS) OR CURRENT EQIVALENT |
| 5. | Discrete Inputs | : 120 VAC 7mA WETTING CURRENT |
| 6. | Analog Inputs | : INTO 250 OHMS MAXIMUM LOAD |
| 7. | Discrete Outputs | : 120 VAC ON CURRENT 2 A CONTINUOUS |
| 8. | Contact Rating | : 120 VAC @ 10 AMPS -- PROVIDE INTERPOSING RELAYS |
| 9. | Analog Outputs | : INTO 500 OHMS MINIMUM |
| 10. | Memory | : AS NECESSARY TO OPERATE PLUS 30% SPARE CAPACITY |
| 11. | Communications | : PROVIDE OPEN NETWORK TO SUIT THE PROJECT APPLICATION. PROVIDE FOR FUTURE MIGRATION TO OTHER AUTOMATION EQUIPMENT. PROVIDE UPWARD MIGRATION TO PERSONAL COMPUTERS AND SERVERS. |
| 12. | Network Features | : OPEN SYSTEM, CONFORMING TO OSI ISO SEVEN LAYER MODEL. PROVIDE FOR REMOTE I/O COMMUNICATION, PLC PEER TO PEER COMMUNICATION AND COMMUNICATION TO FIELD DEVICES OVER FIELD BUS. PROVIDE COMMUNICATION TO HIGHER LEVEL COMPUTING OR PROCESS CONTROL SYSTEM. |
| 13. | Ports | : PROVIDE PORTS REQUIRED TO CONNECT TO REMOTE I/O, DATA HIGHWAY, AND LAPTOP PC, |
| 14. | Mounting | : CHASSIS SYSTEM IN BACK OF PANEL |
| 15. | Connections | : PROVIDE INDIVIDUALLY FUSSED TERMINAL BLOCKS. |
| 16. | Diagnostic Ind | : DC POWER OK, PC RUN, CPU FAULT, BATTERY LOW, FORCED I/O, I/O STATUS |

POWER SUPPLY

| | | |
|---|---|---|
| 17. | Nominal Volts | : 120 VAC 60 HZ |
| 18. | Min Supply Volts | : 85 VAC |
| 19. | Max Supply Volts | : 132 VAC |
| 20. | Power Loss Duration | : WITHSTAND POWER LOSS FOR A MINIMUM OF 20 mSEC |
| 21. | Battery Back-up | : SEE DATA SHEET 702. |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 22. | Environmental | : OPERATE AT 0-140°F (0-60°C) AND 5-95% HUMIDITY, NON-CONDENSING |

PLC PROGRAMMING

| | | |
|---|---|---|
| 23. | Software: | : SEE DATA SHEET 583. |

HUMAN MACHINE INTERFACE (HMI)

| | | |
|---|---|---|
| 24. | HMI | : SEE DATA SHEET |

MISCELLANEOUS

25. Connection : PROVIDE HIGHEST DATA-THROUGHPUT LEVEL POSSIBLE TO PROVIDE UPDATES FOR ALL SYSTEM POINTS AT A FREQUENCY TO SUPPORT A REAL-TIME CONNECTION.
26. Documentation : PROVIDE ALL DISTRIBUTION MEDIA AND DOCUMENTATION
27. Manufacturer(s) : ALLEN BRADLEY CONTROL LOGIX
28. Operating Sequence : SEE SPECIFICATIONS
29. Documentation : PROVIDE HARD COPY AND CD WITH LADDER DIAGRAMS.

NOTES.

a. Provide preliminary ladder diagram with PLC submittal.
b. Provide 15% active spare I/O. Provide as a minimum one spare card of each I/O type.
c. Provide true PID algorithm for continuous control like level, flow and chemical feed.

POLLING PROGRAMMABLE LOGIC CONTROLLER

---

DATA SHEET NO. 567.2

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GENERAL

| | | |
|---|---|---|
| 1. | Tag Number | : POL.PLC-1 |
| 2. | P & I D No. | : 00-DI-602 |
| 3. | Location | : IN WWTF-PLC CABINET |

CONTROLLER

| | | |
|---|---|---|
| 4. | Processor | : ALLEN BRADLEY MICROLOGIX OR CURRENT EQIVALENT |
| 5. | Discrete Inputs | : 120 VAC 7mA WETTING CURRENT |
| 6. | Analog Inputs | : INTO 250 OHMS MAXIMUM LOAD |
| 7. | Discrete Outputs | : 120 VAC ON CURRENT 2 A CONTINUOUS |
| 8. | Contact Rating | : 120 VAC @ 10 AMPS -- PROVIDE INTERPOSING RELAYS |
| 9. | Analog Outputs | : INTO 500 OHMS MINIMUM |
| 10. | Memory | : AS NECESSARY TO OPERATE PLUS 30% SPARE CAPACITY |
| 11. | Hot Backup | : NOT REQUIRED |
| 12. | Communications | : PROVIDE OPEN NETWORK TO SUIT THE PROJECT APPLICATION. PROVIDE FOR FUTURE MIGRATION TO OTHER AUTOMATION EQUIPMENT. PROVIDE UPWARD MIGRATION TO PERSONAL COMPUTERS AND SERVERS. |
| 13. | Network Features | : OPEN SYSTEM, CONFORMING TO OSI ISO SEVEN LAYER MODEL. PROVIDE FOR REMOTE I/O COMMUNICATION, PLC PEER TO PEER COMMUNICATION AND COMMUNICATION TO FIELD DEVICES OVER FIELD BUS. PROVIDE COMMUNICATION TO HIGHER LEVEL COMPUTING OR PROCESS CONTROL SYSTEM. |
| 14. | Ports | : PROVIDE PORTS REQUIRED TO CONNECT TO REMOTE I/O, DATA HIGHWAY, AND LAPTOP PC |
| 15. | Mounting | : CHASSIS SYSTEM IN BACK OF PANEL |
| 16. | Connections | : PROVIDE INDIVIDUALLY FUSSED TERMINAL BLOCKS. |
| 17. | Diagnostic Ind | : DC POWER OK, PC RUN, CPU FAULT, BATTERY LOW, FORCED I/O, I/O STATUS |

POWER SUPPLY

| | | |
|---|---|---|
| 18. | Nominal Volts | : 120 VAC 60 HZ |
| 19. | Min Supply Volts | : 85 VAC |
| 20. | Max Supply Volts | : 132 VAC |
| 21. | Power Loss Duration | : WITHSTAND POWER LOSS FOR A MINIMUM OF 20 mSEC |
| 22. | Battery Back-up | : SEE DATA SHEET 702. |

SERVICE CONDITIONS

| | | |
|---|---|---|
| 23. | Environmental | : OPERATE AT 0-140°F (0-60°C) AND 5-95% HUMIDITY, NON-CONDENSING |

PLC PROGRAMMING

| | | |
|---|---|---|
| 24. | Software: | : SEE DATA SHEET 583. |

MISCELLANEOUS

| | | |
|---|---|---|
| 25. | Connection | : PROVIDE HIGHEST DATA-THROUGHPUT LEVEL POSSIBLE TO PROVIDE UPDATES FOR ALL SYSTEM POINTS AT A FREQUENCY TO SUPPORT A REAL-TIME |

| | | |
|---|---|---|
| | | CONNECTION. |
| 26. | Documentation | : PROVIDE ALL DISTRIBUTION MEDIA AND DOCUMENTATION |
| 27. | Manufacturer(s) | : ALLEN BRADLEY COMPACT LOGIX |
| 28. | Documentation | : PROVIDE HARD COPY AND CD WITH LADDER DIAGRAMS. |

NOTES.

a. Provide preliminary ladder diagram with PLC submittal.
b. Provide 15% active spare I/O. Provide as a minimum one spare card of each I/O type.

**END OF SECTION**

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**SECTION 13345**

**DATA NETWORK**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide, terminate, test and put in operation a complete Ethernet based data network as specified. The network shall include, but not limited to, fiber optic cabling system, network boxes, fiber patch panels, fiber connections, network switches, firewalls, radio equipment, and miscellaneous equipment to provide a complete functional data network system. The work of this section shall be by the Contractor and as specified in SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL.

B. Fiber optic cables shall be provided for use with the WWTF SCADA control system, including the fiber required for the Pump Station and Collection System.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to, the following.

1. SCADA Network Hardware
2. Radio communication Hardware.
3. CAT 6 Cable and Appurtenances
4. Fiber Optic Cable and Appurtenances

C. Shop drawings shall include:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

    a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

2. Installer Qualifications – Include resumes of staff and previous project experience with references. Proposed Products List.

3. Outline drawings of termination cabinets showing dimensions, cables, jumpers and associated hardware for termination.

4. Provide written confirmation that products to be submitted as acceptable to control systems supplier.

5. For each component and material submit shop drawing which shall include:

    a. Manufacturer.

    b. Model number.

    c. General data and description.

    d. Engineering specifications and data sheets.

    e. Catalog cuts.

    f. For information purposes only, submit manufacturer's printed installation instructions.

D. All submittals provided by the Contractor shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments has been addressed and that the submittal is reviewed by the SI.

E. Submit a drawing showing the routing for the fiber optic network. Include the following information:

1. Routing, length, and attenuation based on TIA-568-A.

2. Cable and conduit identification.

3. Locations of manholes, pull boxes and patch panels.

F. Provide network wiring tables spreadsheet in Excel format listing all structured cabling components and cabling source and destinations connections for each fibre optic cable transmit and receive pair for backbone, also include each fibre optic patch cord, each CAT6 patch cord, each patch panel port and each network equipment switch port.

G. Test Documentation:

1. Document results of tests (shop test, field test, acceptance test) and submit copies of documents to Engineers as tests are completed.

H. As-Built:

1. Provide as-built drawings at the completion of the Contract. The marked up drawing set will accurately depict the as-built status of the communication system including termination locations, cable routing, and administration labeling for the cable system.

2. Provide End-to-End insertion loss data for all fiber and individual Splice Loss and Connector Insertion Loss data.

3. Submit Component Data.
    a. Manufacturer and model number
    b. General data description
    c. Engineering specifications and data sheet
    d. Scaled drawings and mounting arrangements
    e. Power and grounding requirements
    f. Electrical and network interfaces (copper and optical)

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Fiber optic cables and related equipment shall be the products of approved manufacturers. Fabrication of the fiber optic cables and related equipment shall utilize the most advanced commercial materials and manufacturing processes. Manufacturer shall be ISO 9001 and TL-9000 certified.

B. Fiber optic cable installation shall be performed by experienced fiber optic cable installers who shall have been regularly engaged in the installation of fiber optic cables for the last five (5) years at the minimum.

C. Fiber optic cable splicing and terminations shall be performed by experienced cable splicers who shall have been regularly engaged in splicing and termination of fiber optic cables for the last five (5) years at the minimum.

D. Retain the services of the fiber optic cable manufacturers technical representative to certify that the fiber optic cable installation is in accordance with the manufacturer’s installation requirements.

E. Retain the services of an independent testing firm who shall perform acceptance testing of the fiber optic cable installation. The testing firm shall have experience in the inspection and testing of cables of the specified type and shall be a member company of NETA.

F. All cables and terminations shall be identified at all locations. All cables shall terminate in an alphanumeric sequence at termination locations.

G. All Fiber Optic cable terminations shall comply with, and be tested to, ANSI/TIA/EIA 568-B standards for single-mode and multi-mode Fiber installation for Fiber Optics.

H. All optical fiber components (optical fiber, cable, connectors, patch panels, hardware and patch cords) shall be manufactured by a single company, unless otherwise noted, in order to ensure consistency and compatibility.

**1.08 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall be provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor's responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guide as specified herein.

**1.09 - REFERENCES**

A. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code (NEC).

B. Underwriters Laboratories, Inc. (UL):

1. U.L. 1581 VW-1: Vertical Tray Cable Flame Test
2. U.L. 1666: Riser Cable
3. U.L. 508: Standards for Safety, Industrial Control Equipment

C. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE Standard 383: Flame Retardancy.
2. IEEE 802 (Series): Standards for Local and metropolitan Area Networks.
3. IEEE 1588: Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.

D. American National Standards Institute (ANSI):

1. ANSI/ISA-99: Security for industrial Automation and Control Systems.

E. NETA: The International Testing Association Acceptance Testing Specification.

F. TIA/EIA-568-B/C (Series): commercial Building Telecommunications Cabling Standards.

G. TIA/EIA-569 (Series): commercial Building Standard for Telecommunications Pathways and Spaces.

H. TIA/EIA-526 (Series): Standard Test Procedures for Fiber Optic Systems.

I. TIA/EIA-604 (Series): Fiber Optic Connector Intermateability Standard (FOCIS).

J. Internet Engineering Task Force (IETF) RFC documents (various).

**1.10 - SHOP TESTS**

A. Fiber optic cables and equipment shall be shop tested at the manufacturer's plant in accordance with the manufacturer's standard testing procedures. Shop tests shall be performed prior to shipment.

B. Submit manufacturer's shop test reports.

**1.11 - EQUIPMENT IDENTIFICATION**

A. Each fiber shall be labeled at each termination point and all splice location including spares. Conductor or circuit identification shall be applied at specified points with circuit numbers or other identification stamped on terminal boards when provided, or on the cable itself in such a manner that the identification is visible around the cable's circumference.

B. Each fiber shall be identified in junction boxes, pull boxes, manholes, handholes, terminal boxes, and cabinets. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper self-adhesive wire markers are not acceptable.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Fiber Optic Cabling System.

1. Corning Cable Systems.
2. Chromatic Technologies, Inc.
3. Belden (Cooper Industries).
4. OFS Fiber.
5. Or equal.

B. Network Switches:

1. Cisco.
2. MOXA
3. Or equal

**2.02 - FIBER OPTIC CABLE**

A. General:

1. Provide single-mode, buffered, optical glass fiber cores based transmission systems. Maximum attenuation losses shall be 3.4 dB/km or less at a wavelength of 850 nm and 1.0 dB/km or less at a wavelength of 1300 nm. Minimum bandwidth shall be 200 MHZ-km at 850 nm and 500 MHZ-km at 1300 nm. Fiber Category shall be OM3 unless otherwise required. All plastic fiber core construction shall not be acceptable.
2. The Fiber Optic Cables provided shall be fully water blocked with a jacket to resist 3 feet deep water.

B. Fiber Optic Breakout Cable:

1. Heavy duty, tight buffer construction with additional strength members, and a oil, water, and chemical resistant, UV stabilized, flame retardant, PVC outer jacket, UL listed OFNR. Fiber cladding shall be 125 micron and fiber buffer shall be 900 micron.
2. Cable specifications:
   a. Fiber Count: As shown on drawings
   b. Suitable for indoor/outdoor, direct buried, cable tray and duct installation.
   c. Minimum Crush Resistance: 80 lbs/inch [3.2 kg/cm]
   d. Operating Temperature: -10 to +50 degrees C [14 to 122 degrees F]

3. Provide a minimum of 4-foot coil of spare fiber in each handhole throughout the cable length. Quantity and locations of handholes as shown on Electrical drawings.

C. Code Compliance:

1. The cable must meet the requirements of the National Electrical Code® (NEC)® Section 770.

2. Cables shall conform to the applicable performance requirements of the Insulated Cable Engineers Association, Inc. (ICEA) *Standard for Indoor-Outdoor Optical Fiber Cable* (ICEA S-104-696).

D. Packing and Shipping:

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. Required cable lengths shall be stated in the purchase order.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weather resistant reel tag attached identifying the reel and cable.

5. Each cable shall be accompanied by a cable data sheet.

E. Shop Tests:

1. All optical fibers in cables lengths of 1,000 m or greater shall be 100 percent attenuation tested. The attenuation shall be measured at 850 nm and 1300 nm for multimode fibers. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers. The manufacturer shall store these values for a minimum of five years. These values shall be available upon request.

**2.03 - TERMINAL CONNECTORS**

A. Manufacturers: Ortronics, Corning Cable Systems, 3M Telecom Systems Group, or approved equal.

B. Connectors: ST type (AFL Fuse Connect ST), pre polished. The connector shall be field installable, requiring no on-site epoxy or polishing. Connector specifications shall be as follows:

1. Insertion loss (typical): 0.3 dB (maximum).

2. Operating Temperature: -40 to +60 degrees C [-40 to +140 degrees F]

**2.04 - CAT6 CABLE**

A. Provide twisted-pair cable, connectors and appurtenances that make up the copper CAT6 cable segments.

B. Cable segments shall meet the requirements of the TIA/EIA-568-B specification for Category Six (CAT6), Unshielded Twisted Pair (UTP) cable.

C. Cable Segments shall meet or exceed the following minimum requirements:

1. The cable shall be tested up to 200 MHz with a guaranteed performance that meets or exceeds the ANSI/TIA/EIA-568B/ISO/IEC 11801 horizontal cable requirements for PS-NEXT, attenuation, structural return loss, and attenuation-to-crosstalk ratio (ACR).

2. The cable shall be constructed from 0.54mm (24AWG), bare copper wire insulated, UTP, UL/NEC CMR rated, with a white, gray, blue or yellow plenum-rated PVC jacket. Two insulated conductors twisted together to form a pair and four pairs laid up to form the basic unit.

3. The cable shall be jacketed in flame-retardant PVC. Cable run in conduit shall meet or exceed FT4 rating. Cable not run in conduit shall meet or exceed FT6 rating.

4. Cable jacketing shall be lead-free. Cable shall be supplied on wooden reels or in reel-in-box. Cable shall be UL listed under file number E138034. CAT6.

**2.05 - CONNECTING CORDS, DEVICES AND ADAPTERS**

A. Optical patch cords shall be provided to patch the network switches to the patch panel. Connectors to be compatible with the network equipment.

B. Provide one new fiber patch panel at each of the following locations:

1. 10.PP-1, 10.PP-2– WWTF Building

2. 01.PP-01 – Pump Station 1

**2.06 - ENCLOSURE WIRING**

A. All fibers shall be terminated, tested, installed and ready for use.

B. All enclosure wiring shall run through a cable manager.

C. Cable managers shall not be filled to more than 50 per cent of their volume upon initial installation.

D. All wires and cables, including spares, shall be identified at each end and at any connection. Use durable non-fading sleeve type wire markers to identify all network cables.

**2.07 - OPTICAL HARDWARE**

A. Manufacturers: Ortronics, Corning Cable Systems, 3M Telecom Systems, Group, or approved equal.

B. Equipment Rack:

1. The equipment rack shall conform to Electronics Industry Association (EIA) EIA-310 standards.

2. The equipment rack shall be manufactured from aluminum for lighter weight and ease of assembly during installation. The rack shall be black in color. Installation fasteners shall be included and shall be black in color.

3. Blank rack panels shall be available to fill unused rack space.

C. Connector Panels: Rack and wall mountable connector housings shall accept an interchangeable connector panel. A connector panel is defined as a modular removable plate containing optical fiber connector adapters or copper jacks. The connector panel shall have the following characteristics:

1. The connector panel shall utilize a single mounting footprint and shall be available with three, four, six, eight or twelve connector adapters in each panel. Copper jack panels shall accept up to four copper jacks. The connector panel shall be interchangeable between the rack and wall mountable hardware being proposed. The panel shall be attached with two push-pull latches to allow quick installation and removal.

D. Connector Modules: Rack mountable connector housings shall accept an interchangeable connector module. A connector module is defined as a modular removable case containing optical fiber connector adapters and provisions for strain-relief, slack storage, and the furcation of fiber optic cables.

E. Rack Mountable Connector Housings: Rack mountable connector housings shall be available for cross-connecting or inter-connecting purposes. The units shall provide for direct connectorization and pigtail splicing.

**2.08 - NETWORK EQUIPMENT ENCLOSURES**

A. Network equipment enclosures shall be used to house networking devices and patch panels.

B. Network equipment enclosures shall provide a wire duct for communication cables and fiber optic cables between the communication devices in control panel and communication raceways.

**2.09 - MANAGED ETHERNET SWITCHES**

A. Ratings:

1. The managed Ethernet switch shall be rated for:

a. -40 to 60 °C (-40 to 140 °F) operating temperature.

b. 5 to 95% noncondensing ambient relative humidity.

B. The Switch shall be UL Listed Industrial Control Equipment.

C. Construction:

1. The switch shall have:

a. Power Source: Single 120 VAC power source.

b. Ports: 10 ports (minimum) fixed configuration plus 2-gigabit copper RJ-45 ports.

c. PoE: 4 ports capable of Power over Ethernet (PoE), providing electrical power along with data on a single Ethernet cable to end devices.

d. Alarms: 6-pin alarm connector to provide an interface for 1 output alarm relay circuit and 2 input alarm relay circuits.

e. LEDs: 4 LED indicators displaying hardware and network link status.

f. Memory: 256 MB DRAM and 64 MB onboard flash memory.

g. SD Card: The switch shall have a slot for a Secure Digital (SD) card.

D. Functions:

1. The switch shall support Ethernet/IP protocol.

2. The switch shall be able to trigger alarms for faults (power supply, temperature, FCS bit error, loss of signal, port operation) and make notifications.

3. The switch shall be able to prioritize automation control traffic (time sync, motion control, safety I/O, standard I/O) using Quality of Service (QoS).

4. The switch shall include the following security features:

a. Username and password for remote and local (console) access.

b. Password for the read-write access to parameters from a control system.

c. Authentication protocol support: AAA, RADIUS.

d. Secure management protocols: SSHv2, SNMPv3, HTTPS.

e. Port-based authentication and VLAN assignment: IEEE 802.1x

5. The switch shall be able to encrypt administrator traffic.

E. Configuration:

1. The managed Ethernet switch shall have the following configuration options:

a. Express Setup procedure with a web browser that configures basic parameters for typical industrial applications.

b. Device Manager Web interface configuration.

c. Built-in global or interface-level macros (command templates) that allow easy setup of the switch in a configuration optimized for the specific application.

d. Logix Designer application in Studio 5000 - a protocol interface using the same software and tools as those for a control system.

F. Diagnostics and Monitoring:

1. The managed Ethernet switch shall support diagnostic and monitoring via:
    a. Web interface (HTTP).
    b. System message logging (syslog).
    c. SNMP protocol version 2c and 3.
    d. Port mirroring.
    e. Ethernet/IP application protocol interface to a control system

**2.10 – FIREWALL**

A. Ratings:

1. The service firewall shall be rated for:
    a. IP41 enclosure type.
    b. -25 to 60 °C (-13 to 140 °F) operating temperature.
    c. 5 to 95% noncondensing ambient relative humidity.

B. Construction:

1. The service firewall shall have:
    a. An industrially hardened exterior with additional shock/vibration protection.
    b. Flat-surface and DIN rail mounting capability.
    c. A 100-240 VAC universal AC power adapter.
2. The services firewall's ports shall include:
    a. 1 Gigabit Ethernet WAN RJ-45 port.
    b. 4 LAN Fast Ethernet RJ-45 ports. The services router shall be able to accept additional Ethernet connections by connecting an external Ethernet switch to the Ethernet switch on the router.
    c. 1 RS-232 RJ-45 console/AUX port and 1 single console/AUX port.
    d. 1 12-in-1 serial port (async and sync).
3. The services firewall shall have status indicators for system and module activity.
4. The services firewall shall have a reset button for default (factory-set) configuration.
5. The services firewall shall have a Real Time Clock.

C. Function:

1. The service firewall shall help deliver highly secure real-time control communication, implementing:
    a. Firewall.
    b. Virtual Private Network (VPN) and Advanced VPN.
    c. Network Address Translation (NAT).
    d. Intrusion Prevention System (IPS).
    e. Network-Based Application Recognition (NBAR) protocol filtering.
    f. Access Control Lists (ACL).
    g. Support Quality of Service (QoS) traffic prioritization.

h. Provide Cell/Area Zone protection by monitoring and blocking inputs, outputs and system requests that do not meet the firewall's configured policy.

i. Protect site-to-site connection by safely tunneling the trusted network to a remote site over an untrusted network.

D. Configuration:

1. The service firewall shall be capable of being configured 3 ways:

a. Installed on the router. The Web-based software also manages and diagnoses network issues and has alarm tools.

b. A single PC based application that configures and manages multiple devices.

c. Using a terminal services emulator.

**2.11 – SMALL FORM FACTOR PLUGGABLE TRANSCEIVER (SFP)**

A. 10GB/S data rate

B. Cable type – Single Mode Fiber

C. Cisco, Advantech or Equal.

**2.12 – SINGLE MODE TO MULTIMODE FIBER CONVERTER**

A. 1000Base-X fiber connector

B. Panel Mount

C. 24VDC Power

D. Features

1. Auto negotiation
2. Link Mode
3. Fiber Fault Alert
4. Remote Loop Back
5. Manufacturer – Pearle, Cisco, or Equal

**2.13 – RADIO**

A. Provide in accordance with radio path survey.

B. WWTF

1. Provide Omni Antenna TELEWAVE ANT220F6, or approved equal.

a. Antenna must be installed at 40 foot elevation. See Contract Drawings for details.

2. Provide CalAMP Viber SC+200 radio Modem.

C. Pump Station No. 1 (Namskaket Pump Station)

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR or approved equal.

a. Antenna must be installed at 12-foot elevation. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

D. Effluent Disposal Site

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR or approved equal.

a. Antenna must be installed at 87-foot elevation on nearby water tank. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

E. Pump Station No. 2 (Snow Pump Station)

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR, or approved equal.

a. Antenna must be installed at 12 foot elevation. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

F. Pump Station No. 3 (Nauset Pump Station)

1. Provide Yagi Antenna TELEWAVE ANT220Y7-WR, or approved equal.

a. Antenna must be installed at 12 foot elevation. See Contract Drawings for details.

2. Provide CalAMP Viper SC+200 radio modem or approved equal.

G. For all locations, provide hardware, cabling and accessories to connect the radio antenna to the associated PLC.

**2.14 - SPARE PARTS**

A. Two (2) spare fiber optic cable connectors for each type used.

B. Furnish one Ethernet switch and one firewall of each type provided.

C. Provide recommended spare parts list with unit prices.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Provide all material, equipment, and labor to install the fiber optic cables and network devices including but not limited to terminating and testing as indicated, and as specified.

B. Installation shall be in accordance with the National Electrical Code and all local codes.

**3.02 – INSTALLATION**

A. Fiber optic cable installation shall be by the Electrical Contractor.

**3.03 - CABLE TERMINATIONS**

A. Terminate cables in accordance with TIA-568.

B. Fan out fibers to allow flexibility and ease of installations for future expansion at connection points. Provide a metal or high density plastic fan-out collar to relieve the stress on the individual fibers. To protect the individual fibers, provide sleeves from the fan-out collar to the terminal point. Terminate all fibers in each cable with a suitable connector as specified.

C. Provide a minimum of 20 feet [6 meters] of neatly coiled, slack fiber optic cable at each terminal cabinet or backboard for flexibility.

**3.04 - PHYSICAL CHECKOUT**

A. General Procedures:

1. Conduct physical checkout of the fiber optic data highway network.

2. Physical checkout shall be performed prior to functional testing.

B. Check Procedures:

1. Verify that fiber optic cables reels have been off-loaded from truck carefully and not damaged

2. Verify that the optical fibers of the cable assembly are the type and quantity as specified.

3. Verify that cable construction is the type specified.

4. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.
5. Verify that fiber optic splice closures have been installed at locations indicated.
6. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's printed recommendations.

**3.05 - FIELD TESTING**

A. Conduct the following field tests after cable installation:

1. Visually, inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 100X (minimum) inspection microscope.

B. Cable Testing:

1. Provide equipment, instrumentation, and supplies necessary to perform testing. Engineer and Owner shall have the option to witness and participate actively in on-site tests.
    a. Notify Engineer and Owner at least 10 days prior to testing.
2. Perform all tests and inspections as required by NETA.
3. Post-Installation Testing: Demonstrate that all fibers in each cable meet requirements of TIA-568 as modified here:
    a. Maximum attenuation as specified.
    b. Measure attenuation in both directions, not in one direction only.
4. Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with EIA/TIA-455-60. The measurements to determine splice loss shall be performed in accordance with manufacturer's recommendations.
    a. Each strand shall be tested on all outside plant cables and/or where splices exist.
5. Replace all cables or mated connector pairs that do not meet attenuation standards and redo tests until cable meets requirements and at no additional cost to the Owner.
6. Submit testing results for review and approval.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 13350**

**SCADA EQUIPMENT**

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## PART 1 - GENERAL

### 1.01 - SCOPE

A. Provide SCADA equipment as specified and in accordance with the Contract Documents. The equipment shall include, but not limited to, servers, uninterruptable power supplies (UPSs), human machine interface (HMI) equipment, and all software packages required to provide a complete and functional control and communication system.

B. Equipment Product Sheets are in 13350 Attachment A.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to, the following.

1. SCADA Network Hardware

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

D. Submit Manufacturer Product Data Sheets, with the information noted below and other data pertinent to the equipment and the application.

1. The product manufacturer technical data sheets.

2. The complete model or catalogue number(s) including any special options.

E. Licensing documentations for all software packages.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTIONS 01610, DELIVERY, STORAGE AND HANDLING and SECTION 13300, PROCESS INSTRUMENTS.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - WARRANTY**

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

**PART 2 - PRODUCTS**

**2.01 - SOFTWARE**

A. All software shall be of the latest version available at the time of submittal review.

B. Rockwell Automation Factory Talk View SE to match software in use at the Water Department. Provide two software clients.

C. WIN 911 software for plant alarm management.

D. A SQL database and XL Reporter will be utilized to develop the plant reports. Reports shall be archived daily but shall be readily accessible to plant operators for one week after generation.

E. Data applications will be stored on external drivers provided by SI with one-touch backup initiation

**2.02 - UNINTRUPTABLE POWER SUPPLY (UPS)**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.03 - THIN CLIENT**

A. General:

1. The Thin Client system shall be based on Microsoft terminal services (remote desktop services) solution, with applications presented to user stations based on thin client hardware. The management of this architecture, including servers, thin client terminals, users, applications and security shall be centrally and securely handled by the proposed Management Software.
2. The Thin Client software will operate on the SCADA server as a virtual machine. Provide Thin Client in the Primary Server and backup Thin Client in the SCADA backup server.

B. Thin Client Hardware shall conform to the following:

1. Thin Client hardware shall be Thin Manager ready and shall not require modification from the manufacturer's standard offering.
2. Hardware shall be capable of using Microsoft Remote Desktop Protocol (RDP) and the associated data compression and encryption.
3. Hardware shall be capable of supporting Network Level Authentication (NLA).
4. Hardware shall be compatible with the supplied Management software.
5. Hardware shall support terminal side USB mouse and keyboard.
6. Hardware shall support local serial ports.
7. Hardware shall support high color, high resolution, and be capable of supporting screen resolutions up to 3840x2160 (UHD).
8. Hardware shall neither require nor contain cooling fans.
9. Hardware shall neither require nor contain local permanent storage (i.e. no flash or hard drive shall be necessary or installed).
10. Hardware shall not require a local operating system to boot.
11. Hardware shall have the ability to boot from the server over a standard network.
12. Hardware shall support standard Ethernet network infrastructures.
13. Hardware shall support using either DHCP, static IP configuration, or terminal profile based IP assignment.
14. In conjunction with the Management Software, the ability to configure hardware shall be supported.
15. Hardware shall support the ability to utilize a single keyboard and mouse to control multiple thin clients.
16. Hardware shall support the ability to utilize a single thin client with up to 5 monitors to drive multiple stations, each with their own display, keyboard and mouse.
17. Hardware shall support the ability to move applications from one monitor to another with a thin client that supports multiple monitors. This should be fully configurable.
18. Hardware shall support automatic login to a predetermined terminal server and start a session without operator input.
19. Hardware shall be capable of interfacing with smart card readers.
20. Hardware shall be capable of redundant networking.
21. Hardware shall be able to utilize multiple network interfaces on the Thin Client for different LAN segments.
22. Hardware shall be capable of interfacing with any touch screen controller.

23. Thin Client Terminals:

    a. Thin Clients shall be set-up to run a terminal session of the HMI by connecting to the SCADA Terminal Server.

C. Thin Client Terminals

1. Compact, fanless, tower form factor with flexible mounting options; desktop or panel mount as indicated on the Contract Drawings.
2. 500 MHz processor minimum.
3. 256 MB of RAM minimum.
4. Video graphics card capable of 1600 x 900 pixels, 60Hz refresh rate and 16-bit color minimum. VGA output.
5. Operating temperature of 10 degrees Celsius to 50 degrees C
6. 110 Ports & devices

    a. Minimum of two USB 2.0 ports supporting USB mouse and keyboard.

D. Interface devices

1. Generic USB keyboard, no hot keys or number pad onboard
2. Two button USB optical mouse with scroll wheel
3. Monitor

    a. LCD flat panel 20-inch nominal size minimum
    b. UHD support for 3840 x 2160 resolution
    c. 16 ms response time maximum
    d. 250 nits (cd/m2) brightness
    e. 400 to 1 contrast ratio minimum
    f. Vertica1 viewing angle of 85 degrees minimum
    g. Horizontal viewing angle of 85 degrees minimum
    h. Analog GRB, Digital DVI-D
    i. Adjustable height stand for desktop applications
    j. Panel mount option for installations in PLC panels as indicated with screen minimum size of 15 inches. Screen shall be touch type unit.

E. Networking:

1. The onboard network interface shall have the following features

    a. Support for latest Microsoft operating system.
    b. Fast Ethernet port accepting standard CAT-6 cables for Ethernet communications
    c. IEEE 802.3ab support for gigabit networking standard
    d. IEEE 802.Q VLAN support
    e. Auto sensing 10/100 Mbps or faster
    f. Support either DHCP or static IP configuration.

F. Power supply shall be capable of providing necessary power. Thin Client and monitor shall be I20VAC from UPS.

G. Thin Client Hardware

1. Thin Client Terminals shall be Arista; Microbox 7824B-B01-003-DR or equal.
2. Provide client terminals for the following services:
   a. OWS-01
   b. OWS-02
   c. Flat Screen TV in Conference Room
   d. Flat Screen TV in Control Room

**2.05 - MANAGEMENT SOFTWARE:**

A. The Management Software shall be able to support configuration of Servers, Thin Clients ('terminals') and Applications from a central interface.

1. Software shall allow centralized configuration of all aspects of the proposed architecture. No client based configuration shall be required.
2. Software shall support connectivity, configuration and interoperability with Microsoft Terminal Services operating systems from Windows 2003 Server through to the latest offering (currently Windows Server 2016).
3. Management software shall be capable of running on the operating systems specified.
4. Software shall support management of the overall terminal services architecture.
5. Software shall permit terminals to be remotely configured and reset from the central interface without the need for the administrator to be at the physical location of the terminal.
6. Software shall permit Windows authentication with auto-login features.
7. Software shall permit automatic login to a predetermined terminal server and start a session without operator input.
8. It shall be possible to configure multiple terminal servers to be used in a load balancing manner without implementing clustering.
9. Load balancing shall be automatically handled by the software and shall be tunable based on CPU utilization, Memory usage and Process usage on the server.
10. Software shall support the ability to queue access requests to the server and complete when resources are available.
11. Software shall support the ability to configure multiple terminal servers to be used and provide the ability to 'failover' to the backup terminal server if the current terminal server fails.
12. Software shall support Shadowing of terminals from management software (Shadowing refers to the ability to view, with authorization, any terminal screen on the managed network).
13. Software shall support the ability to Shadow one terminal on one or more terminals.
14. Software shall have monitoring capabilities to detect and display terminal server assignment, login status, terminal load, and terminal server load.
15. Should a thin client fail, the software should provide the ability to allow quick replacement of the failed client with a spare, with no required configuration changes.
16. Should a thin client fail, the replacement terminal shall be automatically reconnected to the existing (disconnected) terminal session.
17. Software shall support the automatic logout of a session after a configurable period of inactivity.
18. Software shall support the integration of IP camera video as either an overlay on an existing terminal screen or as a separate client application.

19. Software shall support software decoding of IP camera streams as well as hardware decoding (with appropriate thin client hardware).
20. Multiple video streams shall be able to be configured onto a single client display.
21. Software shall permit configuration permitting sound from an application, or from multiple applications, to be played from the thin client device.
22. Software shall support easy backup and restoration of the configured architecture.
23. Software shall be extensible, preferably utilizing an ActiveX control or .NET component.
24. Software shall support the delivery of applications from multiple terminal servers to a single thin client, and visualize the sessions simultaneously.
25. Software shall support the management of applications being delivered to a PC based platform.
26. Software shall support industrial and commercially available thin client hardware.
27. The Management Software shall be able to be used from a portable, network connected mobile device.
28. Software shall support remote configuration with an iOS device such as an iPad or iPhone, or Android device.
29. Thin client emulation software shall be available to provide operator level functionality from a network connected iOS or Android devices.
30. The thin client emulation software shall not permit the operator to configure or otherwise interact in an administrative capacity with the network.
31. The thin client emulation software shall support delivery of applications to the mobile device based on location.
32. The thin client emulation software shall support location based resolvers including Quick Response (QR) Codes, Bluetooth Beacons, Global Positioning System (GPS) and WiFi Access Points.
33. Upon location based resolution, the thin client emulation software shall support different actions based on the user's access group, including Interactive Shadow, Non-interactive Shadow, Manual Transfer, Force Transfer and Clone.
34. The thin client emulation software shall support the combination of location resolvers to create a geo-fence for application delivery.
35. Security of the configuration and access to servers shall be managed and configured with the Management Software.
36. Software shall support but not require different levels of access for security based on user identity.
37. Users shall be able to be placed into security groups for easy management.
38. Software shall support Application access based on user identity.
39. Software shall support configuring of Applications such that only the Application window is presented to the user (i.e. no desktop or Start menu), thereby denying access to unauthorized programs.
40. User level access shall be able to be configured independent of any operating system based authentication, such as Active Directory, and shall not require access to such for configuration.
41. User level access using Microsoft Active Directory or other operating system based authentication shall however be supported.
42. The software shall support synchronization with Microsoft Active Directory organization units (OU).
43. Software shall support the storage of credentials that can be pushed to Microsoft Active Directory.
44. Software shall support automatic password generation at a configurable interval while maintaining Microsoft Active Directory complexity requirements.

45. Software shall support the delivery of applications based on a user's assignment to a Microsoft Active Directory security group.
46. Software shall permit automatic launching of programs without operator input.
47. Software shall support the ability for a supervisor to access their authorized applications and desktop from any configured terminal.
48. Software shall support the ability to permit or deny users, or groups of users, access to applications unless suitably authorized and authenticated.
49. Software shall support blocking of interrupt key sequences such as CTL+ALT+DEL and CTL+ESC.
50. Local terminal USB ports shall not be connected to the server.
51. The Management Software shall be able to manage licensing within the central interface.
52. Licensing shall be flexible based on the number of clients managed on the network.
53. The number of servers managed as a part of the architecture shall not be restricted by the management software license.
54. It shall be possible to add more client licenses to the network without disturbing the connected clients.
55. There shall be a level of licensing which permits an unlimited number of clients to be connected and managed without the need to purchase additional client licenses.

**2.06 – COMPUTER WORK STATIONS**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.07 – PRINTERS**

A. Quantity
   1. Provide quantity as shown on Contract Drawing 00 DI-601.

B. All printers shall be Laser type color printer with scanner except one printer will be dot matrix type printer for alarms processing

C. Printers shall be capable of printing on letter (8.5” x 11”) or tabloid (11”x17”) sheets of paper. The printer shall accept paper fed manually or from one of two paper trays, each with a minimum capacity of 200 sheets. The printer shall print at least 35 pages of text per minute at a resolution of 1200 dpi or greater. The printer shall contain a minimum of 48 MB of on-board RAM, expandable to 320 MB. The report printer shall be a Hewlett Packard LaserJet P4015 series or equal.

D. Report printer(s) shall be provided with a 10/100/1000 Base-TX interface to provide connectivity to the computers over the Ethernet network

**2.10 – NETWORK SERVERS**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.11 – SCADA EQUIPMENT RACK**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.12 – TV MONITOR**

A. Provide in accordance with product sheets included in Attachment A of this section.

**2.13 - SPARE PARTS**

A. Provide recommended spare parts list with unit prices.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Provide, install, test and commission SCADA Equipment and all peripheral devices necessary in accordance with the Contracts Documents.

B. The SI shall install, configure and setup all software packages provided.

### 3.02 - FIELD TESTING

A. Demonstrate system functional operation after completion of installation and prior to plant start up. Refer to SECTION 13331, CONTROL SYSTEM INTEGRATION for control system field testing requirements.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**See Attachment A, Product Sheets**

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**ATTACHMENT A**

**PRODUCT SHEETS**

| | |
|---|---|
| DATA SHEET 583.1 | SOFTWARE |
| DATA SHEET 702.1 | UNINTERUPTIBLE POWER SUPPL |
| DATA SHEET 706.1 | FULL SCADA NODE - COMPUTER DESK TOP WORK STATION |
| DATA SHEET 706.2 | FULL SCADA NODE – DEVELOPER COMPUTER LAPTOP WORKSTATION |
| DATA SHEET 712.1 | NETWORK SERVER |
| DATA SHEET 712.2 | NETWORK SERVER |
| DATA SHEET 750.1 | SCADA EQUIPMENT RACK |
| DATA SHEET 900.1 | TV MONITOR |

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**SOFTWARE**

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DATA SHEET NO. 583.1 . 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Function | : | INTEGRATION OF PLC, HMI, NETOWRK, WORKSTATIONS & PERIPHERALS |
| 2. | Location | : | PART OF CONTROL SYSTEM |

SOFTWARE

| | | | |
|---|---|---|---|
| 3. | PLC Config | : | RSLOGIX 5000 STUDIO PROFESSIONAL EDITION. |
| 4. | HMI Config | : | ROCKWELL FACTORY TALK VIEW SE TO MATCH WHAT IS IN USE AT THE WATER DEPARTMENT. INCLUDE 5 YEARS SUPPORT STARTING 30 DAYS FROM CONTRACT NOTICE TO PROCEED |
| 5. | Historian | : | FACTORYTALK HISTORIAN SITE EDITION, 5000 ACTIVE POINTS |
| 6. | Virtual Software | : | VIRTUAL MACHINE VM WARE OR HYPER V |
| 7. | Thin Client | : | THIN MANAGER |
| 8. | Microsoft: | : | Microsoft Windows Server OEI-16 Core CAL – Data Center Version |

NOTES:

a. Provide all softwares as the most current release available at time of shop drawings submittals.

**UNINTERRUPTIBLE POWER SUPPLY**

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DATA SHEET NO. 702.1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | LINE POWER CONDITIONING AND BACKUP POWER FOR PLC/SCADA SYSTEM |
| 2. | Location | : | SERVER RACK, WWTF-PLC, WW.PS-1-PLC, WW.PS-2-PLC, WW.PS.3-PLC, WDV-PLC |
| 3. | Input Voltage | : | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 20% |
| 4. | Output Voltage | : | 208/120 VAC, 3/1 PHASE, 4 WIRE @ 60 HZ +/- 3% SINE WAVE, +/- 1% VOLTAGE BALANCE |
| 5. | Input Current Total Harmonic Distortion (THD): 3% AT 100% LOAD – 5% AT 50% LOAD | | |
| 6. | Output Voltage Harmonic Distortion: 2% MAX. AT 100% LOAD – 5% MAX. AT 50% LOAD | | |
| 7. | Power Factor | : | 0.90 AT 100% LOAD – 0.90 AT 50% LOAD |
| 8. | Operating Temp. | : | 50 TO 104 DEG. F. |
| 9. | Surge Protection | : | 6000 VOLT AND MEET IEEE C62.41 CATEGORIES A AND B |
| 10. | Backup Time | : | MINIMUM OF 10 MINUTES MINIMUM AT 120% OF FULL LOAD |
| 11. | KVA Size: | : | 10 KVA MINIMUM AND IN ACCORDANCE WITH SIZING CALCULATIONS REQUIREMENT SPECIFIED. |
| 12. | Low Battery Ind. | : | REQUIRED |
| 13. | Brownout Protection | : | REQUIRED |
| 14. | UPS Type | : | VOLTAGE REGULATION LINE INTERACTIVE |
| 15. | Efficiency | : | 92% MINIMUM |
| 16. | Transfer Time | : | LESS THAN ONE MILLISECOND |
| 17. | Communication | : | RS-232 AND MODBUS ETHERNET COMMINUCATION |
| 18. | Digital Display | : | TOUCH SCREEN |
| 19. | Local Alarms | : | LEDs AND AUDITABLE |
| 20. | Digital Alarm Contacts: | : | LOW BACKUP TIME, OVERLOAD, REPLACE BATTERY, LOW BATTERY, LOAD ON INVERTER, LOAD ON BYPASS LCD FAULT, UPS FUALT |
| 21. | Audible Noise | : | LESS THAN 50 dB @ 3 FT |
| 22. | Certificate | : | UL LISTING |

BATTERY

| | | | |
|---|---|---|---|
| 1. | Type | : | SEALED, LEAD ACID MAINTENANCE FREE |
| 2. | Battery Protection | : | THERMAL, OVERVOLTAGE AND OVERCURRENT |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 1. | Manufacturer(s) | : | EATON, BEST, SOLA, APC OR EQUAL |

NOTES.

a. Provide UPS system such that upon failure of the UPS feeder, batteries provided with UPS immediately take over as the power source.

b. Provide external bypass switch with three circuit breakers Make-Before-Break system. Provide bypass to isolate the UPS equipment for maintenance. Provide bypass with switch test so the switch may be tested without the risk of dropping the load caused by static switch failure.

c. Provide static transfer switch to transfer load upon loss of power at the output of the UPS.

d. Provide UPS sizing documentations in the shop drawing submittal. UPS shall supply power to PLCs, RIOs, SCADA severs, Thin Client nodes, network communications equipment workstations and field instruments. Provide sizing documentations analysis which are based on required load plus minimum of 10% spare capacity.

**FULL SCADA NODE - COMPUTER DESK TOP WORKSTATION**

---

DATA SHEET NO. 706.1 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | DESKTOP |
| 2. | Location | : | CONTROL ROOM |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | FULL TOWER CHASSIS |
| 4. | Fans | : | PROVIDE 2-120mm CASE FANS, DUAL BALL BEARINGS, 80 CFM MIN 30,000 HR MTBF |
| 5. | Processor | : | INTEL i7QUAD CORE PROCESSOR 2.6 GHz MINIMUM |
| 6. | Memory | : | 64 GB DDR4 |
| 7. | RAM Cashe | : | L2 512KB |
| 8. | Hard Disk | : | 2-500GB SATA (3GB/S) 7,200 RPM RAID 1 |
| 9. | Controller | : | INTEGRATED |
| 10. | CD-RW | : | CD RW/DVD COMBO |
| 11. | Graphics | : | 2-NVIDIA GTX 260 PCIX 2.0 (MINIMUM 2 DVI PORT) ADAPTERS |
| 12. | Monitor | : | 20 -INCH, LED FLAT PANEL WIDE SCREEN (DVI CABLING) |
| 13. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1 HDMI 1-KEYBOARD (PS/2), 1-PS/2 MOUSE |
| 14. | Expansion Slots | : | 4-PCIX 2.0, 1-PCIX 1.0, 2-PCI, 1-PATA, 6-SATA (3 GB/S) |
| 15. | Keyboard | : | 104 KEY ENHANCED PS/2 KEYBOARD |
| 16. | Mouse | : | MICROSOFT WIRELESS MOUSE |
| 17. | Network Interface | : | 10/100/1000Mbps |
| 18. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz 800 W MIN |
| 19. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 20. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 21. | Software | : | MICROSOFT OFFICE PROFESSIONAL, ADOBE ACROBAT PROFESSIONAL, HMI SOFTWARE CONFIGURATION PACKAGE, CONTROL SYSTEM PROGRAMMING SOFTWARE |
| 22. | Operating System | : | MICROSOFT WINDOWS PROFESSIONAL LATEST VERSION OR LATEST OR WINDOWS SERVER BASED ON CONFIGURATION |
| 23. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 24. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

NOTES.

a. Provide all software as the most current release at time of shop drawings submittal.

b. Provide software keys for each workstation so that control system and HMI software development and configuration will be possible from any workstation.

**FULL SCADA NODE – DEVELOPER COMPUTER LAPTOP WORKSTATION**

---

DATA SHEET NO. 706.2 1

---

| | | | |
|---|---|---|---|
| GENERAL | | | |
| 1. | Service | : | TOUCHSCREEN LAPTOP |
| 2. | Location | : | CONTROL ROOM |
| PERSONAL COMPUTER | | | |
| 3. | Case | : | LAPTOP |
| 5. | Processor | : | INTEL i7 QUAD CORE PROCESSOR 2.6 GHz MINIMUM |
| 6. | Memory | : | 32 GB DDR4 |
| 7. | RAM Cashe | : | L2 512KB |
| 8. | Hard Disk | : | 1 – 1 TB SSD |
| 9. | Controller | : | INTEGRATED |
| 10. | CD-RW | : | CD RW/DVD COMBO |
| 11. | Graphics | : | NVIDIA GFORCE |
| 12. | Monitor | : | 15-INCH, FULL HD PANEL |
| 13. | I/O Ports | : | 1-PARALLEL, 3-USB, 1-SERIAL, 1 HDMI 1-KEYBOARD (PS/2), 1-PS/2 MOUSE |
| 14. | Keyboard | : | 104 KEY ENHANCED PS/2 KEYBOARD |
| 15. | Mouse | : | MOUSE TOUCH PAD |
| 16. | Network Interface | : | 10/100/1000Mbps |
| 17. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 18. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 19. | Software | : | MICROSOFT OFFICE PROFESSIONAL, ADOBE ACROBAT PROFESSIONAL, HMI SOFTWARE CONFIGURATION PACKAGE, PLC CONTROL SYSTEM PROGRAMMING SOFTWARE |
| 20. | Operating System | : | MICROSOFT WINDOWS PROFESSIONAL LATEST VERSION OR LATEST OR WINDOWS SERVER BASED ON CONFIGURATION |
| 21. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |
| MISCELLANEOUS | | | |
| 22. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

NOTES.

a. Purchase the Laptop at the end of the project (1 year prior to substantial completion) of the most current hardware at that time.
b. Provide all software as the most current release at time of shop drawings submittal.
c. Provide software keys.

**NETWORK SERVER**

---

DATA SHEET NO. 712-1. 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | SCADA/THIN CLIENT PRIMARY SERVER AND SCADA/THIN CLIENT BACKUP SERVER |
| 2. | Location | : | SERVER RACK |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | RACK MOUNTED |
| 4. | Processor | : | LATEST INTEL XEON E5-4600 Series, MIN. 12 CORES, 2.4 GHz PROCESSOR (OR EQUIVALENT LATEST AVAILABLE PROCESSOR AT TIME OF BID) |
| 5. | Memory | : | EIGHT MODULES, EACH – 16 GB DDR4 DIMMs |
| 6. | Hard Disk | : | TWO - 1 TB SATA (3 GB/S) 7200 RPM AND TWO 500 GB SSD |
| 7. | Controller | : | EMBEDDED RAID |
| 8. | Network | : | DUAL GIGABIT ETHERNET ADAPTER |
| 9. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1-KEYBOARD (PS/2), 1-MOUSE (PS/2) |
| 10. | Expansion Slots | : | UP TO 6-PCIe, 1-PATA, 6-SATA (3GB/S) |
| 11. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 12. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 13. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 14. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

SERVER SOFTWARE

| | | | |
|---|---|---|---|
| 15. | Operating System | : | MICROSOFT WINDOWS SERVER 2012 (OR LATEST AVAILABLE AT TIME OF BID) |
| 16. | Software | : | CONTROL SYSTEM PROGRAMMING SOFTWARE, HMI SOFTWARE CONFIGURATION PACKAGE, VIRTUAL MACHINE (VM) SOFTWARE. |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 17. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE INCLUDED |

NOTES.

a. Provide all software as the most current release available at the time of shop drawings submittals.
b. Provide advanced system monitoring, management and alerting for reliable and consistent server operation.
c. System monitoring and management features shall include fault monitoring of voltage, fan, and thermal conditions, tracks memory errors, automatic server recovery to reboot and restart the server if the operating system hangs without user intervention.

**NETWORK SERVER**

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DATA SHEET NO. 712-2. 1

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GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | HISTORIAN SERVER AND BACKUP HISTORIAN SERVER |
| 2. | Location | : | SERVER RACK |

PERSONAL COMPUTER

| | | | |
|---|---|---|---|
| 3. | Case | : | RACK MOUNTED |
| 4. | Processor | : | LATEST INTEL XEON E5-2600 Series, MIN. 8 CORES, 2.4 GHz PROCESSOR (OR EQUIVALENT LATEST AVAILABLE PROCESSOR AT TIME OF BID) |
| 5. | Memory | : | FOUR MODUELS, EACH – 16 GB DDR4 DIMMs |
| 6. | Hard Disk | : | TWO - 1 TB SATA (3 GB/S) 7200 RPM AND TWO 500 GB SSD |
| 7. | Controller | : | EMBEDDED RAID |
| 8. | Network | : | DUAL GIGABIT ETHERNET ADAPTER |
| 9. | I/O Ports | : | 1-PARALLEL, 6-USB, 1-SERIAL, 1-KEYBOARD (PS/2), 1-MOUSE (PS/2) |
| 10. | Expansion Slots | : | UP TO 4-PCIe, 1-PATA, 2-SATA (3GB/S) |
| 11. | Power Supply | : | 115 VAC/60 Hz, 230 VAC/50 Hz |
| 12. | Environment | : | 10 - 35 DEG. C 0 - 85% RH |
| 13. | UPS | : | POWERED FROM UPS SPECIFIED ON DATA SHEET 702 |
| 14. | Manufacturer(s) | : | DELL, HP, IBM OR EQUAL |

SERVER SOFTWARE

| | | | |
|---|---|---|---|
| 15. | Operating System | : | MICROSOFT WINDOWS SERVER 2012 (OR LATEST AVAILABLE AT TIME OF BID) |
| 16. | Software | : | HISTORIAN SOFTWARE, MICROSOFT OFFICE SOFTWARE. |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 17. | Service | : | 1ST, 2ND, AND 3RD YEAR ON SITE |

NOTES.

a. Provide all software as the most current release available at the time of shop drawing submittals.
b. Provide advanced system monitoring, management and alerting for reliable and consistent server operation.
c. System monitoring and management features shall include fault monitoring of voltage, fan, and thermal conditions, tracks memory errors, automatic server recovery to reboot and restart the server if the operating system hangs without user intervention.

**SCADA Equipment Rack**

---

DATA SHEET NO. 750.1 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Service | : | SCADA EQUIPMENT |
| 2. | Location | : | ELECTRICAL ROOM (108) |

RACK

| | | | |
|---|---|---|---|
| 3. | Type | : | EIA-310-D, 19 INCH RACK |
| 4. | Front and Rear Doors | : | 80% PERFRATION ON FRONT AND REAR DOORS, SECURITY LOCKS, TOOLLESS DOOR REMOVAL, SPLIT DOOR, MAXIMIZED AIR FLOW SYSTEM. |
| 5. | Side Panels | : | SPLIT, LIGHTWEIGHT, 2 PIECES |
| 6. | Top Panel | : | VENTILATED TOP PANEL |
| 7. | Mounting | : | FLOOR |
| 8. | Cable Management System | : | YES |
| 9. | Standard | : | UL 60950.1 COMPLIANT |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 10. | Manufacturer(s) | : | CISCO R SERIES OR EQUAL |

**TV MONITOR**

---

DATA SHEET NO. 900.1 1

---

GENERAL

| | | | |
|---|---|---|---|
| 1. | Tag | : | TV-1, TV-2 |
| 2. | Location | : | CONFERENCE ROOM (105), CONTROL ROOM (106) |

TV MONITOR

| | | | |
|---|---|---|---|
| 3. | Type | : | LED LCD 4K ULTRA HIGH DEFINTION FLAT PANEL |
| 4. | Size | : | 55 INCH |
| 5. | I/O Ports | : | 6-USB, 3 HDMI |
| 6. | Power Supply | : | 115 VAC/60 Hz |
| 7. | Mounting | : | WALL |
| 8. | Mounting Hardware | : | WALL MOUNTING EASY ADJUSTABLE BRAKET SETUP |
| 9. | Surge Protection | : | YES |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| 10. | Manufacturer(s) | : | SONY, SAMSUNG, LG OR EQUAL |

**SECTION 14300**

**HOISTING EQUIPMENT**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Provide and test hoisting equipment, motors, gear reducers, controls and appurtenances as indicated and in compliance with Contract Documents.

1. Rail and supporting beams included in building structure, refer to structural drawings.

2. Hoist capacities and operating data are indicated in the Hoisting Schedule.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data regarding hoisting equipment characteristics and performance:

2. Certified setting plans, with tolerances, for anchor bolts.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Listing of reference installations as specified with contact names and telephone numbers.

6. List of recommended spare parts other than those specified.
7. Shop and field inspection reports.
8. Motor shop test results.
9. Qualifications of field service engineer.
10. Recommendations for short and long-term storage.
11. Shop and field testing procedures, equipment to be used.
12. Special tools.
13. Number of service person-days provided and per diem field service rate.
14. Manufacturer's product data, specifications and color charts for shop painting.
15. The latest ISO 9001 series certification.
16. Provide Certificate of Responsibility. See SECTION 01300, SUBMITTALS for Certificate form.
17. Provide scaled drawing height and weight of equipment serviced by the hoisting equipment including hook height and travel dimensions.
18. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
   1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Permanently mark the capacity of the hoist and trolley on each hoist, in easy to read letters and in a prominent position.

C. Provide only safety type hooks.

D. Provide hoists so that hook can reach the floor at the lowest level of the lift.

E. Do not use hoists for construction purposes of any nature.

F. Hoists shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

G. Welding: In accordance with American Welding Society Code D1.1.

H. Provide shop tests as specified.

I. Hoisting equipment manufacturer shall provide hoists, motors, gear reducers, switches, and controls regardless of manufacturer as a complete integrated package to ensure coordination, compatibility and operation of the systems.

J. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

K. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping and electrical:

    a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

    a. 2 person-days.

4. Performance Testing: Field performance test equipment specified.

    a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

    a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

L. Manufacturer of hoisting equipment shall have a minimum of five (5) operating installations with hoists of the size specified and in the same service as specified operating for not less than five (5) years.

**1.08 - WARRANTY – Not Used**

**1.09 - REFERENCES**

A. American Bearing Manufacturers Association (ABMA):

1. 9: Load Ratings and Fatigue Life for Ball Bearings.

2. 11: Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of mechanical Engineers (ASME):

1. B30.16: Overhead Hoists (Underhung) Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Aluminum.

D. National Electric Code (NEC).

E. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

F. Occupational Safety and Hazard Association (OSHA):

1. 29 CFR 1910.179: Overhead and Gantry Cranes.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Hoisting equipment capacities and operating data are indicated in the Hoist Schedule.

**2.02 - HOIST AND TROLLEY MANUFACTURERS**

A. Shaw Box.

B. ACCO-Wright.

C. Yale Hoisting Equipment Division.

**2.03 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.04 - ELECTRIC HOISTS**

A. Electric Hoists: Spur-gear driven antifriction bearings throughout, a mechanical load brake, and a separate electrically operated motor brake. Design mechanical load brake with capability of supporting the full load at any point when the motor is stopped. Motor brake shall be externally adjustable, electrically operated friction disk brake that shall apply automatically when the power is off. The brake shall hold 150 percent of the rated load and 125 percent of the rated load at any operating speed. Design shafts of motor, drum, and drum pinion to run in grease-lubricated ball or roller bearings. Design the mechanical-load brake and gear train and bearings to be oil-bath lubricated.

B. Provide hoist with right angle mounting with H-wheel trolley, motorized as specified and indicated.

C. Hoist: Low headroom type meeting the requirements of ASME B30.16.

D. Design drum with machine-cut grooves and guarded flanges and with capacity to take entire run of cable in one layer with no overlapping.

E. Provide hoist with an upper and lower geared limit switch with automatic reset control circuit to prevent overtravel. Settings to be field adjustable in accordance with OSHA 29 CFR 1910.179.

F. Supply sufficient hoisting cable with hoists for two-part single reeving and to accommodate not only the maximum lift but two additional wraps on drum. Make cable flexible high-strength plowsteel cable with a load safety factor of at least 5 to 1.

G. Make load block of rugged construction containing a ball-bearing sheave and a high-grade forged-steel swivel hook with antifriction bearings.

H. Provide control equipment in an enclosed compartment which forms an integral part of hoist and include a transformer for a 120-volt control circuit.

**2.05 - TROLLEYS**

A. Motor-Driven Trolleys: Four-wheel type consisting of a fully enclosed electric motor equipped with a magnetic brake, a geared transmission completely enclosed in an oiltight housing and suspended on flanged driving wheels with power to two wheels. Use ball or roller bearings throughout.

B. Make trolleys designed for operation on beam or rail indicated on drawings. Trolleys to be provided by the hoist manufacturer.

**2.06 - PORTABLE DAVIT (DAV.HST-1)**

A. Manufacturer:

1. Thern

2. Or an acceptable equivalent

B. Portable davit crane consisting of a mast, boom, handle, screw jack, crank operated winch, drum, wire rope and load hook. The crane to be capable of rotating 360 degrees. The boom shall telescope to four indexed positions, boom height shall be capable of adjustment under load, and crane shall be capable of being taken apart for storage or transport.

C. Capacity: Minimum 500-lb rating with boom fully extended and 2000-lb with boom fully retracted.

D. Provide 28 ft of wire rope and a swiveling eye hook.

E. Provide a manual spur gear hand winch with auto disc brake and gear covers.

F. Provide flush bases as indicated on the Mechanical Process drawings. Provide a plastic cap for each base.

1. Mount each base with 316 stainless steel anchors.

G. Materials:

1. Crane, winch, 1/4-inch wire rope, hook, and base: Type 316 stainless steel

**2.07 - SAFETY STOPS**

A. Provide safety stops on all open ends of track (or where indicated) to prevent trolley from running off ends or damaging building. Provide stops with capability of withstanding impact imposed by motion of fully loaded hoist and trolley.

**2.08 - TRACK**

A. Monorail Track: Standard beam of sizes indicated on drawings.

B. Shop fabricate all curves for either track or switches to radius indicated.

C. Erect track level throughout, with section ends machined fitted and spliced with web-type or other designed couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16 inch.

**2.09 - ELECTRICAL CONTROLS**

A. Supply complete integral electrical control system with the electric hoisting equipment (by hoist manufacturer) consisting of starters, circuit breakers, overload relays, limit switches, control transformer for a 120-volt control circuit, control relays, and controlling devices.

B. Furnish magnetic controls for motors. Design controls to permit "inching" in both forward and reverse directions under full load, automatically regulated acceleration, and rapid brake response.

C. Provide each hoist with limit switches of automatic-reset control circuit type to prevent overtravel in both raising and lowering directions.

D. Compliance: Make all electrical equipment including motors, controls, resistors, brakes plus all conduit, wiring, panels, and enclosures with applicable requirements for materials, workmanship, construction, and installation of latest NEMA and National Electrical Code Standards.

**2.10 - MOTORS**

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified herein.

B. Motors for Hoists and Trolley: Totally enclosed, reversible, induction motors especially adapted to hoist service.

1. Enclosure: As indicated in the Hoist Schedule.

2. Insulation: Minimum Class “F” with Class “B” temperature rise, 40 degrees C ambient unless otherwise indicated or specified.

3. Service Factor: 1.15.

4. Provide capacity to start and operate hoists at maximum speed rated capacity indicated without exceeding nameplate ratings for current and power and without operating in the service factor.

5. Provide ball or roller bearings, in accordance with ABMA Standard 9 and Standard 11; minimum L-10 life of 100,000 hours.

6. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

7. Rating: 460V, 3-phase, 60 Hertz.

**2.11 - PUSHBUTTON CONTROL**

A. Provide pendent pushbutton control station with sufficient pushbuttons to control all operations of hoists and trolley. Clearly mark each pushbutton to indicate its function. Make cable long enough to reach within 4 feet (1.2 metre) of operating floor or platform level with a supporting chain. If necessary, attach an arm to hoist so that pendent cable and pushbutton controls will hang vertically and be readily accessible from operating positions.

B. Provide hoist with an upper limit switch of automatic reset control circuit type to prevent overtravel.

**2.12 - CONDUCTORS AND COLLECTORS**

A. Manufacturers:

1. Insul-8-Bar Protected Conductors made by Insul-8-Corp.

2. Safety-T-Bar Conductor Systems made by Howell Corp.

3. Duct-O-Bar Conductor System made by Duct-O-Wire Co.For conductor for electric current supply use safety type in which conductor is shielded by a molded-plastic cover that surrounds conductor except for a slotted opening shaped to contour of collector head. Provide separate conductor for each phase. (Dual

conductors in a single insulating shield are not acceptable.) Make conductor of plated steel or copper designed for carrying maximum anticipated current. Make molded-plastic shield of high dielectric strength, rigid yet sufficiently flexible to permit bending to radius of curves or switches, and resistant to corrosion and deterioration from sunlight or weather. Space insulated supports not over 5 feet on straight track and 3 feet on curves.

B. Provide weather shield for exterior conductors.

C. Use collectors of sliding shoe type with an adjustable spring-load arm capable of horizontal or vertical movement to automatically adapt to irregularities of conductor. Set shoe in a molded-plastic head that will prevent external contact with shoe when it is running on conductor. There shall be no exposed bare current-carrying surfaces or wires in collector or arm where shoe is in contact with conductor.

**2.13 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions and as specified.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

D. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – NOT USED**

**3.02 - INSTALLATION**

A. Install items in accordance with manufacturer's printed instructions and as indicated and specified.

B. Check horizontal and vertical alignment of track and rails.

C. Erect rack level throughout, with section ends machined fitted and spliced with web-type couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16-inch.

D. Do not use cast fittings.

**3.03 - FIELD TOUCH-UP PAINTING**

A. After installation and testing, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

**3.09 - FIELD TESTING**

A. Provide as specified herein. Perform all tests with instrumentation controls and motor controls. Perform testing in accordance with OSHA 29 CFR 1910.179 and as specified herein.

B. After installation of hoist equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service technician, conduct test for each hoist in presence of the Engineer to determine its ability to operate at rated speeds and capacity under conditions specified and indicated. During tests, observe and record, capacity and motor inputs. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results are obtained. Contractor to provide all labor, weights and materials for conducting tests.

1. Provide a 60 minute test for each hoist.

2. Running test shall consist of moving hoist and trolley through two complete cycles. The first cycle will be with no load. For the second cycle, the unit will be loaded with 100 percent of the specified load rating.

3. Test and simulate all limit switches, locking and safety devices.

C. Make all adjustments to place equipment in specified working order at time of above tests.

D. After three (3) unsuccessful testing attempts, remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15056**

**PIPE SUPPORTS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700. GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and in compliance with Contract Documents. The term pipe support includes hangers, guides, restraints, anchors and saddles.

C. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.

D. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all temporary and permanent pipe supports in accordance with the specified requirements.

E. Pipe support locations and types for piping 1/2-inch and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For pipe supports 1/2-inch and larger pipe support shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.

F. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified herein.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and paymet for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Pipe support drawings specified herein and including data for accessory items for acceptance prior to fabrication. The Contractor shall submit pipe support coordination drawings including all piping and pipe supports for all trades.

    a. Detailed drawing of the device with dimensions.

    b. A table of applied forces and moments.

    c. A complete bill of materials.

    d. A unique identification and revision level.

    e. Stamp of a Registered Professional Engineer, registered in the state where this project is being constructed, experienced in pipe support design and pipe stress analysis as specified herein.

    f. Detailed connections to existing structure.

    g. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1.

2. Welding Procedure: Submit description required to illustrate each welding procedure to be performed in the specified work.

3. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.

4. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Owner.

5. Pipe support manufacturers' qualifications as specified herein.

    a. List of at least five (5) successful pipe support projects and current addresses and telephone numbers of persons in charge of representing the owner or the owner of those construction projects during the time of pipe support design, fabrication and installation.

    b. Qualification of manufacturers' Registered Professional Engineer, registered in the state where this project is being constructed, who stamps and seals shop drawings and designs.

6. Coordination drawings for pipe supports shall include as a minimum the following information.

    a. Coordination drawings shall include all pipe supports covered by specifications.

    b. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.

    c. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.

    d. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4-inch scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-inches or less in diameter that will be field routed need not be shown on coordination drawings.

    e. Coordination drawings shall include large-scale details as well as cross and longitudinal sections required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.

f. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the Owner. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Owner shall be notified. Any problems of coordination that require architectural or structural changes of design shall be submitted to the Owner for resolution.

g. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the Contractor and all subcontractors indicating that all work on that drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.

h. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to the Owner.

7. Written notification of any deviations from the requirements of this specification.

8. Support documentation and justification as specified.

9. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.

10. Manufacturer's product data and specifications for shop painting.

11. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

12. A copy of the contract mechanical process, and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

b. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

c. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

d. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. Design criteria as specified herein.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.

E. Structural Concrete: Conform to the requirements of SECTION 03300, CAST-IN-PLACE CONCRETE. Concrete strength: 4,000 PSI unless noted otherwise.

F. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.

G. Pipe Support Manufacturer Qualifications:

1. Must possess a written quality assurance program.

2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.

3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.

4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.

5. Manufacturers' Standardization Society (MSS) Member.

6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components.

H. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

**1.08 - WARRANTY – Not Used**

**1.09 - REFERENCES**

A. The American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. ASTM International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

3. A312: Seamless and Welded Austenic Stainless Steel Pipe

4. A500: Cold Formed Welded and Seamless Carbon Steel Structural Tubing.

5. A572: Specification for Steel Plate.

6. E165: Practice for Liquid Penetrant Inspection Method.

7. E709: Practice for Magnetic Particle Examination.

C. American Welding Society (AWS):

1. D1.1: Structural Welding

D. Canadian Standards Association (CSA):

1. 40.20: General Requirements for Rolled or Welded Structural Quality Steel

2. 40.21: Structural Quality Steel

3. Welding Procedure Specifications.

E. Fluid Sealing Association: Technical Handbook.

F. Manufacturers' Standardization Society (MSS):

1. SP-58: Pipe Hangers and Supports - Materials and Design.

2. SP-69: Pipe Hangers and Supports - Selection and Application.

3. SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.

4. SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

G. National Association of Expansion Joint Manufacturers: Standards of the Expansion Joint Manufacturers Association, Inc.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

A. Provide materials used in pipe supports, which are compatible with the pipes to which they are attached. Provide Type 316L stainless steel supports for all stainless steel piping. Copper plated pipe supports are not acceptable.

B. Allowable materials: As indicated in ANSI B31.1 Appendix A and MSS-SP-58 Table 2.

C. Provide Type 316L stainless steel for pipe supports, hangers, guides, restraints, and anchors that are exterior or interior submerged, in potentially wetted areas in wet wells, channels, tanks, and screening areas and in chemically corrosive atmospheres.

D. Provide only new material. Previously used and/or scrap material is not acceptable.

E. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.

F. Provide sliding Teflon plates. The sliding surfaces shall be a nominal 3/8-inches glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product.

1. The blended TFE material used for this bearing shall be composed of virgin (unreprocessed) TFE resin tested per ASTM D1457 and reinforcing agents milled glass fibers. This structural material shall have the following representative mechanical and physical properties:

2. Tensile strength -2,000 psi.

3. Elongation –225 percent

4. Specific Gravity -2.17 to 2.22

5. The coefficient of friction shall average 0.06 under compressive load of 2,000 psi .

6. The compressive creep shall be a minimum of 2 percent at 2,000 psi and 70 degrees F.

7. The elements shall be flat, clean and prepared for installation in the structure. Slots and holes shall be fabricated in the bearing manufacturer's plant.

G. Concrete anchor bolts - Hilti Kwik-Bolt II Stud Anchors, Rawl Bolt, Phillips Wedge Anchors, or equal.

**2.02 - DESIGN, LOCATION, AND TYPE OF PIPE SUPPORTS**

A. Design and provide pipe supports for piping 1/2-inch and larger to include the following loads:

1. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.
2. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.
3. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.
4. Wind Loadings: Wind loadings.

B. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.

C. For all pump suction and discharge nozzles provide an anchor located between the pump nozzles and the nearest expansion joint or non-rigid coupling.

D. Where possible, provide pipe supports, which are the manufacturers' standard products.

1. Provide pipe supports with individual means of adjustment for alignment.
2. Provide pipe supports complete with appurtenances including locking and adjusting nuts.
3. Hanger rods shall be subjected to tension only.
4. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.
5. Provide concrete inserts capable of supporting the design loads.
6. Metal framing systems will be acceptable to support piping 2 inch and smaller.
7. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 inch in length.
8. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.
9. Provide supplementary steel as needed.
10. Do not support pipes from other pipe, conduits or metal stairs.
11. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.
12. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.
13. All pipe supports located in fluid flow shall be supplied with double nutting.

E. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes.

F. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.

G. For piping 2-inch and smaller provide manufacturer's standard supports and standard spacing guidelines

H. Pipe supports connected to structural framing and slabs are subject to the following limitations:

1. Less than 100 lb horizontal load per support.
2. For a maximum of one pipe support per footof slab width perpendicular to the span.
3. Piping not supported from floors by metal framing must meet the limitations as specified above.

I. All outside above ground supports shall be Type 316L stainless steel as specified herein.

J. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.

K. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.

**2.03 - FABRICATION**

A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.

B. Providing welding in accordance with Structural Welding Code.

C. Provide dimensional tolerances as specified in MSS-SP-89.

D. Provide threading and tapping in accordance with MSS-SP-89.

**2.04 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.

B. Perform welding in accordance with Structural Welding Code:

1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. The Qualified Inspector shall inspect the preparation of grove welds for throat opening and for snug positioning for back-up bars.
2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.
3. Magnetic Particle Inspection: Perform in accordance with ASTM E709.
4. Liquid Penetrant Inspection: Perform in accordance with ASTM E165.
5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to the Owner.
6. Test Locations: As selected by the Owner.
7. Correct any deficiencies detected as directed by the Engineer at no additional cost to the Owner.

C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in SECTION 03300, CAST-IN-PLACE CONCRETE.

D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.

E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.

F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.

G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or required by the Contractor's pipe support systems. Where hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch/100 feet, for each 100 degrees F change in temperature exceed 1/2-inch, provide sliding supports.

I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8-inch thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.

J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.

K. Apply an anti-seize compound to nuts and bolts on all pipe supports.

L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.

**3.02 – PAINTING**

A. After installation, pait Pipe Supports in accrodacne with SECTION 09941, FIELD PAINTING.

**3.03 - CLEAN UP**

A. Prior to sart-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER'S TRAINING – Not Used**

**3.06 - LUBRICATION REQUIREMENTS – Not Used**

**3.07 - SPARE PARTS – Not Used**

**3.08 - INSTALLATION OF BUILDING ATTACHMENTS**

A. Support piping from structural framing, unless otherwise indicated. Support of piping off of structural CMU wall is acceptable. Provide anchorage into grouted cells. Piping can be supported from SBR tank walls.

B. Concrete Inserts:

1. Use existing embedded concrete items whenever possible.

2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

**3.09 - THRUST ANCHORS AND GUIDES**

A. Thrust Anchors:

1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.

2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.

B. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

**3.10 - PIPE SUPPORTS**

A. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.

B. Provide minimum of two pipe supports for each pipe piece.

C. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.

D. Provide pipe supports so that there is no interference with maintenance or removal of equipment.

E. Unless otherwise indicated or authorized by the Engineer, place piping running parallel to walls approximately 1-1/2 inch out from face of wall and at least 3 inches below ceiling.

F. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.

G. Piping supports for vertical piping passing through floor sleeves: use hot dipped galvanized steel riser clamps.

H. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.

I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

J. Do not support piping from other piping.

K. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.

L. Whenever possible, pipe attachments for horizontal piping shall be pipe clamps.

M. All rigid rod hangers shall provide a means of vertical adjustment after erection.

N. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.

O. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.

P. Hanger spacing shall not exceed the spacing listed below:

1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.

2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.

Q. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.

R. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

S. All threads shall be UNC unless otherwise specified.

T. TFE slide bearing plates with steel backup plates shall be stitch weld attachments to the structure. A 1/8-inch fillet weld, 1/2-inch long every 3 inches on center each side of an element shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.

**3.11 - INSULATED PIPING**

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where vapor barriers are indicated on water piping, install coated protective shields.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15066**

**STAINLESS STEEL PIPE AND FITTINGS**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Provide and test stainless steel pipe, fittings and appurtenances as indicated and in compliance with Contract Documents.

C. Pipe and fittings 2-1/2 inch and larger are included in this specification, for pipe and fittings 2 inch and smaller provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 – DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Pipe manufacturer’s technical specification and product data.

2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.

a. Pipe layouts in full detail.

b. Location of hangers and supports.

c. Location and type of anchors.

d. Location of couplings and expansion joints.

e. 1/2-inch = 1 foot-0 inches scale details of all wall penetrations and fabricated fittings or special fittings.

f. Schedules of pipe, fittings, expansion joints and other appurtenances.

3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.

4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.

5. Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.

6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

7. Material Certification:

   a. Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

   b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

8. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

   a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

   b. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

   c. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

   d. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

   1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Job Conditions:

   1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

**1.08 - WARRANTY – NOT USED**

**1.09 - REFERENCES**

A. American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. ASTM International (ASTM):

1. A240: Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
2. A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
3. A530: Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
4. A774: Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
5. A778: Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

C. Fluid Sealing Association: Technical Handbook.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - STAINLESS STEEL PIPE**

A. Manufacturers:

1. Douglas Brothers
2. Felker
3. J.F. Ahern
4. Dixie Southern

B. Material:

1. Type 316L sheet and plate per ASTM A240.
2. Maximum carbon content of 316L material limited to 0.03 percent.
3. Finish: 2D.

C. Fabrication:

1. Fabricate in accordance with ASTM A778 in NPS sizes shown with dimensional tolerances per ASTM A530.
2. Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge, 0.125-inch, with the TIG (GTAW) process. Properly bevel heavier walls and use a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process.
3. Add filler wire of ELC grades to all welds to provide a cross section at the weld equal to or greater than the parent metal. Distribute smooth and evenly weld deposit and provide a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping.
4. Concavity, undercut, cracks or crevices are not acceptable.
5. Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.
6. Remove excessive weld deposits, slag, spatter, and projections by grinding.

7. Continuously weld angle face rings on both sides to the pipe or fitting.

8. Grind all welds on gasket surfaces smooth.

9. Contour pipe branches, taps and bosses to the radius of the main pipe run and bevel and weld with full penetration. No projections to the inside of the branch or main run are acceptable. Provide a smooth transition from ID of run to ID of branch.

10. Wire-brush inside and outside weld areas with brushes of stainless steel that are specifically designed to be used only on stainless steel.

11. After manufacture, passivate stainless steel pipe, fittings, and appurtenances by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time to be sufficient for removal of oxidation and ferrous contamination without more than superficial etch of surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash. Perform in accordance with ASTM A380.

12. After fabrication, either passivate by immersion (see above paragraph) or scrub interior and exterior of welds with same solution or pickling paste and stainless steel wire brushes to remove weld discoloration and then neutralize and wash clean. Perform in accordance with ASTM A380.

13. Perform all welding in the shop. Field welding is not acceptable. If field welding is allowed for certain circumstances, the Contractor shall submit the welders qualifications and an acceptable method of cleaning the pipe and fittings for review prior to start of any field welding.

14. Fittings: Butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Socket weld fittings are not acceptable. Elbows up to 24-inch diameter: Provide smooth flow-die formed, long radius; with centerline to end of elbow equal to 1.5 times the nominal pipe size.

15. Fabricate tees and branch connections true and square with wall thickness same as pipe.

16. Reducers evenly tapered with tangent ends for butt weld connection. Reducers may be straight tapered cone construction.

17. Secure flanges to pipe ends and plug openings prior to shipment.

D. Design:

1. Stainless steel pipe: Nominal pipe size diameter pipe fabricated of stainless steel sheets having the following Schedule, U.S.S. gauges and plate thickness:

| Nominal Pipe Size inches | Actual O.D. inches | Schedule/Gauge/Plate | Nominal Wall Thickness inches |
|---|---|---|---|
| 2.5 | 2.875 | SCH 5S or 10S | 0.083 |
| 3 | 3.500 | SCH 5S or 10S | 0.083 |
| 4 | 4.500 | SCH 5S or 10S | 0.083 |
| 6 | 6.625 | SCH 5S or 10S | 0.109 |
| 8 | 8.625 | SCH 5S or 10S | 0.109 |
| 10 | 10.750 | 12 Ga. Sheet | 0.109 |
| 12 | 12.750 | 12 Ga. Sheet | 0.109 |
| 14 | 14.000 | 11 Ga. Sheet | 0.125 |
| 16 | 16.000 | 11 Ga. Sheet | 0.125 |
| 18 | 18.000 | 11 Ga. Sheet | 0.125 |
| 20 | 20.000 | 10 Ga. Sheet | 0.140 |

| Nominal Pipe Size inches | Actual O.D. inches | Schedule/Gauge/Plate | Nominal Wall Thickness inches |
|---|---|---|---|
| 24 | 24.000 | 3/16 inch Plate | 0.188 |

2. For buried piping use a minimum SCH 10S or as indicated in the Process Piping Schedule.

3. Joints: Flanged or, bolted split sleeve type couplings as indicated and specified. Split couplings requiring cut or roll grooving of the pipe not allowed unless specifically called for.

4. Flanged Joints: Van Stone back-up flange type, ANSI Class 150 lb. (PN10).

5. Provide stainless steel back-up flanges of the grade of pipe specified with the following thickness. Galvanized steel and ductile iron flanges are not acceptable.

| Pipe Size, inches | Flange Thickness, inches |
|---|---|
| 2.5, 3 and 4 | 0.375 |
| 6 and 8 | 0.500 |
| 10 to 18 | 0.750 |
| 20 and 24 | 0.750 |

6. Hardware: Type 316 stainless steel.

7. Fabricate flanged joint face rings fabricated of rolled stainless steel angles.

8. Use angle face rings with thickness equal to or greater than the wall of the pipe or fitting to which it is welded. Continuously weld on both sides to the pipe or fitting. Fabricate angle legs so as not to interfere with the flange bolt holes.

9. Isolate stainless steel flanges from all other ferrous metal connections at valves, flanges and equipment with flange insulating kit.

    a. Pipe Flange Insulating Kit:

        (1) Flange gasket: Type E, 1/8-inch thick NEMA Grade G-10 reinforced epoxy retainer with two seals of the following material:

            (a) Wastewater and Residuals: Nitrile.

            (b) Aeration Systems: EPDM.

        (2) Insulating sleeves: 1/32-inch thick NEMA Grade G-10, full length, one for each flange bolt.

        (3) Insulating washers: 1/8-inch thick NEMA Grade G-10, two for each flange bolt.

        (4) Mechanical washers: 1/8-inch thick Type 316 stainless steel, two for each flange bolt.

        (5) Manufacturers:

            (a) Trojan Insulating Gasket Advance Products and Systems.

            (b) Or equal.

**2.02 - BOLTED SPLIT SLEEVE TYPE COUPLINGS**

A. Provide stainless steel couplings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

**2.03 - EXPANSION JOINTS**

A. Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

**2.04 - PIPE SUPPORTS**

A. Provide in accordance with SECTION 15056, PIPE SUPPORTS.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – NOT USED**

**3.02 - INSTALLATION**

A. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

B. Pitch piping toward low points. Provide for draining low points.

C. Before assembly, remove dirt and chips from inside pipe and fittings.

D. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped.

1. Except as otherwise specified, provide number and size of bolts conforming to same ANSI standards.

2. Provide Type 316 stainless steel hardware.

3. Provide ring gaskets of materials designed for the service specified and indicated, 1/16-inch thick gaskets.

4. Make up flanged joints tight with care being taken to prevent undue strain upon valves or other pieces of equipment.

5. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

6. Provide insulating kits as specified herein.

**3.03 - PAINTING – NOT USED**

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein

**3.07 - LUBRICATION REQUIREMENTS – NOT USED**

**3.08 - SPARE PARTS – NOT USED**

**3.09 - FIELD TESTING**

A. Clean off dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.

2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

3. Test when desired and comply with Engineer's orders and specifications.

4. Fill section of pipe with water and expel air.

5. Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to test pressures indicated in the Process Pipe Schedule.

6. No visible leakage in joints.

7. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section failed to pass test.

8. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

9. Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.

10. Modifications to test procedure only if permitted by Engineer.

**3.09 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15101**

**PROCESS VALVES AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Provide and process valves and appurtenances as indicated and in compliance with Contract Documents.

B. Provide sizes and capacities as indicated or specified.

C. Attention is directed to the document 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data, regarding valve characteristics and performance including Cv.
2. Shop drawing data for accessory items.
3. Manufacturer's literature as needed to supplement certified data.
4. Operating and maintenance instructions and parts lists.
5. Listing of reference installations as specified with contact names and telephone numbers.
6. Valve shop test results.
7. Qualifications of field service technician.
8. Shop and Field inspections reports.
9. List of recommended spare parts other than those specified.
10. Recommendations for short and long term storage.
11. Special tools.
12. Shop and field testing procedures and equipment to be used.
13. Number of service technician days provided and per diem field service rate.
14. Manufacturer’s product data and specifications for shop painting.
15. Provide a layout drawing, plan and section showing orientation of plug, gate, check, ball valves and actuators and nearest obstructions for each valve.
16. Manufacturer's product data and specifications for shop painting.
17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
18. The latest ISO 9001 series certification or quality system plan.
19. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

20. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Provide enclosures for the area classifications specified and indicated.

C. Contractor responsible for verifying outside diameter of pipe to be tapped.

D. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and specified herein.

E. Manufacturer of valve shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

F. If equipment proposed is heavier, taller, different laying length or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

    1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

**1.08 - REFERENCES**

A. American Society of Mechanical Engineers (ASME):

    1. B1.20.7: Hose Coupling Screw Threads.

    2. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

    3. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

    4. B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.

B. ASTM International (ASTM):

    1. A48: Standard Specification for Gray Iron Castings.

    2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

    3. A536: Standard Specification for Ductile Iron Castings.

C. American Water Works Association (AWWA):

    1. C500: Metal-Seated Gate Valves for Water Supply Service.

    2. C504: Rubber-Seated Butterfly Valves.

3. C509: Standard Specifications for Resilient-Seated Gate Valves for Water and Sewage Systems.
4. D102: Coating Steel Water-Storage Tanks.

D. NSF International (NSF):

1. 61: Drinking water system components Health effects

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - MATERIALS**

**2.01 - DOUBLE ROTATING-REVOLVING DIS GATE VALVES 3-INCH TO 72-INCH**

**(FOR EFF SYSTEM)**

A. Manufacturers:

1. Kennedy
2. J&S

B. Provide valve in compliance with AWWA C500, latest edition.

C. Materials:

1. Valve Body, Bonnet, Diss, Wedges: Ductile Iron ASTM-A536 (65/45/12).
   a. Provide valve body and bonnet of ductile iron full body thickness.
2. Scraper, Stem Nut, Disc and Body Seat Rings: B62-Low Zinc Bronze.
3. Ductile Iron Wedge Bearing Surfaces: Type 316 stainless steel ASTM-A276.
4. Stem: Type 316 Stainless Steel ASTM-A276.
5. Valve Bolts and Nuts: Type 316 Stainless Steel.

D. Valve Construction:

1. Rated Working Pressure:
   a. Valves 3-inch through 54-inch: 250 psi
2. Exposed valves: Flanged OS&Y valves. Face-to-face dimensions to comply with ANSI B16.10, flanges to comply with ANSI B16.1.
   a. Provide conventional packing in OS&Y valves.
   b. Provide Type 316 stainless steel bolts and bronze nuts for stuffing box follower.
3. Buried Valves: NRS with gear operator:
   a. Ends: Mechanical joint.
   b. Provide conventional packing or double O rings in non-rising stem valves.
4. Provide two 360 degree ductile iron rotating discs, interchangeable and field replaceable without removal of valve body from the pipeline.
5. Provide self-adjusting bronze scrapers to allow valve to be mounted in the horizontal position or angle as shown from vertical or horizontal centerlines.
6. Provide Type 316 Stainless Steel stem with an integrally cast thrust collar.
7. Where required, provide each valve body with integrally cast electric motor mounting pads.

8. Provide a full port body design with full port completely through the entire valve body and seat rings to allow for pigging of pipelines.
    a. Valve in full open position shall provide a clear and unobstructed water way.
9. Provide valve body guides and tracks with a bronze bearing surface throughout the entire travel of the bottom side of a horizontally installed valve.
    a. Guide Contact Area: ASTM B21 Bronze.
10. Provide valve design to allow complete re-packing of valve stem under pressure when the valve is in the full open position.
11. End connections, provide type as indicated and specified:
    a. Flanged ANSI B.16.1 Class 125 (PN10) or Class 250 (PN16).
    b. Grooved.
    c. Mechanical Joint.
12. Provide all discs and wedges free of any type of pockets, linkages and pins.

E. Provide geared operators for all valves 16-inch and larger.
1. Gearing: Steel with enclosed cases.
2. Provide spur or bevel gearing as required by valve application and orientation.
3. Provide buried valves with totally enclosed gear cases.
4. Provide chainwheels where required as specified herein.

F. Testing:
1. Factory test each valve per AWWA C-500, latest Revision.

G. Provide a two part liquid epoxy on interior and exterior of valve.

**2.02 - ECCENTRIC PLUG VALVES**

A. Manufacturers:
1. DeZurik.
2. Val-Matic.

B. Type: Non-lubricated, eccentric.

C. Body Working Pressure:
1. Cast Iron, ASTM A126 Class B or Ductile Iron, ASTM A536, Grade 64-45-12.
    a. Valves 4-inch through 12-inch: 175 psi.
    b. Valves 14-inch and larger: 150 psi.

D. Ends:
1. Grooved: ANSI/AWWA C606 for ductile iron valves.
2. Flanged: ANSI B16.1 Class 125 pound for cast iron valves.
3. Buried Valves: Mechanical joint.

E. Valve Ports:

1. Provide rectangular ported valves, circular ports are not acceptable.

2. All valves100% port area.

F. Valve Seats:

1. Coat plug with seat material specified. Bolted systems are not acceptable.

   a. Seat Material: Neoprene or Buna-N synthetic rubber.

2. Provide valves with one piece coated plugs with mating seats of 90 percent, minimum, pure nickel 1/8-inch welded into the body of valves.

3. Provide valves with seats clamped to valve with mating seat of 90 percent, minimum, pure nickel welded to the valve body.

G. Upper and Lower Plug Journal Bearings:

1. Removable, permanently lubricated stainless steel bushings for valves 20-inch and smaller.

2. Provide grit seals for upper and lower plug shafts for all valves.

H. Stem Seals:

1. Adjustable multiple V-packing.

2. Replaceable and adjustable without valve disassembly.

3. Provide valves with two sets of packing rated for vacuum service for all pump suction isolation service and for services where a vacuum is specified and indicated.

I. Operators for Valves 4-inch and larger:

1. Manually Operators:

   a. Gear operated with handwheels, levers are not acceptable.

   b. Provide gear operators rated for bi-directional shutoff at the valve working pressure rating as specified herein.

   c. Gear operators: Totally enclosed worm gear, traveling nut type is not acceptable. Provide permanent lubrication, watertight and dustproof, with adjustable open and closed stops and plug position indicator.

   d. Provide all work gears designed and certified to withstand input loads up to 300-feet-pounds minimum at the stops without damage.

   e. Buried or submerged valves: Provide watertight gear operator with handwheel operated floorstand as shown. Gear operator to be totally enclosed and gasketed with Type 316 stainless steel hardware.

   f. Chainwheels: Provide where required as specified herein.

   g. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

2. Electric Motor Actuators: Provide where indicated and provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

J. Glass Lining

1. Provide glass lined valves for systems requiring glass lining as indicated in the Process Piping Schedule.
2. Provide glass lining fused to metal base by firing entire valve to temperature above 1,400 degree F and held at temperature for sufficient time to develop smooth vitreous lining which has molecular bond with metal.
3. Lining: Provide minimum of 0.008-inch thick and withstanding instantaneous thermal shock of 350 degree F differential, without crazing, blistering, or spalling. Lining free of pinholes which expose metal.
4. Provide lining hardness of 5 to 6 on the Mohs scale, and of density 2.5 to 3.0 grams per cubic centimeter.

K. Shop Testing:

1. Provide all plug valves tested and certified bubble tight in both directions at the full rated working pressure as specified herein.

L. Shop Painting:

1. Provide fusion bonded epoxy, 12 mils (305 micrometres) inside and out.

**2.03 - BUTTERFLY VALVES – LIQUID SERVICE (AWWA)**

A. Manufacturers:

1. DeZurik.
2. Val-Matic.
3. Pratt.

B. Provide valves conforming to AWWA Standard C504 for Rubber Seated Butterfly Valves except as modified herein.

C. Valves utilizing: Continuous rubber lining on the internal body surfaces and extending over the flanges, or a disk which sits at an angle to the axis of the pipe are acceptable.

D. Valve Bearings: Self-lubricating, nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Cast or ductile iron thrust or journal bearing surfaces are NOT acceptable.

E. Class 150B valves except as specified or indicated.

F. Valve Body: ASTM A126 Class B cast iron or ductile iron.

1. Exposed: Flanged short body valve.
2. Buried service: Mechanical joint body.

G. Valve Seats:

1. Wastewater: Molded neoprene, Buna-N or other synthetic elastomer resistant to oil and grease.
2. Provide seat mounted on disc or in body.
3. Provide seats offset from shaft and field replaceable for all valves 24-inch and larger.
4. Provide seats mounted on disc, mechanically fastened to disc with Type 316 stainless steel hex head screws. Provide rubber seat reinforced with stainless steel retaining ring. Seats vulcanized or bonded to the disc are not acceptable.

H. Mating surfaces for valves with seat on disc: Type 316 stainless steel.

1. Provide mating surface mechanically retained in body and sealed with O-ring.

I. For valves with seats mounted on body provide the seats clamped or mechanically secured with Type 316 stainless steel fasteners.

J. Mating surfaces for valve with seat in body: Type 316 stainless steel.

K. Plated or sprayed on mating surface material not acceptable.

L. Seat Placement:

1. If seat on disc provide disc of ASTM A126 Class B cast iron or ductile iron.

2. If seat in body, provide disc of ASTM A126 Class B cast iron, ductile iron or Type 316 stainless steel. Type 316 Stainless steel edge on cast or ductile-iron discs secured with Type 316 stainless steel threaded fasteners, heat shrunk on disc, a welded-on overlay.

M. Shaft: Type 316 stainless steel. Either one piece extending completely through disc or stub shafts inserted into valve disc stubs.

N. Shaft seal of the split-V type or O-ring type. Seal replaceable without disassembly of valve.

O. Manual Operators:

1. Operator capable of valve operation at rated pressure with a maximum 80 lb pull on actuator. Operator to be self-locking.

2. Valves 8-inch and smaller, provide lever operator, 18-inch maximum length.

3. Valves 10-inch and larger, or where chain wheels are required, provide traveling nut operator. Provide position indicator.

4. Chainwheels: Provide where required as specified herein.

P. Buried: Provide gear operator with operating nut and valve box or handwheel operated floorstand as shown. Gear operator to be totally enclosed with gasketed Type 316 stainless steel covers with Type 316 stainless steel fasteners for access to valve packing.

Q. Electric Motor Operator: Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENACES.

**2.04 - BUTTERFLY VALVES – AERATION SERVICE**

A. Manufacturers:

1. DeZurik

2. Flowseal

3. ABZ

4. Tyco Flow Control

B. Provide valves rated for 250 degree F continuous operation and 300 degree F intermittent operation.

C. Body:

1. Wafer-lug type with full-lug body, drilled and tapped for mounting bolts design.

2. Material:

a. Type 316 stainless steel

3. Provide to mate with 125 pound ANSI B16.1 (Class 125) flanges.

4. Wafer-lug type with full-lug body, drilled and tapped for mounting bolts.

D. Seat: Dovetail, EPDM, installed in the body with elastomer formed continuously over the ends to provide seal with mating pipe flanges.

E. Disk: Air profile design, Type 316 stainless steel. Provide bubble-tight shut off at 25 psi working air pressure.

F. Stem: One-piece of Type 316 stainless steel with bronze or Teflon bushings and EPDM or Buna-N O rings or self-adjusting packing.

1. Disc stem connection:

a. 12-inch and smaller: Type 316 stainless steel torque plug.

b. 14-inch and larger: Type 316 stainless steel disc screws.

G. Valve Operators:

1. Manually operated valves 12-inch and smaller provide lever-type with 10-position lock plate and valve position indicator.

2. Manually operated valves 14-inch and larger provide geared-type permanently lubricated, totally enclosed operator with stops to prevent over-travel, and with valve position indicator and hand wheel or chain wheel as specified.

3. Provide chainwheel operator where required as specified herein.

4. Electric motor actuators: Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

**2.05 - BALL VALVES – GENERAL SERVICE**

A. Manufacturers:

1. Jamesbury

2. KF

3. Inline

4. Kitz

B. Valves 1/2-inch through 4-inch

1. Materials:

a. Body and End Cap: Three piece, ASTM A351 Grade CF8M.

b. Body Seal: PTFE.

c. Seat: RTFE.

d. Ball: Type 316 stainless steel.

e. Stem: Type 316 stainless steel.

2. Pressure Rating:

a. 1/2-inch through 2-inch: 1000 psi at 100 degrees F

b. 2-1/2-inchthrough 4-inch: 800 psi at 100 degrees F

3. Ends:

a. 2-inch and Smaller: Screwed or flanged.

b. 3-inch and larger: Flanged.

C. Valves 4-inch through 12-inch.

1. Materials:

a. Body and Adaptor: Two piece, ASTM A351 Grade CF8M.

b. Seat: TFE.

c. Ball: Type 316 stainless steel.

d. Stem: Type 316 stainless steel.

2. Pressure Rating: ANSI Class 150.

3. Ends: Flanged.

D. Actuators:

1. Manual:

a. 4-inch and Smaller: Lever.

b. 6-inch and Larger: Gear operator.

c. Provide chainwheels where required as specified herein.

**2.06 - BALL VALVES - NON-METALLIC**

A. Manufacturers:

1. Spears

2. ASAHI

3. NIBCO/Chemtrol

4. Hayward

B. Materials:

1. Body: Material as specified or indicated.

a. PVC: ASTM D-1784, Type 1, Grade 1, Class 12454B.

2. Ball: Same material as valve body.

3. Seats: Teflon, concave design to absorb expansion.

a. Triangular seat design is not acceptable.

b. Provide viton or EPDM back up cushions to absorb expansion.

4. Seals: Viton, all Viton shall contain a minimum of 55 percent Viton.

5. For seat and seal materials, provide viton for chemical services.

6. Provide vented ball valves for sodium hypochlorite services.

7. Materials provided for valve components in contact with the chemical shall be compatible with chemical service indicated.

C. Ends: Type as specified or indicated:

1. Provide ends flanged in accordance with ANSI B16.1 Class 150 lb. standard drilling.

2. True union design with integral union nuts on both ends of valve.

a. Threads between union nuts and valve body: Provide Buttress threads to protect against pipeline expansion and water hammer stresses.

D. Machine the following to final tolerances:
   1. Exterior of ball
   2. Interior of socket and threaded connections
   3. Teflon seat recesses
   4. Stem
   5. Neck I.D.
   6. Both end connectors
   7. Both carriers

E. Valve Port:
   1. 2-inch and smaller valves: full port.
   2. 3-inch and 4-inch valves: maximum of one pipe size reduction.
   3. 6-inchvalves: Venturi design.

F. Valve Ratings:
   1. PVC: 150 psi at 120 degrees F.

G. Physical Properties:
   1. Tensile stress, psi; per ASTM D638 Test Method:
      a. PVC: 7800
   2. Flexural Stress, psi; per ASTM D790 Test Method:
      a. PVC: 15650
   3. Compressive Strength, psi; per ASTM D695 Test Method:
      a. PVC: 14220
   4. Hardness, Rockwell R, per ASTM D785 Test Method:
      a. PVC: 115
   5. Water Absorption, percent, 24 hr., 1/8-inch thickness, per ASTM D570 Test Method:
      a. PVC: 0.07 percent

H. Operators:
   1. Lever, with retaining screw.

**2.07 - BALL CHECK VALVES – METALLIC**

A. Manufacturers:
   1. VAG-Golden Anderson.
   2. Flomatic.

B. Body: Cast Iron ASTM A126 Class B.

C. Cover: Cast Iron ASTM A126 Class B.

D. Ball: Vulcanized Buna-N with hollow metal core.

E. Bolting: Carbon Steel.

F. Pressure Rating: 150 psi.

G. Ends: Flanged ANSI B-16.1 Class 125.

**2.08 - BALL CHECK VALVES - NON-METALLIC**

A. Manufacturers:

1. Spears.
2. ASAHI.
3. NIBCO/Chemtrol.
4. Hayward.

B. Materials:

1. Body: Material as specified or indicated.
   a. PVC: ASTM D-1784, Type 1, Grade 1, Class 12454B.
2. Ball: Same material as valve body.
3. Seats: Teflon, concave design to absorb expansion.
   a. Triangular seat design is not acceptable.
   b. Provide Viton or EPDM back up cushions to absorb expansion.
4. For seat and seal materials, provide viton for chemical services.
5. Seals: Viton, all Viton to contain a minimum of 55 percent Viton.
6. Materials provided for valve components in contact with the chemical shall be compatible with chemical service indicated.

C. Ends: Type as specified or indicated.

1. Provide ends flanged in accordance with ANSI B16.1 Class 150 standard drilling.
2. True union design with integral union nuts on both ends of valve.
   a. Provide O-rings suitable for the service specified and indicated.
   b. Threads between union nuts and valve body: Deep molded square ACME threads to protect against pipeline expansion and water hammer stresses.

**2.09 - RUBBER FLAPPER CHECK VALVES**

A. Manufacturers:

1. Val-Matic.
2. DeZurik APCO.
3. Crispin.

B. Materials:

1. Body and Cover: Ductile Iron ASTM A536 Grade 65-42-12.
2. Rubber Flapper: Buna N 70 Durometer ASTM 2000-BG encapsulating an ASTM A36 steel plate.
3. Hinge Pin: AISI 1018.

C. Provide valves with a full pipe size flow area.

D. Provide valves 4-inch and larger capable of passing a 3-inch sphere.

E. Provide a threaded connection with bronze plug on cover and on the bottom of the valve.

F. Working Pressure:

1. 2-inch through 24-inch : 250 psi.

G. Ends: Flanged ANSI B16.1, Class 150.

H. Provide seating surface at a 45 degree angle such that the flapper travels a maximum of 35 degrees from full closed to full open position.

I. Provide valve with cover designed for removal of the valve internals without removing the valve from the pipeline.

J. Backflow Device:

1. Provide a screw type rising stem backflow device located on the bottom of the check valves.

2. Provide a stainless steel T-handle device with bronzed bushings.

**2.10 - SPLIT DISC CHECK VALVES – AERATION SERVICE**

A. Manufacturers:

1. Marlin

B. Working Pressure: 150 psi (1050 kPa).

C. Body Type: Lug, wafer types are not acceptable

D. Materials:

1. Valve Body: Type 316 stainless steel ASTM A351 CF8M.

2. Valve Disc: Type 316 stainless steel ASTM A351 Grade CF8M.

3. Seat: Viton-B, suitable for temperatures to 400 degrees F (204 degrees C).

4. Springs: Inconel 600, suitable for temperatures to 600 degrees F (315 degrees C).

**2.11 - GLOBE VALVES – NON METALLIC**

A. Manufacturers:

1. Spears.

2. Hayward Industrial products.

B. Type: Angle pattern.

C. Size: 1/4-inch through 2-inch .

1. Pressure Rating: 150 psi at 70 degrees F.

2. Fine pitched stem threads.

3. Ends: Threaded NPT.

D. Materials:

1. Body, Bonnet, Piston and Stem: PVC.

2. Seats and Seals: Viton.

**2.12 - SOLENOID VALVES**

A. Manufacturers:

1. JD Gould.
2. ASCO.
3. Berkert.

B. Type:

1. Size: 1/8-inch to 2-inch.
2. Globe type.
3. 2-way, internal piston pilot operated.
4. Energize to open.
5. Operating Pressure Differential: 150 psi.

C. Materials:

1. Body: Type 316 stainless steel.
2. Seat Discs: PTFE.
3. Piston Assembly: Type 316 stainless steel.
4. Pilot Assembly: Type 316 stainless steel jacket welded on steel core.

D. Coil: Class F.

E. Electrical: 120 Volt, 1 phase, 60 Hertz.

F. Ends: Threaded.

G. Enclosure: NEMA 4X for locations in non-classified areas and NEMA 7 for use in classified areas.

**2.13 - PINCH VALVES**

A. Manufacturers:

1. Flowrox.
2. Onyx.
3. RF Valves

B. Type: Enclosed full metal sealed body, mechanical pinch type.

1. Valves to be manufacturer's standard cataloged product and modified to meet the specification.
2. Valve manufacturer and sleeve manufacturer must be ISO 9000 certified. Provide certification and quality system plan.
3. Provide a listing of contacts and telephone numbers of a minimum of three (3) installations with valves of the same type and size and in the same service as specified operating for not less than three (3) years.

C. Valve Body:

1. Provide a split gasketed valve body. Valve bodies must be split perpendicular to the valve stem.
2. Body working pressure rating: 150 psi.
3. The upper and lower body sections must be interchangeable with all valves of the same size, design and model number.

4. Provide valve with a fugitive emissions package that includes stem and body seals to provide secondary containment of the fluid in the valve. Provide an additional secondary containment system to isolate the stem from the liquid in the valve body in the event of sleeve failure.
    a. Provide a 2-inch pressure gauge and PVC protective diaphragm for indication of sleeve failure.
    b. Gauge piping: Type 316L schedule 40 stainless steel.
5. Ends: Flanged, drilled and tapped to Class 150 ANSI standard.
6. Prime and finish paint interior and exterior of valve body and actuator assembly with two 60 micron coats of epoxy primer and one 60 micron coat of epoxy finish coat or equal.
7. Test the body and the fugitive emissions system at the specified working pressure without the sleeve installed.

D. Sleeves:
1. Fabricate sleeve of one-piece construction.
2. Provide inner protective lining of nitrile rubber elastomer with a maximum IRH hardness of 40 to 80.
3. Reinforce sleeve with Kevlar cord.
4. Provide positive opening tabs attached to pinch bar mechanism. Attach with Type 316 stainless steel hardware.
5. Sleeve working pressure rating: 150 psi . Provide sleeves designed with a minimum safety factor of 3 above the specified pressure rating.
6. Test sleeves at the specified pressure rating independent of the valve body.
7. The sleeve shall be the only part of the valve in contact with the process fluid and rated for the pressure and service specified and indicated.
8. Port area: 100 percent of the pipe diameter through the entire valve.
9. Sleeves to be suitable for the service specified. Provide evidence that the sleeve material has been used successfully in the same service conditions as specified for a minimum of five (5) years. The material will not be acceptable if there have been failures within three (3) years of start of operation.

E. Operating Mechanism:
1. Provide double acting type that pinches the sleeve on the centerline equally from two sides. Single acting mechanisms are not acceptable.
2. Provide lubrication fittings.
3. Provide mechanical stops to prevent over pinching of the sleeve.
4. Manual Valves:
    a. Valves 6-inch and smaller: Handwheel.
    b. Provide gear operators for valves 8-inch and larger and for valves located 6 feet-6 inches above the operating level.
    c. Provide chainwheels where required as specified herein.
5. Provide electric motor actuators where indicated and as specified in Section 15109.
6. Mechanism must be capable of frequent opening and closing cycles.
7. Provide the word "SHUT" and a direction arrow for all handwheels.

F. Materials:

1. Body: ASTM A48 Class 30 cast iron.
2. Sleeve: Material as recommended by the valve manufacturer for the service specified and indicated.
3. Closing mechanism and internal guides:
   a. Type 316 stainless steel.
   b. Pinch Bars: Type 316 stainless steel or ASTM A535-80 Class 65-45-12 ductile iron epoxy coated
4. Valve stem: Type 316L stainless steel.
5. Thrust bearing: brass.
6. Valve position indicator: Type 316L stainless steel.
7. Bushings: Polyethylene RCH 1000.

G. Shop Testing:

1. Provide certified test data for the following or conduct tests:
   a. Provide tests by an independent company.
   b. Test valves for a minimum of 3,700,000 pressure changes from 0 to 106 psi.
   c. For valves to be used for hose pumps test valves mounted on a hose pump suction nozzle. Close the valve creating a full vacuum with pump running for 24 hours and test valve for an additional 24 hours slightly open to create 50 percent vacuum. After these two tests, test valve fully closed to determine if full vacuum can be reached and contained once the pump is stopped. Test two valves of each size.
   d. Provide a written report with test procedure and results.
2. Hydrostatically test valve body without sleeve to 150 psi, for two valves of each size.
3. Hydrostatically test valve sleeve to 150 psi, and test at 3:1 safety factor for two valves of each size.
4. Test valve mechanisms with atmospheric on one side of valve and pressures from 0 to 150 psi on other side.
5. Hydrostatic tests and results must meet ANSI B.16.104 Class V shutoff.

**2.14 - AIR RELEASE VALVES – CLEAN WATER SERVICE**

A. Manufacturers:

1. Val-Matic.
2. Crispin.
3. DeZurik-APCO
4. ARI.

B. Valves: Provide air release valves of the automatic float operated type designed to release accumulated air from a piping system while the system is in operation and under pressure.

C. Provide valves manufactured and tested in accordance with AWWA C512.

D. Provide valves used in potable water service certified to ANSI/NSF 61 Drinking Water System Components - Health Effects.

E. Valve manufacturer must have a quality management system that is certified to ISO 9001:2000 by an accredited, certifying body.

F. Provide valves with the cover bolted to the valve body and sealed with a flat gasket.

G. Provide replaceable resilient seats.

H. Provide drop tight shut off to the full valve pressure rating.

I. Provide floats guaranteed against failure including pressure surges.

J. Mechanical linkage to provide sufficient mechanical advantage so that the valve will open under full operating pressure.

1. Simple lever designs: Provide valves consisting of a single pivot arm and a resilient orifice button.

2. Compound lever designs: Provide valves consisting of two levers and an adjustable threaded resilient orifice button.

K. Provide valve body with threaded NPT inlets and outlets.

1. Inlet Connection: Provide hexagonal for a wrench connection.

2. Working Pressure: 60 psi.

3. Provide valves with two (2) additional NPT connections with ball valves as specified herein, one connection with a plug and one with a hose coupling for the gauges, testing, and draining.

4. Provide a vacuum check on the outlet to prevent air from re-entering the system during negative pressure conditions.

L. Provide valves with an inflow preventer to prevent the introduction of contaminated water through the air valve outlet.

1. Provide the inflow preventer to allow the admittance and exhausting of air while preventing contaminated water from entering during normal operating conditions.

a. Provide the inflow preventer flow tested by an independent testing lab approved by the American Society of Sanitary Engineers.

M. Materials:

1. Valve Body, Cover and Baffle:

a. ASTM A126 Class B cast iron for working pressures up to 300 psig.

b. ASTM A536 Grade 65-45-12 Cast Ductile Iron. For working pressures 300 psig (2100 kPa) and greater.

c. ASTM A216 Grade WCB cast steel.

d. ASTM A351 Grade CF8M stainless steel.

e. ASTM B584 Alloy C83600 cast bronze.

2. Floats, Orifice and linkage: Type 316 stainless steel, non-metallic components are not acceptable.

3. Orifice Button: Viton for simple lever valves and Buna-N for compound lever designs.

4. Hardware: Type 316 stainless steel.

5. Screened Hood: Type 316 stainless steel.

N. Testing:

1. Test valves at 1.5 times the rated working pressure.

**2.15 - AIR RELEASE VALVES – WASTEWATER SERVICE**

A. Manufacturers:

1. Val-Matic.
2. Crispin.
3. DeZurik-APCO.
4. ARI.

B. Valves: Fully automatic float operated valves designed to release air from the piping system while the system is in operation and under pressure.

C. For wastewater services provide valves with the following:

1. Extended valve body.
2. 2-inch cleanout.
3. Minimum 2-inch inlet.
4. 1/2-inch outlet with stainless steel ball valve with hose connection.
5. 1-inch drain with stainless steel ball valve.
6. Provide ball valve as specified herein.

D. Valves 3-inch and Smaller: NPT inlet and outlet connections equivalent to the valve size.

1. Provide stainless steel ball valve for isolation as specified herein.

E. Valves 4-inch and Larger: Flanged inlet and outlet connections equivalent to the valve size.

1. Provide plug valve for isolation as specified herein.
2. Flanges: ANSI B16.1 Class 125.

F. Provide valves with two (2) additional NPT connections for the addition of gauges and for testing, and draining.

G. Provide valve body with a through flow area equal to the nominal valve size.

H. Provide valves with a bolted cover and flat gasket.

1. Valves 4-inch and Larger: Provide cover fitted to the valve body with a machined registered fit.

I. Provide guide shafts supported by bushings.

1. Valves 4-inch and Larger: Provide float double guided and a resilient bumper.

J. Floats: Provide floats with bottom shaped for accelerated closure.

K. Seats to provide drop tight shut off at full valve pressure rating.

L. Provide vacuum check on valve outlet to prevent air from re-entering the system during negative pressure conditions.

M. Materials:

1. Valve Body, Cover and Baffle:
   a. ASTM A126 Class B Cast Iron for Class 125 valves.
2. Floats, Guide Shafts and Bushings: Type 316 stainless steel.
3. Seats: Buna-N.
4. Hardware: Type 316 stainless steel.
5. Interior Valve Coating: Fusion bonded epoxy.

**2.16 - CHAINWHEEL OPERATORS – (DUCTILE IRON)**

A. Provide chainwheels with chain and chain guides. For all valves with handwheels or gear operators higher than 6.5 feet above operating floor level.

B. Provide chain that reaches to within 3 feet of the operating floor level.

C. For valves with gear operator mount with chainwheel in the vertical position.

D. Provide secondary safety restraint system.

E. Manufacturer:

1. Trumbull.

F. Materials:

1. Chainwheels: Sprocket type wheel, ductile iron.
2. Chain: Galvanized steel connecting link chain.
3. Hardware and Attachments: Galvanized steel.
4. Safety Restraint Cables and Hardware: Type 316 stainless steel.

**2.17 - FLOORSTANDS-NRS INDICATING TYPE**

A. Type: Non-Rising Stem (NRS), Indicating.

B. Materials:

1. Pedestal: Cast Type 316 stainless steel with a vertical indicating slot.
2. Indicator: Bronze. Provide indicator that travels on a threaded stem to indicate the position of the valve.
3. Handwheel: Type 316 stainless steel, 12-inch diameter.
4. Couplings: Type 316 stainless steel.

C. Provide the word “OPEN” cast in the pedestal at the top of the indicating slot and provide a “CLOSED” tag mounted to the pedestal, to indicate the closed position of the valve.

D. Floorstands fabricated by welding flanges to pipe are not acceptable.

**2.18 - EXTENSION STEMS**

A. Provide where indicated and required for operation of all valves

B. Material:

1. Stems: Type 316L solid stainless steel bar or Schedule 40 Type 316L pipe
    a. Minimum Size: 1.25 inch diameter, Slenderness ration <200
2. Connectors, thrust relief assemblies, torque tube assemblies, universal joints and operating nuts: Type 316 or Type 316L stainless steel
3. Miter gears: Cast iron with 2 part epoxy coating

**2.19 - FLOOR BOXES-CAST IRON**

A. Manufacturer:

1. Trumbull Industries.

B. Provide floor boxes where indicated to provide support for extension stems for non-rising stem valves and a cover for the operating nut.

C. Floor Box Depth: 6 inches and capable of use in thicker floors with a 2-1/2 inch or 3 inch schedule 40 steel pipe nipple

D. Materials:

1. Body and Cover: Cast Iron ASTM A126
2. Bushing: Bronze, NSF 61
3. Hardware: Type 316 stainless steel

**2.20 - STEM GUIDES**

A. Manufacturer:

1. Trumbull Industries.

B. Provide valve stem guides where indicated and as required by the valves manufacturer.

C. Stem Guide Spacing: 6 to 8 feet, maximum slenderness ratio of 200.

D. Stem Guides for Stems 2-inch and Smaller:

1. Materials:

a. Stem Guide: Cast Type 316 stainless steel with 2 to 36 inch adjustment.

b. Bushing: Bronze, NSF 61

c. Hardware: Type 316 stainless steel.

E. Stem Guides for Stems 2-1/8-inch to 4 inch:

1. Materials:

a. Stem Guide: Ductile Iron 65-45-12 with 2-3/4 to 17-1/4 inch adjustment.

b. Bushing: Split type, Bronze, NSF 61

c. Hardware: Type 316 stainless steel.

**2.21 - ELECTRIC MOTOR ACTUATORS**

A. Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

**2.22 - SHOP PAINTING**

A. Coat internal and external ferrous surfaces of valve with NSF Certified Epoxy in accordance with ANSI/NSF Std. 61, and in conformance to AWWA D102 Inside System No. 1 for all valves not specified to have a fusion bonded epoxy coating.

B. Process Valve Color: Red.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the Owner.

D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

E. Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.

F. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

**3.02 - PAINTING**

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with requirements specified in SECTION 01600, CONTROL OF MATERIALS.

**3.08 - GATE AND KNIFE GATE VALVES**

A. Install gate valve stem as shown or with stems between vertical and 45 degrees above the horizontal. Valve installed with stems below horizontal are not acceptable.

**3.09 - CHECK VALVES**

A. Install swing check valves horizontally in pipelines unless otherwise indicated.

**3.10 - PLUG VALVES**

A. Install valves in horizontal piping with shaft horizontal such that in open position, plug is located in upper part of valve body. Orient valves so that in closed position, flow is against the face of the plug.

**3.11 - FLOORSTAND OPERATORS AND STEM GUIDES**

A. Set floorstand operators and stem guides so stems run smoothly in true alignment. Anchor guides to walls. Check distances from centerlines of gates to operating level or base of floorstand and adjust if to suit actual conditions of installation.

**3.12 - VALVE BOXES**

A. Provide valve box for each buried valve and where indicated.

B. Set box so top is flush with finished surface and so box does not bear on valve, or pipe.

**3.13 - FIELD TESTING**

A. Pressure test valves with pipeline pressure testing.

B. Test functions of each valve.

C. Make all adjustments necessary to place valves in specified working order at time of above tests.

D. Remove and replace valves and appurtenances at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that valves will perform the service specified, indicated and as submitted and accepted.

**3.14 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15103**

**STAINLESS STEEL SLIDE GATES AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the specifications.

B. Provide and test stainless steel slide gates and appurtenances as indicated and in compliance with Contract Documents.

### 1.02 - MEASUREMENT AND PAYMENTS

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.
2. Data for gate and actuator characteristics and performance.
3. Complete description of all materials, material thicknesses of all components.
4. Maximum bending stress and deflection of the slide under design head specified and indicated.
5. Installation drawings showing the details required for installation, dimensions, clearances and anchor bolt locations
6. Shop drawing data for accessory items.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.

9. Operating and maintenance instructions and parts lists.
10. For manufacturers not named provide a listing of reference installations as specified with contact names and telephone numbers.
11. Certified results of gate shop testing, including shop leakage test results of each gate at the design seating and unseating head specified and indicated
12. List of recommended spare parts other than those specified.
13. Shop and field inspection reports.
14. Qualifications of field service engineer.
15. Recommendations for short and long-term storage.
16. Shop and field testing procedures and set up
17. Special tools.
18. Manufacturer's product data, specifications and color charts for shop painting.
19. Motor shop test results.
20. The latest ISO 9001 series certification or quality system plan.
21. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, structural, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
   1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Gates shall be the product of one manufacturer.

C. Gates shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Slide gates and appurtenances must be fabricated, assembled and tested in the United States of America.

E. Welding: In accordance with latest applicable American Welding Society Code, ASME Welding Code,or equivalent.

F. Shop tests as specified, including shop leakage testing of each gate at the design seating and unseating head to confirm compliance with the leakage rate specified and indicated.

G. The Contractor shall obtain the gates and appurtenances from the gate manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

H. Services of Manufacturer's Representative as stated in SECTION 01400, DELIVERY, STORAGE AND HANDLING and as specified herein.

I. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical connection:

   a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

   a. 2 person-days.

4. Field Performance Testing: Field performance test equipment specified.

   a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

J. Manufacturer of gates shall have a minimum of five (5) operating installations with gates of the size specified and in the same service as specified operating for not less than five (5) years or manufacturer of gates shall utilize a Project Manager that is experienced in stainless steel gate design and construction. The Project Manager shall be an employee of the gate manufacturer and shall have designed a minimum of five (5) operating installations with gates of the size specified and in the same service as specified operating for not less than five (5) years.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2. A276: Standard Specifications for Stainless Steel Bars and Shapes.
3. B584: Standard Specification for Copper Alloy Sand Castings for General Applications.
4. D2000: Standard Classification System for Rubber Products in Automotive Applications.
5. D4020: Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials

B. American Welding Society Code.

C. American Water Works Association (AWWA):

1. C561: Fabricated Stainless Steel Slide Gates

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Gate sizes and operating data are indicated in the Slide Gate Schedule.

**2.02 - MANUFACTURERS**

A. Stainless Steel Slide Gates:

1. Whipps
2. RW Gate Co.
3. Acceptable Equivalent Product.

**2.03 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**2.04 - SLIDE GATE CONSTRUCTION**

A. Provide all gates produced by a single manufacturer and designed for installation in the channels and structures as specified and indicated.

B. Gate Configuration: As indicated in the Slide Gate Schedule.

C. Provide all gates in conformance with AWWA C561 and as specified.

D. Self contained, rising or non-rising stem, flush bottom type with self-adjusting seals.

E. Gates with adjustable wedges or wedging devices are not acceptable.

F. Provide all structural components 1/4-inch minimum thickness.

G. Gate assemblies shall be media blasted or passivated in accordance with ASTM A380 prior to shipment to remove all mill scale, weld splatter, discoloration, or other surface imperfections.

H. Leakage Rate:

1. Seating head and unseating head conditions: Leakage not to exceed 0.05 gpm per foot of seating perimeter.

I. Assembly to consist of the following:

1. Frame.
2. Slide.
3. Stem
4. Seals.
5. Benchstand with operator type as indicated in the Slide Gate Schedule.

J. Materials:

1. Frame Assembly and Retainers: ASTM A240 Type 316L stainless steel.
2. Slides and Stiffeners: ASTM A240 Type 316L stainless steel.
    a. 1/4-inch minimum thickness.
3. Seat, seals and facing: ASTM D4020 UHMW (Ultra-high Molecular Weight Polyethylene
4. Invert Seal for upward acting gates only: ASTM D2000 Neoprene or EPDM
5. Stems: ASTM A276 Type 316 stainless steel.
    a. Minimum diameter: 1-1/2-inch.
6. Lift Nuts: ASTM B584 Bronze
7. Floorstand and Wall Brackets: ASTM A276 Type 316L stainless steel
8. Gear Operator Housing: Cast aluminum or ductile iron
9. Hardware, studs and nuts: ASTM A276 Type 316 stainless steel
10. Anchor bolts: Type 316 stainless steel. Minimum diameter of 1/2-inch.

K. Slide:

1. Slide and reinforcing stiffeners welded to the slide.
    a. Stainless steel plate, minimum 1/4-inch.
    b. Reinforcement: Provide a minimum of two horizontal stiffeners welded to the slide and two vertical stiffeners welded to outside of the horizontal stiffeners.
    c. Provide slide to engage the guide a minimum of 1 inch on each side and have a minimum material thickness of a 1/4 inch.
        (1) Gates with the width of the gate opening x maximum design head is 80 $ft^2$ or greater, provide the portion of the slide that engages the guide members 1/2 inch thick edge design where it engages the guide.
        (2) Gates with the width of the gate opening x maximum design head is 120 $ft^2$ or greater, provide the portion of the slide that engages the guide members 3 inch thick edge design where it engages the guide.
    d. Provide the stem connector constructed of two angles or plates welded to the slide. Provide a minimum of two bolts connecting the stem to the stem connector.
2. Deflection: Maximum of 1/720 of the span or 1/16 inch whichever is smaller, under design head specified.

L. Seals:

1. Provide a self-adjusting seal system suitable for the leakage, frequent cycling and velocities specified herein, and mounted such that there is no obstruction to the specified gate opening size.
2. Provide gates equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.
3. Extend the seat/seals to accommodate the 1.50 x the slide height with the gate in the fully open or fully closed position.
4. Provide all upward opening gates with a resilient flush bottom seal for sealing the invert of the gate.
5. Provide all downward opening weir gates with self-adjusting UHMW seat/seals across the invert member.
6. Provide all seals mechanically fastened to the frame or slide, force fit seals or seals attached with adhesive are not acceptable.
7. Provide all seats and seals to be field replaceable without the need to remove grout or concrete and without the need to remove the frame from the wall or wall thimble.
8. Gates using “J” or “P” seals are not acceptable.

M. Frames:

1. Provide frame assembly including guide members, invert members and yoke members constructed of formed stainless steel plate with a minimum thickness of 1/4-inch.
2. Provide gussets to support the guide members for unseating gates as required by the design head specified and indicated.
    a. Provide gussets extended to support the outer portion of the guide assembly and positioned to transfer the load to the anchor bolts or the wall thimble studs.
3. Provide frames for mounting type as indicated in the Slide Gate Schedule.
    a. Embedded
    b. Wall mounted with stainless steel anchor bolts and non-shrink, non-metallic grout or EPDM gasket
    c. Thimble mounted with stainless steel mounting studs and mastic gasket
4. Provide all wall mounted and thimble mounted gates with a flanged frame. Flat frame gates are not acceptable.
5. Provide all wall mounted and wall thimble mounted frames with a minimum guide weight of 11 lbs/ft and a minimum guide extension weight of 6.5 lbs/ft.
6. Provide guide extensions constructed of C-channel shape or similar. Angles are not acceptable guide extensions.
7. Frame Guides and Invert Members: Provide frames as a one-piece, fully welded assembly.
    a. Bolt-on yokes are acceptable when necessary to facilitate slide removal.
    b. Frames that require field assembly are not acceptable unless the overall frame size exceeds a size suitable for shipment on a standard flat bed truck.
8. Provide the frame guides extending to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening slide gates or downward opening weir gates.
9. For self-contained gates, provide a yoke across the top of the frame guides with the yoke formed by two structural members fixed to the top of the guides to provide a one-piece rigid frame.
    a. Provide the yoke designed to allow removal of the slide.
10. Provide a rigid stainless steel invert member across the bottom of the opening.
    a. Invert member: Flush bottom type on upward opening gates with a minimum weight as specified

11. Provide a rigid stainless steel top seal member across the top of the opening on gates designed to cover submerged openings.

12. Provide a rigid stainless steel member across the invert of the opening on downward opening weir gates.

N. Stems:

1. Provide a threaded operating stem to connect the operating mechanism to the slide.

2. For rising stem gates provide the threaded portion engaging the operating nut in the manual operator or motor actuator.

3. For non-rising stem gates provide the threaded portion engaging the nut on the slide.

4. Minimum stem outside diameter of 1-1/2 inches.

5. Stem extension pipes are not acceptable.

6. Provide the stem constructed of solid stainless steel bar for the entire length

7. Tensile strength: Not less than 60,000 psi for stems.

8. Provide the stem threaded to allow full travel of the slide unless otherwise specified or indicated.

9. L/R: Not to exceed 200.

10. Provide the stem in accordance with AWWA C561, to withstand in tension the loads caused by an 80 pound effort on the manual crank or handwheel without exceeding 25 percent of the ultimate tensile strength of the stem material.

11. Motor Operators: Design Stems to withstand in compression 1.30 x stalled output.

12. Provide the stem, in tension, designed to withstand a load caused by a 40 pound effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

13. Provide the threaded portion of the stem machined rolled or cut full depth ACME type threads with 16 micro-inch or better finish. Stub threads are not acceptable.

14. Provide stems of more than one piece joined by bronze or stainless steel couplings with the coupling bolted to the stem.

15. Provide dual stems for upward opening gates wider than 60-inch when the opening width is 2 x greater or more than the height of the slide. Provide dual stems for downward opening gates wider than 48 inch when the opening width is 2 x greater or more than the height of the slide.

16. Provide stems on manually operated gates with an adjustable stop collar to prevent over closing of the gate.

17. For rising stem gates, provide clear plastic covers with 1-inch graduations. Provide vent holes to prevent condensation.

**2.05 - STEM GUIDES**

A. Provide stem guides where required to maintain L/R of 200 or less for the unsupported length of the stem

B. Provide stem guides and brackets of Type 316L stainless steel.

1. Adjustable in two directions

2. Minimum Thickness: 1/4-inch.

3. Bushings: UHMW or bronze

**2.06 - WALL THIMBLES**

A. Provide where indicated on the Slide Gate Schedule.

1. Provide "E" thimbles for all gates connected to piping systems

B. Provide "E" thimble depth equal to the thickness of the concrete wall in which the thimble is to be mounted.

C. For "F" thimbles in walls 36 inch thick and smaller provide thimble depth equal to the thickness of the concrete wall in which the thimble is to be mounted. For walls 36 inches thick and larger provide a minimum of 36-inch deep "F" thimble.

D. Provide a water stop continuously welded or stitch welded and sealed on both sides around the periphery of the thimble.

E. Provide wall thimbles of fabricated Type 316L stainless steel construction of adequate section to withstand all operational and installation stresses.

1. Minimum thickness including front face: 1/4-inch.

F. Provide the thimble square and plumb and the front face sufficiently flat to provide a mounting surface for the gate frame to achieve the specified leakage rate.

G. Provide the face of the wall thimble machined if recommended by the gate manufacturer. If the wall thimble is to be machined provide the front face with a minimum thickness of 1/4-inch after machining.

H. Provide a gasket or mastic to seal between the gate frame and the wall thimble.

**2.07 - MANUAL OPERATORS**

A. Provide a manual gate operator for each gate so specified.

1. Provide all gates with slides 24 inches tall or taller with a gearbox operator suitable for use with a portable operator.

B. Type of operator as indicated in the Slide Gate Schedule.

C. Manually operated floorstands and benchstands:

1. Handwheel or crank operated floorstand or benchstand as indicated in the Slide Gate Schedule.

a. Handwheel: No gear reduction.

b. Handwheel or Crank Gearbox Operator: Single or double gear reduction.

c. Material: Cast ductile iron housing

2. Provide a threaded cast bronze lift nut to engage operating stem.

3. Provide roller bearings above and below a flange on the operating nut to support both opening and closing thrusts.

4. Operate gates under the operating head and design head, as specified and indicated, with no greater than a 40 pound effort on the crank or handwheel.

5. Gears, where required, steel with machined cut teeth designed for smooth operation.

6. Provide Type 304 or 400 Series stainless steel pinion shafts on crank operated benchstands and floorstands supported on tapered roller bearing or ball bearings with all components totally enclosed in a weatherproof housing with a removable cover.

a. Design bearing arrangement for use with portable operators specified herein.

7. Provide mechanical seals on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist mechanism.

8. Provide lubricating fittings for the lubrication of all gears and bearings.

9. Floorstands: Provide a Type 316L stainless steel pedestal, constructed of minimum Schedule 40 tube and 3/8-inch thick base plates, designed to position the input shaft or crank operator or handwheel approximately 36-inch above the operating level.

10. Benchstands: Provide with a rectangular cast ductile iron base machined and drilled for mounting purposes. Provide all adaptor plates of Type 316L stainless steel.

11. Permanently attach or cast an arrow with the word "OPEN" on the floorstand, benchstand or handwheel indicating the direction of rotation to open the gate.

12. Handwheels: Minimum 15 inches, maximum 24 inches diameter and removable.

13. Cranks: Cast aluminum or stainless steel with revolving nylon grip and removable.

14. Provide two gearboxes for all upward opening gates 60 inch wide and larger and with opening widths greater than 2 x gate height. Provide two gearboxes for all downward-opening gates wider than 48 inch wide and larger and with opening widths greater than 2 x gate height.

    a. Provide Type 316 stainless steel interconnecting shaft.

    b. Provide flexible couplings at each end of the interconnecting shaft.

    c. Provide a handwheel or crank mounted on the pinion shaft of one of the gear boxes.

D. Extended Operators

1. Provide an extended operator system to bring the pinion shaft to 36 inches above the operating level utilizing chain and sprockets when the centerline of the handwheel on a non-geared operator is located 48 inches or more above the operating level.

2. Chainwheels are not acceptable.

3. Provide a removable Type 316L stainless steel cover to enclose the chain and sprockets.

4. If the centerline of the pinion shaft is 60 inches or less above the operating level a handwheel may be used with a gearbox in lieu of the extended operator system specified above.

E. Operating Nut

1. When indicated or specified provide 2 inch square operating nut and with a non-rising stem.

    a. Nut Material: Bronze.

    b. Where indicated and specified provide a Type 316L stainless steel or cast iron floor box be set in the concrete floor above the gate as indicated.

    c. Provide one Type 316L stainless steel T-handle wrench for operation.

F. Floorstands and Wall Brackets

1. Provide Type 316L stainless steel floorstands of a height such that the handwheel or crank operated pinion shaft is located 36 inches above the operating level.

2. Provide Type 316L stainless steel wall brackets to support floorstands.

    a. Provide wall brackets reinforced to withstand in compression a minimum of 2 x rated output of the operator with an 80 pound effort on the crank or handwheel.

G. Electric Drill Operator:

1. Provide portable operator with reversing switch and safety hold-down, ON-OFF switch incorporated in handle.

a. Electrical Service: 120V 3-phase, 60 Hertz.

2. Drive through overload release clutch of positive spring-loaded pawl type releasing instantly at preset torque of 40 feet-pound.

3. Provide adapter to fit pinion shaft of floorstand.

4. Provide 25 feet long heavy duty cord with 3-prong plug with unit.

**2.08 – ELECTIC MOTOR ACTUATORS**

A. Provide in accordance with Section 15109.

**2.09 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.10 - SHOP TESTING**

A. Assemble each gate and inspect for proper seating.

1. Check clearance between frame and disc seating surfaces.

B. Fully open and close each gate in guide system to insure gates operate freely as recommended by the gate manufacturer.

C. Conduct a shop leakage test at the design unseating head on each gate to confirm leakage as specified and indicated for Field Testing.

D. Operate floorstands and benchstands to insure proper assembly and operation.

E. Repeat tests until specified results are obtained.

F. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – NOT USED**

**3.02 - INSTALLATION**

A. Install items in accordance with shop drawings, manufacturer's printed instructions and as indicated.

B. Clean debris, dirt, and gravel, from inside of gates and channels before placing gates.

C. Install slide gates in completely assembled condition.

D. Erect and support slide gates in positions free from distortion and strain on appurtenances during handling and installation.

E. Inspect material for defects in workmanship and material.

F. Clean out debris and foreign material from gate opening and seats, test operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Repair gates and other equipment which do not operate easily or are otherwise defective.

G. Set floorstand operators and stem guides so stems run smoothly in true alignment. Anchor guides firmly to walls. Check distances from centerlines of gates to operating level or base of floorstand and adjust if necessary to suit actual conditions of installation.

**3.03 - PAINTING**

A. After installation and testing accepted by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

1. One set of all special tools.

**3.09 - FIELD TESTING**

A. Field testing will not be conducted without a procedure accepted by the Engineer calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 1 for checklist.

B. After installation of gates, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct operating and leakage test for each gate in presence of the Engineer to determine its ability to operate as specified, and to operate smoothly without jamming under specified conditions.

C. Test all operators.

D. Leakage Test: Leakage not to exceed 0.05 gpm per foot of seal perimeter.

1. Conduct tests at design heads shown in the slide gate schedule.

E. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

F. Repeat tests until specified results are obtained.

G. Contractor to provide all water labor, piping, testing equipment for conducting tests.

H. Make all adjustments necessary to place equipment in specified working order at time of above tests.

I. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15109**

**ELECTRIC MOTOR ACTUATORS AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Provide electric motor actuators and appurtenances as indicated and in compliance with Contract Documents.

1. Actuators for all valves, gates and equipment to be the product of one manufacturer.

B. Attention is directed to the document 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS

B. As used in this section, the following terms are understood to have the following meanings:

1. “Furnish” shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. “Install” shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. “Provide” shall mean furnish and install.

4. “"Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. “Piping” shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. “Concealed” shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, bured, and/or similar conditions.

7. “Exposed” shall mean not concealed as defined as above.

8. “"Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. “Coordinate” shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Certified shop and erection drawings.

a. Drawings shall be in conformance with all other requirements as specified in this specification.

2. Data, regarding actuator and motor characteristics and performance.

3. Actuator and Valve set-up for each application: Position or torque seating

4. Shop drawing data for accessory items.

5. Manufacturer’s literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts lists.

7. Listing of reference installations as specified with contact names and telephone numbers.
8. Actuator shop test results.
9. Motor shop test results.
10. Qualifications of field service engineer.
11. Schematic control and power wiring diagrams for valve actuators. Clearly indicate all terminations and required field wiring.
12. Local Control Stations:
    a. Submit local control stations with valve actuators submittal. Clearly identify which actuators are being supplied with local control stations.
    b. Submit schematic control and power wiring diagrams for valve actuator local control stations.
    c. Clearly indicate all required terminations and field wiring.
    d. Submit control station elevation drawings showing locations of interior and exterior components.
13. Shop and Field inspections reports.
14. Recommended spare parts other than those specified.
15. Recommendations for short and long term storage.
16. Special tools.
17. Shop and field testing procedures and equipment to be used.
18. Torque capability and settings for each actuator.
    a. Provide a listing of operating torque, safety factor applied and actuator torque capability and actuator safety factor as specified for each valve, gate and equipment.
19. Number of service person days provided and per diem field service rate.
20. Manufacturer's product data and specifications for shop painting including statement of compliance for compatibility with field painting.
21. Provide a listing of the materials recommended for each service specified and indicated.
22. ISO 9001 certification.
23. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".
    1. Failure to include all drawings or a statement application to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with Section 01400 and as specified herein.

B. Actuators for all valves, gates and equipment to be the product of one manufacturer.

1. Contractor to coordinate with all valve, gate and equipment suppliers.

C. Actuators to be manufacturer's standard cataloged product and modified to provide compliance with the specifications and the service conditions specified and indicated.

D. Shop tests as specified.

E. Provide Services of Manufacturer's Representative as stated in Section 01600 and as specified herein.

F. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect setting, alignment, field erection; coordination of, electrical and miscellaneous utility connections:

a. 1/2 person-day per actuator.

3. Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

a. 1/2 person-day per actuator.

4. Field Performance Testing: Field performance test equipment specified.

a. 1/2 person-day per actuator.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classrooms sessions.

a. 2 person-days, 2 trips.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service engineer to assist in placing the equipment in operation or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

G. Manufacturer of actuators must have at least five (5) operating installations with actuators of the type and size specified and in the same service as specified operating for not less than five (5) years.

**1.08 - REFERENCES**

A. ASTM International (ASTM):

1. B117: Standard Practice for Operating Salt Spray (Fog) Apparatus.

2. B179: Standard Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes.

B. FM Global (FM):

1. 3615: Explosionproof Electrical Equipment General Requirements.

C. Institute of Electrical and Electronics Engineers (IEEE):

1. 802.15.4: Standard for Information Technology.

D. Underwriters Laboratory (UL)

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Rotork Controls Inc.

B. Limitorque | Flowserve

C. Or an approved equal

**2.02 – VALVE ACTUATORS AT THE WWTF**

A. 4” line size and greater to be rated 480VAC, 3-phase.

B. Less than 4” to be 120 VAC, single phase.

**2.03 – VALVE ACTUATORS AT THE WICK DISTRIBUTION VAULT**

A. All valve actuators to be 120 VAC, single phase.

**2.04 - ELECTRIC ACTUATORS – 3 PHASE**

A. Each actuator shall include electric motor, reduction gearing, reversing starters, thermal overloads, controls transformer, limit controls, non-intrusive local controls as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

1. Provide actuators capable of setting of torque, turns, and configuration of indication contacts, through the use of a non intrusive infra red setting tool without the necessity to remove any electrical compartment covers. The setting tool must be the means for adjustment. The use of control knobs for programming the actuator is not acceptable.

2. Provide actuators with torque capability 150 percent above the maximum operating torque required by each valve, gate or equipment.

3. Enclosure:

a. Provide actuators rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

b. Watertight to IP68, classification. Enclosure must be certified NEMA 6 for all units except those in classified areas.

c. Provide explosion proof Class 1, Division 1, Groups C, D, E, F, & G. NEMA 7 FM (Factory Mutual) certified to FM3615 for actuators as indicated and located in classified areas.

4. Provide an internal watertight compartment to protect switches, contacts, motor and internal electronics from ingress of moisture and dust when the external terminal cover is removed.

5. Breathers, drains and or heaters are not permitted, enclosure must be totally sealed.

6. Provide each actuator with a handwheel for manual operation. Provide a hammer blow device which permits motor to come up to speed before picking up load and unseating valve.

B. Motors:

1. Open/Close applications: Motors, Class F with 15 minute duty rating.

2. Modulating applications: motors, Class H with a 30 minute duty rating.

3. Motor: Low inertia, high torque type, specifically designed for use with motor actuators, to prevent over travel.

C. Provide internal clutch that cannot engage handwheel operating mechanism and motor-operating mechanism at the same time. Friction type declutching is not acceptable.

1. Provide handwheel with arrow and the word CLOSE or SHUT cast on handwheel to indicate turning direction to close.

2. Handwheel must not rotate during power operation.

3. Provide handwheel and low gear ratio combined to give maximum rate of movement possible with 80 lb rim pull.

D. Drive Unit:

1. Metal worm wheel and worm shaft type.

2. Provide an oil filled drive housing. Grease lubrication is not acceptable.

3. Worm shaft to operate in ball or roller bearings and be machine cut, ground, and highly polished, hot rolled steel, hardness 50-60 Rockwell Scale C bronze worm wheel with large contact area. Provide mating surfaces of dissimilar metals to prevent galling. Cast metals or gears manufactured from non-metallic materials are not acceptable.

4. Worm and shafts: Heat treated steel and accurately machined. Output or driving shaft to operate in bronze bearing or in ball or roller bearings.

5. Make provisions to take thrust in both directions.

6. Worm and wheel to be oil lubricated at all times.

7. Drive housing: Cast iron or aluminum depending on size of actuator offered, all thrust or torque bearing components shall be ductile iron.

8. Provide drive bushing as part of a detachable thrust base making for easy retrofit.

E. Fully wire electric motor operators at factory and furnish complete with terminal strips for external power and control connections. Wiring: copper with tropical grade PVC cover. Internal wiring to remain in a water tight compartment with external cover removed.

F. For actuators provided with Local Control Stations specified in Paragraph 2.05 – Local Control Stations, coordinate the actuator control voltage, contact ratings and hardwired I/O requirements with the control stations being provided.

G. Manual Control: Provide the following Control, Status, Alarm and Diagnostic capabilities locally, at the actuator:

1. Control:

a. Open/Stop/Close.

b. Desired Valve Position Control 0-100 percent.

2. Status:
    a. Motor Running Open Direction.
    b. Motor Running Close Direction.
    c. Fully Open.
    d. Fully Closed.
    e. Percentage Open 0-100 percent in 1 percent increments.
    f. Percentage Output Torque 0-100 percent in 1 percent increments.
3. Alarms:
    a. Remote Control Communications Failure.
    b. Actuator Alarm.
    c. Valve Alarm.
    d. Battery Low Alarm.
4. Diagnostics:
    a. Provide an integral diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator, gate or valve performance. Access to data shall be via a non-intrusive an IrDA™ port to an appropriate devise capable of standard IRDA communications i.e. Notebook PC, Windows CE based "Personal Digital Assistant (PDA)" or an IrDA™ compatible cellular telephone.
    b. Provide diagnostic software from actuator manufacturer to allow configuration and diagnostic information to be reviewed, analyzed and reconfigured. Provide diagnostic status screens capable of showing multiple functions simultaneously so troubleshooting can be affected rapidly and efficiently.

H. Automatic Control: Provide REMOTE automatic control.

I. Provide each actuator fitted with four (4) hard-wired configurable contacts. Each Contact shall be rated at 5A, 250VAC, 30VDC and able to provide any one of the following:
1. Status:
    a. Valve Fully Open.
    b. Valve Fully Closed.
    c. Valve Opening or Closing.
    d. Valve Moving (Continuous or Pulsing).
    e. Local Stop Selected.
    f. Local Selected.
    g. Remote Selected.
    h. Open or Close Interlock Active.
    i. ESD Active.
2. Alarms:
    a. Motor Tripped on Torque in Mid-Travel.
    b. Motor Tripped on Torque Going Open.
    c. Motor Tripped on Torque Going Closed.
    d. Pre-Set Torque Exceeded.

e. Valve Jammed.

f. Actuator Being Operated by Handwheel.

g. Lost Main Power Phase.

h. Customer 24V DC or 120V AC Supply Lost.

i. Battery Low.

j. Internal Failure Detected.

k. Thermostat Tripped.

J. Provide a back-up power source integral to the actuator to ensure that in the event of a main power supply loss or failure that the LCD display indication contacts must remain operational for a minimum of 24 hours and still function on change of status.

K. Control

1. Provide non intrusive selectors on actuator electrical controls cover. One for Local/Stop/Remote selection, pad-lockable in each position and the other for local Open/Close control. Switches penetrating the housing are not acceptable.

L. Starters/transformers: Consists of two relay contactors, 3-pole, mechanically interlocked, reversing with suitable arc suppressors.

1. Electrical Service:

a. 460V, 3-phase, 60 Hertz.

2. Provide inverse time element overload relays.

3. Provide a control transformer capable of generating either 110VAC or 24VDC.

4. Provide electromechanical starter capable of OPEN/CLOSE sixty starts per hour or solid state starter for modulating service capable of 1200 starts per hour.

5. Provide replaceable fuses to protect wiring, fuses must be locally available.

6. Provide automatic phase correction.

M. Limit Controls:

1. Type: Positive in action ensuring tight seating and full openings.

2. Position Setting Range: 2.5 to 100,000 turns, with resolution of 7.5 degrees of one actuator output revolution.

3. Provide mechanism designed to minimize drift or over-travel and to open or close valve, gate or equipment to fixed, predetermined limits of opening and closing travel.

4. Provide controls that disconnect driving mechanism from stem utilizing Hall effect magnetic pulse system or similar technology. Measurement of torque shall be by direct measurement of force at the output of the actuator. Methods of measuring torque derived from the motor such as motor speed, current, flux, are not acceptable. Position and torque sensor shall accurately measure and control the position of the actuator without the use of mechanical gears. Potentiometers for position transmission are not acceptable.

5. Provide torque switches for both directions of travel.

a. Sensing to be independent of voltage fluctuation.

b. Provide torque protection to prevent repeated starting in the same direction.

c. The initial unseating hammer blow shall not cause overtorque.

d. Provide torque switch settings independent of OPEN/CLOSE position switches.

N. Provide output drive coupling to accept rising stem for rising spindle valves and include roller and ball type thrust bearings.

O. Provide actuator sized to close valve, gate or equipment against differential pressure as specified and indicated. Size actuator motor to seat and unseat valve gate or equipment and ensure torque switch trip at maximum valve torque when supply voltage is 10 percent below normal. Size motor to open or close valve, gate or equipment to satisfy the process dynamics.

P. All fasteners and hardware: Type 316 stainless steel.

Q. Secondary Gear Boxes:

1. Provide secondary gearing for multi turn or quarter-turn applications where operating times, thrust or torque considerations require.

    a. Secondary Gearing: Bevel or spur, totally enclosed in a cast iron housing, fully sealed and lubricated for the service indicated and specified.

2. Provide gear assemblies that are a manufacturer's standard selection or combination of as detailed in published product literature.

    a. Provide each gearbox with a removable output drive coupling sized for the service specified and indicated.

    b. Provide quarter-turn gearboxes equipped with adjustable mechanical stops (at 0 and 90 degrees +/- 5 percent) to permit limiting open and closed travel during manual operation.

    c. Factory prime and finish paint all gear boxes with 2 part high solids epoxy or as specified herein for the actuator.

**2.05 – ELECTRIC ACTUATORS – SINGLE PHASE**

A. Each actuator shall include electric motor, reduction gearing, reversing starters, thermal overloads, limit controls as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

1. Provide actuators with torque capability 150 percent above the maximum operating torque required by each valve, gate or equipment.

2. Gearing: Rolled steel worm gear and aluminum bronze worm wheel. Non-metallic gearing is not acceptable.

3. Enclosure:

    a. Provide actuators rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

    b. Watertight to IP68, classification. Enclosure must be certified NEMA 6 for all units except those in classified areas.

    c. Provide explosion proof Class 1, Division 1, Groups C, D, E, F, & G. NEMA 7 FM (Factory Mutual) certified to FM3615 for actuators as indicated and located in classified areas.

    d. Material: Aluminum with epoxy-polyester powder coating

4. Provide each actuator with a handwheel for manual operation, auto declutch lever and automatic reset when motor is energized.

5. Provide actuator with a top mounted continuous visual position indicator.

6. Provide 20 watt internal space heater

7. Provide two cam actuated and adjustable end of travel limit switches

8. Provide two can actuated torque switches for over torque protection

9. Provide mechanical stops

B. Provide manual or automatic control as indicated and specified.

C. Automatic Control: Provide REMOTE automatic control.

D. Electrical Service:

1. 120V, 1-phase, 60 Hertz

E. Limit Controls:

1. Type: Limit switches.

2. Provide torque switches for both directions of travel.

F. Provide actuator sized to close valve against required differential. Size actuator motor to seat and unseat valve and ensure torque switch trip at maximum valve torque when supply voltage is 10 percent below normal. Size motor to open or close valve to satisfy the process dynamics.

G. All fasteners and hardware: Type 316 stainless steel.

**2.06 - SHOP TESTS**

A. Motor Test:

1. Give each motor a standard commercial test in the shop of the motor manufacturer, and submit certified copies of the test results to the Engineer for review prior to installation of the motors.

B. Actuator Testing:

1. Test performance of each actuator. Provide individual test certificates at no additional cost to the Owner simulate a typical valve, gate or equipment load and record the following parameters:

a. Current a maximum torque setting.

b. Torque at maximum torque setting.

c. Test voltage and frequency.

d. Flash test voltage.

e. Actuator output speed or operating time.

2. Test housing oil tightness, 30 psi for 2 minutes.

3. Insulation test on motor and control circuit.

4. In addition, record details of specification on the test certificate, such gear ratios for both manual and automatic drive, closing direction, wiring diagram code number, and when applicable remote transmitter resistance and interposing relay voltage.

C. In event that specified tests indicate that motor or actuator will not meet specifications, Engineer has the right to require complete witnessed tests for all motors and actuators at no additional cost to the Owner.

1. Repeat tests until specified results are obtained.

2. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

**2.07 - SHOP PAINTING**

A. Paint Finish: Baked on polyester powder coating 70 microns thick and must have passed ASTM B117 35 degrees C Salt Spray Test for 1,000 hours.

1. Provide materials for touch-up of all damaged or abraided surfaces due to installation.

2. Ferrous surfaces obviously not to be painted shall be given a shop applied coat of grease or rust resistant coating.

**2.08 - LOCAL CONTROL STATION**

A. Enclosure:

1. Provide devices rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

2. NEMA 4X (Ingress Protection Rating IP68) Type 316 stainless steel for all non classified areas.

3. Mount on a pedestal, or on adjacent structure.

a. Hardware and Mounting Supports: Type 316 stainless steel.

B. Provide each actuator mounted in excess of 6 feet above the operating level or in a position that cannot be accessed with a single integrated disconnect and local control station. Mount local control station on a wall, column or pedestal 5.0 feet above the operating level.

C. Provide red, green, and yellow indicating lights as on actuator. GREEN light on when valve, gate or equipment is completely closed, RED light on when valve, gate or equipment is completely opened, and YELLOW light when valve, gate or equipment is in mid travel.

D. Control circuits: 120 VAC.

E. LOCAL/STOP/REMOTE switch: Padlockable in all positions. With actuator selector set to “Remote” actuator shall be capable of accepting operation input through separate pushbutton station, that pushbutton station has been selected for remote “COMPUTER” control.

F. OPEN/CLOSE switch: With actuator selector set to “Remote”, actuator shall be capable of accepting operation input from separate pushbutton station, when pushbutton station has been selected for local “Open/Close” control.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install items in accordance with manufacturer's printed instructions and as indicated and specified.

**3.02 - PAINTING**

A. After installation and accepted testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.03 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.04 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.05 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS**

A. Comply with the requirements specified in Section 01600.

B. Provide for each Actuator:

1. Two fuses of each size

C. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. One set of all special tools

2. Supply each actuator with a start-up kit consisting of installation instructions, electrical wiring diagrams and two sets of cover screws and seals.

**3.08 - FIELD TESTING**

A. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service engineer, conduct running test for each actuator in presence of Engineer to determine its ability to operate without vibration or jamming and to operate at the speeds specified.

1. During tests, observe and record, motor inputs.

2. Promptly correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results and results acceptable to the Engineer are obtained.

3. Contractor to provide all labor, equipment, and materials necessary for conducting tests.

B. Make all adjustments necessary to place equipment in specified working order at time of above tests.

C. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to satisfaction of the Engineer that units will perform the service specified and indicated.

**3.09 - CONTRACT CLOSEOUT**

A. Provide submittals in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15113**

**FRP STOP LOGS AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Provide and test FRP stop logs and appurtenances as indicated and in compliance with Contract Documents.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

2. Data for stop log characteristics and performance.

3. Complete description of all materials, material thicknesses of all components.

4. Maximum bending stress and deflection of the stop logs under design head specified and indicated.

5. Installation drawings showing the details required for installation, dimensions, clearances and anchor bolt locations

6. Shop drawing data for accessory items.

7. Certified setting plans, with tolerances, for anchor bolts.

8. Manufacturer's literature as needed to supplement certified data.
9. Operating and maintenance instructions and parts lists.
10. Shop and field inspection reports.
11. Qualifications of field service engineer.
12. Recommendations for short and long-term storage.
13. Field testing procedures and set up
14. Special tools.
15. The latest ISO 9001 series certification or quality system plan.

C. A copy of the contract mechanical process and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 - PRODUCT HANDLING**

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Stop logs shall be the product of one manufacturer.

C. Stop logs shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. The Contractor shall obtain the stop logs, guide frames (groves) and appurtenances from the stop log manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

F. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

G. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment and field erection:

   a. 1 person-days.

3. Functional Testing: Check alignment and perform a functional test. Tests to include all items specified.

   a. 1 person-days.

4. Testing: Field performance test equipment specified.

   a. 1 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

8. Manufacturer of stop logs shall have a minimum of ten (10) operating installations with stop logs of the size specified or larger and in the same service and head as specified operating for not less than five (5) years.

**1.09 - REFERENCES**

A. ASTM International (ASTM):

1. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

2. A276: Standard Specifications for Stainless Steel Bars and Shapes.

3. D2000: Standard Classification System for Rubber Products in Automotive Applications.

4. D2563: Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

5. D4020: Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials

B. American Welding Society Code (AWS):

1. D1.6: Structural Welding Code – Stainless Steel

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - SYSTEM DESCRIPTION**

A. Stop log sizes and operating data are indicated in the Stop Log Schedule.

**2.02 - MANUFACTURERS**

A. FRP Stop Logs:

1. Plasti-Fab

2. Protectolite

**2.03 - STOP LOG CONSTRUCTION**

A. Provide all stop logs produced by a single manufacturer and designed for installation in the channels and structures as specified and indicated.

B. Stop log Configuration, Dimensions and Characteristics: As indicated in the Stop Log Schedule.

C. Leakage Rate: Not to exceed 0.20 gpm per foot of wetted seal perimeter.

D. Stop Log Height: As indicated and designed to function as specified and indicated when stacked in any order.

E. Provide stop logs designed so that the maximum fiber stress, ultimate or yield whichever applies, does not exceed 2.5 times the working stress.

1. Provide stop logs reinforced to withstand the maximum head indicated in the Stop Log Schedule with a deflection less than L/360 of the opening width or 1/4-inch whichever is less.

2. Stop logs with covers fabricated from pressed or laminated sheet material are not acceptable.

3. Warpage: Crown not to exceed 1/16-inch in any direction throughout the entire length.

4. Allowable surface tolerances in accordance with ASTM D2563 as follows:

| Defect | Allowable Tolerance |
|---|---|
| Cracks, crazing, chips, pits, blisters, dry spots, fish eyes, burned areas or entrapped air | None |
| Scratches | None more than 0.002 inches deep |
| Exposed Glass, exposure of cut edges | None |
| Wrinkles and Solid Blisters | Maximum deviation: 10 percent thickness not to exceed 1/8-inch |
| Surface Porosity (pinholes or pores in the laminate surface) | None |
| Foreign Matter | None |

F. Provide stop logs with strength to prevent distortion during normal handling, during installation and while in service as specified and indicated.

G. Provide all structural components of the guide frames fabricated of stainless steel with strength to prevent distortion during normal handling, during installation and while in service as specified and indicated.

H. Provide all welds performed by welders with AWS D1.6 certification for stainless steel.

I. Finish: Mill finish on stainless steel.

1. Provide weld on stainless steel sandblasted to remove weld burn and scale.

J. Materials:

1. Stop Logs: FRP (Fiberglass Reinforced Polyester)

2. Frame Guides and Invert: ASTM A240 Type 316L stainless steel

3. Seals: Neoprene ASTM D2000

4. Lifting Pins or Eyes: ASTM A276 Type 316 stainless steel

5. Fasteners, Nuts and Bolts: ASTM A276 Type 316 stainless steel

a. Anchor Bolts: Minimum 1/2- inch diameter

**2.04 - STOP LOGS**

A. Provide stop logs constructed of FRP totally encapsulating a reinforcing structure, ultraviolet stabilized and seamless to protect the reinforcing structure from corrosion.

1. Provide 1/8-inch glass mat laminate with the following minimum physical properties:

| Minimum Physical Laminate | Minimum Value | Test Method |
|---|---|---|
| Tensile strength | 14,700 psi | ASTM D638 |
| Flexural strength | 23,300 psi | ASTM D790 |
| Flexural modulus | 800,000 psi | ASTM D790 |
| Impact, Notches, Izod, foot pound per inch | 9 feet-pounds/ inch | ASTM D256 |
| Water absorption (percent 24 hr) | <0.13 percent | ASTM D570 |

B. Provide each stop log height as indicated in the Stop Log Schedule

C. Provide stop logs design for drainage.

D. Provide two lifting pins or eyes in the top of each stop log for removal and installation by means of the specified stop log lifter.

E. Provide each stop log with a FRP or Type 316 stainless steel identification tag indicating the following:

1. Manufacturer and model number
2. Width of the opening
3. Design head
4. Seal Material

**2.05 - SEALS**

A. Provide stop logs with a continuous resilient seal along the bottom of the stop log and a labyrinth seal fastened to the guide to restrict the leakage to the rate specified.

B. Provide all seals molded of extruded virgin neoprene in accordance with ASTM D2000, replaceable and retained to the stop logs.

C. Seal Characteristics:

| Minimum Physical Characteristics | Minimum Value |
|---|---|
| Specific Gravity | 1.25 |
| Hardness | 55 to 65 Shore A Durometer |
| Tensile Strength | 1500 psi |
| Elongation | 300 percent |
| Low Temperature Brittleness | -40 degrees F |
| Maximum Compression Set | 25 percent |

**2.06 - FRAMES**

A. Provide frame guides or grooves and invert members constructed of stainless steel plate with a minimum thickness of 1/4-inch.

B. Provide frame design to allow for embedded mounting or mounting directly to a wall with stainless steel anchor bolts and grout.

C. Provide mounting style as indicated in the Stop Log Schedule

D. Provide a flush bottom invert member across the bottom of the guides.

E. Provide a slot for mating with the stop log.

F. Provide guides with neoprene seals on both sides with two raised seating points fastened to the guide with UHMW clamping bars and stainless steel hardware.

**2.07 - STOP LOG LIFTER**

A. Provide one (1) stop log lifter for each different stop log (guide frame) width.

B. Provide the lifter constructed of aluminum and fitted with UHMW guide bars and stainless steel fasteners.

C. Provide the lifter with lifting hooks designed to engage the slots in the top of the stop logs.

D. Provide a lanyard release.

E. Provide the lifter capable of installing and removing all stop logs of the same width whether they are installed or at the operating floor level.

**2.08 - STORAGE RACKS**

A. Provide storage racks as indicated to house stop logs while they are not in use.

B. Provide storage racks constructed of FRP with Type 316 stainless steel hardware and mounted as indicated.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.02 - INSTALLATION**

A. Install items in accordance with shop drawings, manufacturer's printed instructions and as indicated.

B. Clean debris, dirt, and gravel, from inside of stop logs, guide frames and channels before placing stop logs.

C. Install guide frames in a true vertical position and grout all voids between guide frames and walls.

D. Inspect material for defects in workmanship and material.

**3.03 - PAINTING – Not Used**

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

**3.05 - MANUFACTURER’S FIELD SERVICES**

A. Manufacturer’s Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER’S TRAINING**

A. Manufacturer’s training shall be provided as specified herein.

**3.07 - LUBRICATION REQUIREMENTS – Not Used**

**3.08 - SPARE PARTS**

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

1. One set of all special tools is required.

**3.09 - FIELD TESTING**

A. Field testing will not be conducted without a procedure accepted by the Engineer calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 1 for checklist.

B. After installation of guide frames, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct operating and leakage test for each stop log in presence of the Engineer to determine its ability to operate as specified, and to operate smoothly without jamming under specified conditions.

C. Test installation and removal of each stop log location with the number of stop logs as indicated.

D. Leakage Test: Leakage not to exceed 0.20 gpm per foot of seating perimeter.

1. Conduct tests at design heads shown in the Stop Log Schedule.

E. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

F. Repeat tests until specified results are obtained.

G. Contractor to provide all water labor, piping, testing equipment for conducting tests.

H. Make all adjustments necessary to place equipment in specified working order at time of above tests.

I. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted.

**3.10 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15195**

**NATURAL GAS PIPING SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 15195, NATURAL GAS PIPING SYSTEMS is a part of DIVISION 15, PLUMBING whhich requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. DIVISION 15, PLUMBING. See SECTION 15400, PLUMBING SYSTEMS.

B. The Work of SECTION 15195, NATURAL GAS PIPING SYSTEMS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. Provide natural gas piping systems as indicated and in compliance with Contract Documents, complete and ready for operation.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

C. Coordinate with the Local Gas Utility as to any Local restrictions or requirements relative to the installation of the system.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS and as specified herein:

1. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, options, etc. of each item.
    a. Pipe and fittings
    b. Valves
    c. Gas equipment connectors
    d. Regulators
    e. Pressure gauges
    f. Pipe hangers and supports
2. Certification - Submit documentation certifying completion of the following items in compliance with this Section.
    a. System purging
3. Test Reports - prepare as specified in Part 3 of this Section.
    a. Pressure tests
4. Operation and Maintenance Manuals - Prepare manuals in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA.
    a. Valves
    b. Regulators
5. Closeout Submittals
    a. Record Drawings - Prepare as specified in Part 1 of this Section.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and to maintain equipment and material warranties.
2. Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.
3. Deliver spare parts at same time as pertaining equipment. Deliver to Owner after completion of work.

C. Receiving:

1. All equipment, material and spare parts shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.
2. Inspect for damage and correctness, and inventory items, upon delivery to site.
3. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.
4. Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions:

1. Drawings and specification direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment, controls, or appurtenances.

2. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished shall fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.

2. Install equipment that complies with state, local and federal codes and regulations.

D. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, prepare and submit for review, detailed structural, mechanical and electrical drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes shall be at no additional compensation.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American National Standards Institute (ANSI):

1. B16.33: Manually Operated metallic Gas Valves for use in Gas Piping Systems up to 125 psi (Sizes NPS ½ - NPS 2).

2. Z21.24: Connectors for Gas Appliances

D. American Society for Mechanical Engineers (ASME):

1. B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)

2. B1.20.1: Pipe Threads, General Purpose, Inch

3. B16.3: Malleable Iron Threaded Fittings

4. B16.5: Pipe Flanges and Flanged Fittings

5. B16.9: Factory-Made Wrought Steel Buttwelding Fittings
6. B16.38: Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 1/2 to 12 inches, 125 psig Maximum
7. B16.39: Malleable Iron Threaded Pipe Unions
8. B18.2.1: Square and Hex Bolts and Screws, Inch Series
9. B18.2.2: Square and Hex Nuts
10. B31.8: Gas Transmission and Distribution Piping Systems
11. B40.1: Pressure Gauges and Gauge Attachments
12. BPVC SEC VIII D1: Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

E. American Society for Testing and Materials (ASTM):

1. A36: Carbon Structural Steel
2. A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
4. A194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

F. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

G. Sheet Metal And Air Conditioning Contractors' National Association (SMACNA):

1. SMACNA Seismic Restraint Mnl: Seismic Restraint Manual: Guidelines for Mechanical Systems

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance information on location and size of all concrete pads, chases, frames, boxes, pits, sleeves, and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer before proceeding.

H. Attend regular coordination and job progress meetings required.

**1.10 - PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

A. Inserts and anchor bolts shall be furnished under this Section and installed under SECTION 03300, CAST-IN-PLACE CONCRETE. Prepare a schedule showing location, size and function of all required inserts and anchor bolts and deliver schedule to representative of the installing trade.

B. For new construction, pipe sleeves shall be furnished under this Section and installed by the trade whose finished interior surfaces will be penetrated. Prepare a schedule showing location, size and function of all required pipe sleeves and deliver schedule to representatives of all installing trades. For existing construction, pipe sleeves shall be furnished and installed under this Section.

**1.11 - PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION – Not Used**

**1.12 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform to the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes including, but not limited to, the Massachusetts Building Code and the Massachusetts Fuel Gas Code.
2. Local Fire Department
3. Local Gas Utility
4. Occupational Safety and Health Administration (OSHA)
5. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and acceptance, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**1.13 - RECORD DRAWINGS**

A. Prepare and maintain Record Drawing in accordance with SECTION 01700, CONTRACT CLOSEOUT and as specified herein.

B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of Drawings at the job site at all times. On a daily basis, record work completed and all changes from original Drawings clearly and accurately, including work installed as a modification or addition to the original design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.

C. Record drawings shall show record condition of pipe routing and sizes, valve locations, details, control changes, and corrections to equipment schedules. Schedules shall show actual manufacturer and make and model numbers of installed equipment. Remove all superseded data to show the completed work. Accurately indicate the location, size, type, and elevation of new buried piping and their relationship to existing buried piping.

D. The record drawings will be used as a guide for determining the progress of the Work installed. They shall be inspected on a regular basis and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be accepted until the Record Drawings are accurate and up-to-date.

E. At completion of Work prepare a complete set of CAD-drafted record drawings on bond paper showing all systems as actually installed. The Contract Drawing electronic CAD files will be made available for the Plumbing Subcontractor's use to serve as backgrounds for the Record Drawings. Provide all drawings necessary to show the required record information. Submit CAD-drafted prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer. Submit final accepted Record Drawing electronic files in PDF format.

F. Certify the accuracy of the Record Drawings. Record Drawings shall become the property of the Owner.

G. When required by jurisdiction, submit the Record Drawings for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

**1.14 - AMERICAN IRON AND STEEL ACT**

A. This Contract is subject to PL-113-76 the Consolidated Appropriations Act, 2014, Section 436 (American Iron and Steel Act), which requires the use of iron and steel products that are wholly manufactured in the United States for inclusion in the Work. It is understood that any iron and steel used on this project are to be produced in the United States, and produced in a manner which complies with the American Iron and Steel Requirement. Any melting, bending, coating, galvanizing, cutting, etc. process for manufacturing or fabrication will be in full compliance with the American Iron and Steel as mandated in the Environmental Protection Agency's State Revolving Fund Programs.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Branch piping to appliances or equipment shall be at least as large as the inlets thereof.

B. Where applicable, all products requiring approval by the Massachusetts Department of Public Safety shall be so approved.

**2.02 - NAMEPLATES**

A. Major equipment including regulators shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of metal. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

**2.03 - PIPE AND FITTINGS**

A. Aboveground Piping:

1. Pipe: Black steel, ASTM A 53, Type E, Grade B, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, flanged or plain end beveled for butt welding.

2. Threaded Fittings: ASME B16.3, black malleable iron.

3. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.

4. Unions: ASME B16.39, black malleable iron.

5. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

   a. Gaskets: Fluorinated elastomer, compatible with flange faces.

   b. Bolting: Stainless steel; ASTM A 193, Grade B8M or B8MA, Type 316, for bolts; and ASTM A 194, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1.

6. Pipe Thread Paste or Tape: Antiseize and sealant paste or tape of polytetrafluoroethylene (PTFE).

7. Welding Filler Metal: ASME B31.8.

**2.04 - VALVES, ABOVEGROUND**

A. Valves shall be of only one of the types specified herein.

B. Shutoff Valves, Sizes Larger Than 2 Inch.

1. Cast-iron or steel body ball valve with flanged ends in accordance with ASME B16.38 with PTFE seats, UL/CSA approved.

C. Shutoff Valves, Sizes 2 Inch and Smaller

1. Bronze or steel body ball valve in accordance with ANSI B16.33, full port pattern, reinforced PTFE seals, threaded ends, PTFE seat, UL/CSA approved.

**2.05 - GAS EQUIPMENT CONNECTORS**

A. All gas equipment connectors shall be AGA-approved for natural gas service.

1. Flexible Connectors: ANSI Z21.24 and approved for use in Massachusetts.

**2.06 - REGULATORS**

A. UL/CSA-approved for natural gas service, self-contained with spring-loaded diaphragm pressure regulating valve and atmospheric vent, corrosion resistant construction, threaded ends for sizes 2-inch and smaller, otherwise flanged. Regulators shall have corrosion resistant factory painted finish. Regulators shall be designed for the gas used.

**2.07 - PRESSURE GAUGES**

A. ASME B 40.1, 1 1/2 percent accuracy or better, minimum 2 1/2 inch dial certified for natural gas service. Gauge shall indicate operating pressure in middle one-half of scale.

**2.08 - PIPE HANGERS AND SUPPORTS**

A. Provide MSS SP-58, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise.

B. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and flat washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

C. Hangers, supports, rods and fasteners shall be hot-dipped galvanized steel, except shall be series 300 stainless steel in outdoor locations, and in chemical storage rooms, truck bay, headworks, and disc filter room.

**2.09 - SUPPLEMENTARY STEEL AND CHANNELS**

A. Provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment and systems provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. Unless otherwise specified herein, all supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be hot dipped galvanized after fabrication. Unless otherwise specified herein, all channels shall be hot dipped galvanized. Supplementary steel and channels shall be series 300 stainless steel in outdoor locations, and in chemical storage rooms, truck bay, headworks, and disc filter room.

**2.10 - PIPE SLEEVES**

A. Sleeves in Masonry and Concrete Walls, Floors, and Flat Roofs: Service weight cast iron or standard class ductile iron pipe, except shall be schedule 40 series 300 stainless steel in outdoor locations, in indoor chemical areas, and in indoor areas with exposed water surfaces such as water channels. Where sleeves are cast into new concrete, sleeves shall be ASTM A 53, Schedule 40 or Standard Weight steel pipe, have 2 inch high annular ring water stop continuously welded all around the pipe sleeve, and be hot-dipped galvanized after fabrication, except shall be series 300 stainless steel in outdoor locations, and in chemical storage rooms, truck bay, headworks, and disc filter room.

B. Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs: Hot-dip galvanized steel sheet, minimum 26 gage thickness, except shall be Series 300 stainless steel in outdoor locations, and in chemical storage rooms, truck bay, headworks, and disc filter room.

C. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and Series 300 stainless steel hardware.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Plumbing Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - MANUFACTURERS INSTRUCTIONS**

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project

**3.04 - INSTALLATION**

A. Installation, workmanship, inspection and testing shall be in accordance with the specified Fuel Gas Code with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of piping thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other accepted methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

B. Piping shall not be permitted in Electrical Rooms and stairwells.

C. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Make provisions in buried piping for differential settlement. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment and structure.

E. Piping: Cut pipe to actual dimensions and assemble to prevent residual stress. Within buildings, run piping parallel to structure lines and conceal in finished spaces. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap.

1. Cleanliness

a. Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear.

2. Aboveground Steel Piping

a. Determine and establish measurements for piping at job site and accurately cut pipe lengths accordingly. For 2 inch diameter and smaller, use threaded joints. For 2 1/2-inch diameter and larger, use flanged or butt-welded joints.

(1) Threaded Joints: Where possible use pipe with factory-cut threads, otherwise cut pipe ends square, remove fins and burrs and cut taper pipe threads in accordance with ASME B1.20.1. Provide threads smooth, clean and full-cut. Anti-seize jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil. PTFE tape is also acceptable. Apply jointing compound to male threads only. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to valves and meters for which a mean of disconnection is not otherwise provided.

(2) Welded Joints: Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ASME B31.8.

(3) Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.

(4) Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted.

F. Valves:

1. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to pipes.

2. Shutoff Valves

a. Provide shut-off valve at connection to each gas appliance and where otherwise indicated.

G. Gas Regulators:

1. Provide ball shutoff valve ahead of each regulator. For regulators installed inside buildings, extend a full-size vent line from relief outlet on regulator to a point outside of building that is acceptable to the building code. Each indoor regulator shall have a dedicated vent line and shall not be manifolded with other indoor regulators. On outlet side of regulator, provide a union and a 3/8-inch gauge tap with plug.

H. Appliances:

1. Provide connections to the natural gas service, and pipe all gas train vents to the outdoors, in accordance with all local and State codes. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a pipe reducer for changes in pipe size.

I. Pipe Hangers and Supports:

1. Selection, fabrication, and installation of piping hangers and supports shall conform with MSS SP-58, unless otherwise indicated.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and contraction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers will be clear of other piping, hangers, conduits, lighting fixtures, equipment, ceiling suspension systems, ductwork and other obstructions.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Rod Sizes, MSS SP-58.

6. Maximum Spacing Between Supports:

   a. Support piping within one foot on either side of regulators, valves, and changes in direction. Support within 2 feet of wall penetrations.

   b. Vertical Piping: Support piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support within 2 feet of floor and roof penetrations and within 2 feet of offsets and 90 degree turns.

   c. Horizontal Piping: Locate supports within one foot of each change of direction, and within 18 inches of joints for straight runs. Support straight runs of steel piping as follows:

| **Maximum Spacing Feet** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nominal Pipe Size inches** | **≤ 1** | **1 1/4** | **1 1/2** | **2** | **2 1/2** | **3** | **4** | **5** | **6** |
| Steel Pipe (Vapor) | 8 | 9 | 12 | 13 | 14 | 15 | 17 | 19 | 21 |

J. Seismic Bracing Requirements

1. Piping and equipment shall be supported and braced to resist seismic loads where required by the specified Building Code. Provide seismic restraints in accordance with SMACNA Seismic Restraint Mnl unless otherwise required by the specified building code.

K. Pipe Through-Penetrations

1. Provide pipe sleeves where pipe passes through walls, floors, ceiling, roofs, and partitions. In new construction, sleeves will be installed, secured in proper position and location during construction by the trade whose element will be penetrated. Such trades include concrete, masonry, drywall and/or plaster in the case of framed construction. In existing construction, pipe sleeves shall be furnished and installed under this Section. Core drilled holes in masonry and concrete may be provided by this Section in lieu of pipe sleeves, however cored drilled holes in masonry shall have cavities completely grouted smooth under this Section. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors and roofs.

2. Pipe Penetrations Through Building Exterior Construction: Provide a mechanically adjustable segmented elastomeric seal, with sleeve sized as recommended by seal manufacturer

3. Pipe Penetrations Through Building Interior Construction: Provide not less than 1½-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with rock wool insulation.

   a. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone.

   b. For fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with UL listed fill, void, or cavity material to maintain fire resistive integrity. Install firestopping assembly in accordance with UL FRD systems, and as recommended by manufacturer. Completely fill voids flush with the surface. Firestopping for filling voids in floors in which smallest dimension of a void is 4 inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed firestoppings shall be replaced with new firestoppings as specified in this Section.

4. Extend sleeves in floor slabs 2 inches above the finished floor. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

5. Seismic-braced pipe

   a. Proper clearances between penetrating gas system piping and any barrier shall be provided. The penetration holes shall be sized such that the hole diameter is 2 inches larger for pipe diameters 1-inch nominal to 3-inch nominal, and 4 inches larger for 4 inch and larger nominal diameter pipe.

   b. All open space around seismically braced through-penetrations shall be protected by a Listed, flexible through-penetration seal system.

L. Final Connections: Make final connections to equipment and appliances using rigid pipe and fittings, except for the following:

1. HVAC fan units of ½ horsepower or greater:

   a. Install flexible connectors. Connectors shall have sufficient slack to avoid all stresses associated with vibration.

**3.05 - FIELD QUALITY CONTROL**

A. After system installation has been completed and prior to initial operation, inspect piping systems for compliance with Drawings, Specifications and accepted submittals. Perform pressure tests and purging in compliance with the specified requirements. Have piping accepted by the Engineer before concealing.

B. Test Procedures and Reports:

1. Test each new system to demonstrate compliance with the contract requirements. Tests shall be witnessed by the Engineer. Correct defects in the Work and repeat tests until Work is in compliance with contract requirements.

2. Prepare and submit procedures for all specified tests to the Engineer for acceptance prior to the planned tests. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case.

3. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide all material and labor required for testing. Provide fuel, water, electricity, instruments, appliances, equipment, connecting devices, and personnel for the tests.

4. Gages used in pressure tests shall have been calibrated within the 6-month period preceding the tests. Leaks found during tests shall be repaired by replacing pipe and/or fittings and the system retested. Caulking of joints shall not be permitted.

5. Repair defects disclosed by tests or, if required by the Engineer, replace defective work with new work without additional cost. If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted at no additional cost.

6. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing design deficiencies. State that no deficiencies are evident if that is the case.

7. When tests have been completed and corrections made, submit signed and dated test reports.

C. Piping Inspection:

1. Inspect for compliance with the specified Fuel Gas Code. Replace, repair and then re-inspect defective welds.

D. Piping Pressure Tests:

1. Test system gas tight in accordance with the specified Fuel Gas Code with the additions specified herein. Use test pressure of 1-1/2 times maximum working pressure, but in no case less than 50 psig. Do not test until every joint has set and cool at least 8 hours at temperatures above 50 degrees F. Use clean dry air or inert gas, such as nitrogen or carbon dioxide, for testing. Systems which may be contaminated by gas shall first be purged as specified. Make tests on entire system or on sections that can be isolated by valves. After pressurization, isolate entire piping system from sources of air during test period. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. Take first reading at least one hour after test pressure has been applied. Do not take test readings during rapid weather changes.

2. There shall be no reduction in the applied test pressure other than that due to a change in ambient temperature. Allow for ambient temperature change in accordance with the relationship $PF + 14.7 = (P_1 + 14.7) (T_2 + 460) / T_1 + 460)$, in which "T" and "P" represent Fahrenheit temperature and gage pressure, respectively, subscripts "1" and "2" denote initial and final readings, and "PF" is the calculated final pressure. If "PF" exceeds the measured final pressure (final gage reading) by 1/2 psi or more, isolate sections of the piping system, retest each section individually, and apply a solution of warm soapy water to joints of each section for which a reduction in pressure occurs after allowing for ambient temperature change. In performing tests, use a test gage calibrated in one psi increments and readable to 1/2 psi.

3. Correct defects in Work and repeat test until no reduction in pressure occurs.

E. System Purging: After completing pressure tests, and before testing a gas-contaminated line, purge line with nitrogen to remove all air and gas. Clean completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to the specified Fuel Gas Code.

**CAUTION**

**Failure to purge may result in explosion within line when air-to-gas is at correct mixture.**

**3.06 - PAINTING**

A. Field painting of above ground piping shall be provided under SECTION 09941, FIELD PAINTING by the Painting Subcontractor .

B. Field Painting shall not be applied until after installation and testing is complete.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15300**

**AUTOMATIC WET-PIPE SPRINKLER SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. Sub-bids shall be in accordance with MGL c.149, §44A through §44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 15, MECHANICAL shall include the complete Work specified in the following: SECTION 15300, AUTOMATIC WET-PIPE SPRINKLER SYSTEMS

C. The Work of SECTION 15300, AUTOMATIC WET-PIPE SPRINKLER SYSTEMS is shown on Contract Drawings numbered:

00 F-001 10 F-101 , 10 F-102 99 F-501

D. Sub-bids for Work under this sub-bid shall comply with the requirements of MGL c.149, §44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Sub-bidder: _____

Subbid for: SECTION 15300, AUTOMATIC WET-PIPE SPRINKLER SYSTEMS

Project: Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No.: 2019-1

E. The Work of this sub-bid requires the Subcontractor to install all materials furnished by it unless otherwise specified.

### 1.01 - SCOPE

A. Design and provide new automatic wet-pipe fire suppression sprinkler systems for the areas indicated and in compliance with Contract Documents, complete and ready for operation.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section of these Contract Specifications, the Contract Drawings, and the codes and standards listed herein.

C. Coordinate with the Local Water Utility as to any Local restrictions or requirements relative to backflow prevention devices and metering.

D. Provide a licensed Fire Protection Professional Engineer to design the systems.

E. The General Contractor is to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints for Fire Protection Sprinkler System Work. This Work shall conform ot the requirements specified under the applicable sections of the specfications.

F. Hoisting, Scaffolding, staging and planking: The Fire Protection Subcontractor shall provide, set up, and maintain all derricks, hoisting machinery, and shall do all hoisting required for their Work.

1. The Fire Protection Subcontractor shall furnish, install, and maintain all scaffolding, staging and planking for their Work.

2. Scaffold shall have solid backs and floors to prevent dropping materials therefrom to the floor or ground.

G. Temporary Electricity: The Fire Protection Subcontractor shall furnish all extension cords, sockets, motors, and accessories for their Work.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTAL PROCEDURES and as specified herein.

1. Certificate of Design: Submit a completed certificate of design, prior to start of the design work. For Certificate form, see SECTION 01300, SUBMITTAL PROCEDURES.

2. Shop Drawings

   a. Working Drawings - Prepare 24 by 36 -inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Drawings shall clearly show location of sprinkler heads with spacing dimensions as well as orientation of sprinkler heads in relation to obstructions; piping system layout including valve risers and trim, inspectors test connections, fire department connection, gauges, system drains, isolation valves, water flow alarms; and support and hangers. Building sections shall show typical branch line, main line and sprinkler head elevation above the floor. Show point to point electrical wiring diagrams. Submit Working Drawings stamped and signed by the Fire Protection Engineer.

3. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item.

   a. Pipe, fittings and mechanical couplings

   b. Valves

   c. Buried utility warning and identification tape

   d. Sprinkler heads

   e. Spare heads cabinet and contents

   f. Alarm check valves

   g. Riser check valves

   h. Fire department connections

   i. Sight drains

   j. Backflow preventers. Submit a layout drawing indicating the location of all backflow preventers to the Massachusetts Department of Environmental Protection (DEP) for their approval prior to submitting to the Engineer.

   k. Pressure gauges

   l. Audible alarms

   m. Alarm initiating devices

   n. Pipe hangers and supports

   o. Paint

4. Hydraulic Calculations:

   a. Sprinkler system design - Prepare computer program generated hydraulic calculations in accordance with NFPA 13 to substantiate compliance with hydraulic design requirements. Submit name of software program used. Submit hydraulic calculations stamped and signed by the Fire Protection Engineer.

   b. Provide hydrant flow test data less than one year old conforming to NFPA 291. In case of a winter test, provide comparison to local water department tests or estimates of minimum summer flow and pressure for basis of design. The lesser combined flow and pressure test results shall be used for the hydraulic design of the system.

5. Certification - Submit documentation certifying completion of the following items in compliance with this Section.

   a. Flushing

   b. Disinfection

6. Test Reports - prepare as specified in Part 3 of this Section.
    a. Test Procedures
    b. Pressure tests
    c. Alarm tests
    d. Flow tests
    e. Backflow preventer tests
7. Operation and Maintenance Manuals - Prepare manuals in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA.
    a. Sprinkler heads
    b. Valves
    c. Alarm check valves
    d. Riser check valves
    e. Backflow preventers
    f. Audible Alarms
    g. Alarm initiating devices
8. Spare Parts and Special Tools:
    a. Include a list of spare parts as recommended by the manufacturer of each system component, where applicable. Each spare part shall be listed with the current unit price.
    b. Include a list of special tools and test equipment required for maintenance and testing.
9. Record Drawings
    a. Record Drawings of each system for record purposes, stamped and signed by the Fire Protection Engineer.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:
1. All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and to maintain equipment and material warranties.
2. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
3. Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.
4. Spare parts shall be delivered at same time as pertinent equipment. Deliver to Owner after completion of work.

C. Receiving:

1. All equipment, material and spare parts shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.

4. Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

**1.06 - DESIGN CRITERIA**

A. General:

1. Wet-pipe sprinkler system shall be provided in areas indicated on the Drawings. The system shall comply with the requirements indicated on the Drawings and NFPA 13 edition adopted by the Commonwealth of Massachusetts. Connection to the water supply line shall be as shown on the Drawings. Design automatic fire suppression sprinkler systems in accordance with the required and advisory provisions of NFPA 13 by hydraulic calculations using the area/density method for uniform distribution of water over the design area. Each system shall include materials, accessories, and equipment inside and outside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings to be submitted for acceptance. Locate sprinkler heads in a consistent pattern with ceiling grids, lights, area smoke detectors, and air supply diffusers. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved for use in wet pipe sprinkler systems.

B. Location of Sprinkler Heads:

1. Sprinkler heads shall be uniformly spaced to ensure full area coverage. Spacing of sprinklers and position and orientation of sprinklers in relation to the ceiling, walls, and obstructions shall conform to NFPA 13 for the hazard occupancy indicated. Maximum sprinkler head spacing shall not exceed limits specified in NFPA 13 for the corresponding hazard occupancy.

C. Water Distribution:

1. Water distribution shall be uniform throughout the area in which the sprinkler heads will open. Discharge from individual sprinklers in the hydraulically most remote area shall be not less than 100 percent of the specified density.

D. Density of Application of Water:

1. Size pipe to provide the indicated density when the system is discharging the specified total maximum required flow.

E. Sprinkler Discharge Area:

1. Sprinkler discharge area shall be the hydraulically most remote area as defined in NFPA 13.

F. Outside Hose Allowances:

1. Hydraulic calculations shall include the indicated allowance for outside hose streams.

G. Friction Losses:

1. Calculate losses in piping in accordance with the Hazen-Williams formula with 'C' value as specified in NFPA 13 for the piping material employed. Velocity in the sprinkler piping shall be limited to a maximum of 20 ft/sec.

H. Water Supply:

1. Base hydraulic calculations on the indicated static pressure, flow and corresponding residual pressure at the fire water service point of connection to the water main. Provide the indicated pressure cushion between total calculated demand curve and the water supply curve.

I. Seismic Design Requirements:

1. Conform to the seismic design requirements specified in NFPA 13. Hangers, supports and through - penetrations shall be designed to protect piping and valves from earthquake damage.

2. Conform to the seismic design requirements of the specified Building Code. Site seismic criteria can be found on Drawing 00 S-001 of the contract drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Comply with requirements of Authority Having Jurisdiction for approvals, materials, hose threads, installation, inspections, and testing.

C. Comply with requirements of Owner's insurance underwriter for submittal, approvals, materials, installation, inspections, and testing.

D. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13.

E. Fire Protection Engineer: Hydraulic calculations, working drawings, record drawings, and installation inspection reports shall be prepared by, or under the supervision of, an individual who is experienced with the types of works specified herein, and is licensed as a Fire Protection Professional Engineer in the state of Massachusetts.

F. Tests shall be conducted in presence of Authorities Having Jurisdiction. Fire Protection Subcontractor shall notify the Authorities Having Jurisdiction and Engineer minimum five days prior to performing tests.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American Society For Testing And Materials (ASTM):

1. A36: Carbon Structural Steel

2. A47: Malleable Iron Castings

3. A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

4. A536: Ductile Iron Castings

5. A795: Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

D. American Society Of Mechanical Engineers (ASME):

1. B1.20.1: Pipe Threads, General Purpose (Inch)

2. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

3. B16.3: Malleable Iron Threaded Fittings

4. B16.4: Cast Iron Threaded Fittings

5. B16.9: Factory-Made Wrought Steel Butt- Welding Fittings
6. B16.11: Forged Fittings, Socket-Welding and Threaded
7. B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
8. B18.2.1: Square and Hex Bolts and Screws (Inch Series)
9. B18.2.2: Square and Hex Nuts (Inch Series)
10. B40.1: Gauges - Pressure Indicating Dial Type

E. American Society Of Sanitary Engineering (ASSE):

1. 1015: Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

F. American Welding Society (AWS):

1. D10.9: Qualification of Welding Procedures and Welders for Piping and Tubing

G. American Water Works Association (AWWA):

1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. C151: Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

H. FM Global (FM):

1. P7825: Approval Guide

I. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

J. National Fire Protection Association (NFPA)

1. 13: Installation of Sprinkler Systems
2. 24: Installation of Private Fire Service Mains and Their Appurtenances
3. 25: Inspection, Testing, and Maintenance of Water Based Fire Protection Systems
4. 291: Fire Flow Testing and Marking of Hydrants

K. Underwriters Laboratories, Inc. (UL)

1. 04: Fire Protection Equipment Directory
2. 262: Gate Valves for Fire-Protection Service
3. Fire Prot Dir: Fire Protection Equipment Directory

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance information on location and size of all concrete pads, chases, frames, boxes, pits, sleeves, and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interferences, or for proper execution of specified work.

E. If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer before proceeding.

H. Attend regular coordination and job progress meetings required.

**1.10 - PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

A. Inserts and anchor bolts shall be furnished under this Section and installed under SECTION 03300, CAST-IN-PLACE CONCRETE. Prepare a schedule showing location, size and function of all required inserts and anchor bolts and deliver schedule to representative of the installing trade.

B. For new construction, pipe sleeves shall be furnished under this Section and installed by the trade whose finished interior surfaces will be penetrated. Prepare a schedule showing location, size and function of all required pipe sleeves and deliver schedule to representatives of all installing trades. For existing construction, pipe sleeves shall be furnished and installed under this Section.

**1.11 - PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION**

A. Not used.

**1.12 - ELECTRICAL WORK**

A. All electrical apparatus and controls associated with equipment installed under this Section shall be furnished and mounted under this Section. All wiring of controls to the fire alarm control panel will be furnished and installed by Division 16.

**1.13 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes including, but not limited to, NFPA 13 as adopted by Massachusetts, the Massachusetts Fire Safety Code, the Massachusetts Building Code, and the Massachusetts Plumbing Code.
2. Massachusetts Department of Environmental Protection.
3. Local Fire Department.
4. Local Water and Sewer Authority.
5. Occupational Safety and Health Administration (OSHA).
6. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and acceptance, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**1.14 - RECORD DRAWINGS**

A. Prepare and maintain record drawings in accordance with SECTION 01346, AS-BUILT DRAWINGS and as specified herein.

B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of record drawings at the job site at all times. On a daily basis, record work completed and all changes from original contract drawings clearly and accurately, including work installed as a modification or addition to the original design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.

C. Record drawings shall show as-built condition of all items required by NFPA 13 for Working Drawings (Plans). Remove all superceded data to show the completed work. Accurately indicate the location, size, type, and elevation of new buried piping and their relationship to existing buried piping.

D. The record drawings will be used as a guide for determining the progress of the Work installed. They shall be inspected on a regular basis and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be authorized until the record drawings are accurate and up-to-date.

E. At completion of Work prepare a complete set of CAD-drafted record drawings on bond paper showing all systems as actually installed. The contract drawing electronic CAD files will be made available for the Fire Protection Subcontractor's use to serve as backgrounds for the record drawings. Provide all drawings necessary to show the required record information. Submit CAD-drafted prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer. Submit final accepted Record Drawing electronic files in PDF format.

F. Certify the accuracy of the record drawings. Record drawings shall be stamped and signed by the Fire Protection Engineer. Record drawings shall become the property of the Owner.

G. When required by jurisdiction, submit the record drawings for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

**1.15 - MAINTENANCE ACCESSORIES AND TOOLS**

A. All special tools necessary for the operation and maintenance of the Fire Protection system and equipment shall be furnished. Wrenches for the removal of each type of sprinkler head installed shall be furnished within the spare sprinkler head cabinet at the alarm check valve riser location or where directed by the Engineer.

**1.16 - AMERICAN IRON AND STEEL ACT**

A. This Contract is subject to PL-113-76 the Consolidated Appropriations Act, 2014, Section 436 (American Iron and Steel Act), which requires the use of iron and steel products that are wholly manufactured in the United States for inclusion in the Work. It is understood that any iron and steel used on this project are to be produced in the United States, and produced in a manner which complies with the American Iron and Steel Requirement. Any melting, bending, coating, galvanizing, cutting, etc. process for manufacturing or fabrication will be in full compliance with the American Iron and Steel as mandated in the Environmental Protection Agency's State Revolving Fund Programs.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Material and equipment for fire protection service shall be UL 04 Fire Protection Equipment Directory listed and/or FM P7825 approved for use in wet pipe sprinkler systems where such classes of material and equipment are available as listed or approved by these organizations. Where the terms "listed" or "approved" appear in this Section, such shall mean listed or approved in the aforementioned directories.

B. Where applicable, all products requiring approval by the Massachusetts Department of Public Safety shall be so approved.

C. All components subject to pressure shall be rated for minimum 175 psig working pressure.

**2.02 - BURIED PIPING SYSTEMS**

A. Pipe and Fittings:

1. Provide pipe and fittings conforming to NFPA 24 for piping under the building and outside of building walls. Minimum depth of cover shall be 5 feet from finished grade. Piping beyond 5 feet outside of building walls shall be provided under Division 2.

2. Piping shall be AWWA C151/A21.1, Class 52, outside coated, double cement line ductile iron pipe and fittings. Fittings shall have 250 psig rating. Lining shall be seal coated and shall conform with AWWA C104/A21.4. Coat exterior of buried piping and fittings with coal tar pitch varnish coating. Provide mechanical type push on joints with AWWA C111/A21.11 gaskets for buried piping and AWWA C111/A21.15 flange joints with full ring gaskets for above ground piping at termination of buried piping inside the building. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used.

3. Provide socket clamps with tie rods at each change in direction, coat with asplaltum. Anchor joints in accordance with NFPA 24. Provide concrete thrust block at all changes in direction and at the elbow where the pipe turns up toward the floor. Restrain the pipe riser with steel rods from the elbow to the flange above the floor. Provide flexible couplings on exterior side of foundation wall.

B. Buried Utility Warning and Identification Tape:

1. Detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

C. Post Indicator Valves

1. Provide with operating nut located about 3 feet above finish grade with lever lockable in the open valve position. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint. Provide tamper switch.

**2.03 - ABOVEGROUND PIPING SYSTEMS**

A. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings shall not be permitted. Perform welding in the shop; field welding shall not be permitted. Conceal piping in areas with suspended ceilings.

B. Pipe, Fittings and Mechanical Couplings:

1. NFPA 13, except as modified herein. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasketed fittings shall not be permitted.

2. Unless otherwise specified to be hot-dipped galvanized, pipe shall be black steel pipe and shall be pre-oxidized with a suitable protective coating. All empty piping that may be periodically filled with water including, but not limited to, drain piping, test piping, and fire department connection piping up to the check valve, shall be hot dipped galvanized inside and out.

3. Schedule 40 black steel pipe shall be ASTM A53, Type E, Grade B, or ASTM A795 Type E, Grade A for Schedule 30 or 40. Schedule 10 black steel pipe shall be ASTM A795, Type E, Grade A. Steel pipe shall be Schedule 40 for sizes 1 -inch and smaller, and Schedule 10 for sizes 1 1/4-inch and larger, except all steel pipe upstream of the alarm check valve including drain piping and test piping shall be Schedule 40.

4. Schedule 40 pipe 2-inch and smaller shall be joined by screwed joints in accordance with specification ASME B1.20.1.

5. Schedule 40 pipe 2 1/2-inch and larger shall be joined by flanged joints, welded joints, or by mechanical couplings. For mechanical couplings, pipe ends shall have cut grooves. Roll grooving shall not be permitted.

6. Schedule 10 pipe 1 1/4-inch and larger shall be joined by welded joints in accordance with AWS D10.9 or by mechanical couplings. For mechanical couplings, pipe ends shall have rolled grooves. Cut grooving shall not be permitted.

7. Screwed fittings shall be cast iron, class 125, black, and in accordance with ASME B16.4 or malleable iron, class 150, black, and in accordance with ASME B16.3.

8. Welded fittings shall be steel, standard weight, black, and in accordance with ASME B16.9 and ASME B16.11.

9. Flanged fittings shall be cast iron, short body, class 175 and in accordance with ASME B16.1, ASME B16.21, ASME B18.2.1, and ASME B18.2.2. Provide hexagon head machine bolts, hexagon head nuts, and washers, all heavy finished cadmium plated.

10. Rubber gasketed grooved mechanical couplings and fittings shall be NFPA 13 listed and approved and consist of combination housings and gaskets. Housings shall either be malleable iron ASTM A47 or ductile iron ASTM A536 and shall be hot-dipped galvanized where galvanized piping is specified to be used. Gasket material shall be listed for the intended service and shall be Grade "E", EPDM. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

    a. Mechanical couplings shall be Victaulic Style 07 "Zero Flex" couplings for rigid connections in equipment rooms; Style 77 standard flexible couplings at pumps and vibration producing equipment; Style 77 at flexure points in equipment rooms and Style 75 at flexure points elsewhere (to meet seismic requirements); Style 72 outlet couplings; Style 750 reducers; and Style 741 "Vic-Flange" adapters at all valves and equipment connections 2 1/2-inch and larger.

    b. Victaulic "installation-ready" couplings may be substituted, Style 107 for Style 07, and Style 177 for Styles 77 and 75.

11. Expansion: When crossing building expansion or seismic joints, expansion or seismic loops, as required by NFPA 13, shall be installed with the appropriate couplings to allow for expansion in agreement with that as provided for by the building joint. Piping shall be securely anchored to the building structure on both sides of the building expansion and/or seismic joint.

C. Sprinkler Heads:

1. Provide nominal 1/2-inch or 3/4-inch orifice sprinkler heads, 175 psig working pressure. O-rings will not be permitted in sprinkler heads. Release element of each head shall be of the ordinary temperature rating or higher as required by NFPA 13. Provide sprinkler head guards as specified and/or required by NFPA 13. Sprinklers shall be used in accordance with their listed and approved coverage limitations.

2. Unless otherwise specified or indicated, sprinkler heads shall be of conventional design, standard response or quick response, standard coverage, upright style. Extended coverage sprinklers shall not be used.

3. Sprinkler heads located in unfinished areas without ceilings (mechanical rooms, storage rooms, process areas, etc.) and combustible concealed spaces above ceilings shall be of conventional design, upright style, and shall have a rough brass finish.

4. Sprinkler heads located in finished areas without ceilings shall be of conventional design upright style and shall have a polished chrome finish.

5. Sprinkler heads located in areas with suspended ceilings shall be of conventional design, recessed pendent style, low profile ceiling plate (escutcheon) and shall have a polished chrome finish.

6. Sprinkler heads located at skylights shall be conventional design, polished chrome finish, style to suit, upright, pendant or sidewall.

7. Sprinkler heads to protect small unheated spaces shall be individual dry sidewall, pendent or upright style each connected separately to the wet-pipe sprinkler piping.

8. All recessed sprinkler heads shall be of the adjustable type.

9. Provide wax-coated heads in corrosive areas including, but not limited to, all heads in indoor chemical areas, and in indoor areas with exposed water surfaces such as water channels.

10. Sprinkler Head Guards: Provide head guards on all sprinkler heads within 7 feet-0 inches of any floor and/or under stairs, and elsewhere where susceptible to accidental damage. Guards shall be constructed of galvanized wire with locking device to permit authorized removal for sprinkler and head repair. Do not provide guards on sidewall heads.

11. Spare Heads Cabinet: Provide metal cabinet with extra sprinkler heads and two sprinkler head wrenches for each type of head adjacent to each alarm check valve riser. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

D. Valves:

1. NFPA 13. Provide valves of types approved for fire service. Gate valves shall open by counterclockwise rotation. Provide an OS&Y gate valve beneath each alarm check valve.

a. Gate Valves 2 1/2-Inch and Larger: Outside screw and yoke indicating type, iron body, bronze mounted gate valves, straightway pattern, flanged ends, 175 psig working water pressure.

b. Gate Valves 2-Inch and Smaller: Outside screw and yoke indicating type, bronze body, straightway pattern, screwed ends, 175 psig working water pressure.

c. Butterfly Valves: Indicator type, built-in double pole/double throw tamper switch, 175 psig working water pressure. Butterfly valves of sizes up to 6-inch shall have locking type handles. Butterfly valves 8-inch size shall have gear operators. Butterfly valves may be substituted for gate valves except where NFPA/UL specifically requires an outside screw and yoke gate valve.

d. Ball Valves 3-Inch and Smaller: Brass body, chrome plated brass ball with nylon seat, cadmium plated vinyl insulated handle, female NPT inlet and outlet, 600 psig working water pressure.

e. Check Valves 2 1/2-Inch and Larger: Iron body, bronze mounted, flanged ends, swing type for placement in the horizontal position, 175 psig working water pressure. Provide flanged inspection and access cover plate for check valves 4-inch and larger.

f. Check Valves 2-Inch and Smaller: Iron body, stainless steel trim, EPDM seal, screwed ends, silent check type, 200 psig working water pressure.

g. Drain and Inspectors Test Valves: Bronze globe valve with integral bronze seat, renewable disc, union bonnet, inside screw rising spindle, suitable for 300 psig non-shock cold water.

h. Automatic Ball Drip Valve: 1/2-inch, bronze body, corrosion resistant metal ball and spring, threaded ends, 175 psig working water pressure.

E. Alarm Check Valve Assemblies:

1. Provide alarm check valves complete with variable pressure retarding chamber, alarm test valve, alarm shutoff valve, check valves, drain valves, pressure gages, and all other appurtenances for the proper operation of the system.

F. Riser Check Valves:

1. Provide riser check valves complete with alarm test valve, drain in valve, pressure gages, and all other appurtenances for the proper operation of the system.

G. Fire Department Connections:

1. Provide listed and approved 4-inch single Storz type connections or 4 x 2 1/2 x 2 1/2-inch siamese type connections as required by the local fire department. Fire department connections shall have hose threads to suit local fire department with brass pin lug caps and chains, and identifying fire department connection escutcheon plate. Provide polished chrome plated finish.

H. Sight Drains:

1. Reliable Model B, one inch, to suit.

I. Backflow Preventers:

1. Provide listed and approved double check backflow preventer with OS&Y gate valve on both ends and strainer on inlet. Body shall be epoxy coated cast iron with rubber check valve disks, bronze seats, stainless steel trim, and bronze test cocks. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR. Listing of the specific make, model, design, and size in the FCCCHR shall be acceptable as the required documentation." Double check backflow preventers shall be tested and certified under ASSE 1015.

2. Provide strainer without screen.

3. For backflow preventer testing, provide downstream of the backflow prevention assembly UL 668 hose valves with 2 1/2-inch National standard male hose threads with cap and chain.

J. Pressure Gauges:

1. Pressure gauges shall be listed and approved for fire protection service, ASME B40.1, 3 percent accuracy or better, with wetted parts consisting of bronze bourdon tube and brass socket. The movement shall be designed to provide shock and vibration resistance. Gauges shall withstand temperatures of -40 to 150 degrees F.

2. Gauges shall have a minimum 2 1/2-inch diameter face. Dial gradations reading in "PSIG" shall be such that the normal operating pressure of the system installed shall be indicated near the middle of the scale.

3. Select gauges for use on "wet" systems with pressurized water piping.

4. Gauges shall be equipped with a ball valve shutoff and snubber. An outlet, at least 1/4 inch in diameter, plugged for the installation of the inspector's gauge shall be located between each valve and gauge.

**2.04 - ALARM SYSTEMS**

A. Audible Alarms:

1. Provide electric alarm bells of the approved weatherproof and guarded type. Mount alarms outdoors on the exterior walls of each building at the location(s) indicated. Bells shall sound locally upon the flow of water in each corresponding sprinkler system. Electric alarm bells shall operate on 24 VDC power unless other voltage is required by the fire alarm system. Bell shall be 8-inch size with weatherproof backbox for outdoor installation.

B. Alarm Initiating Devices:

1. Provide switches with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system and electric alarm bell where so indicated. Connection of switches to the fire alarm system shall be under SECTION 16721, FIRE ALARM SAFETY. Switches shall be listed and approved. Do not install a shutoff valve in the piping between the alarm check valve and any pressure switch.

2. Pressure Switches: Provide pressure actuated adjustable switches designed for use in wet-pipe automatic fire sprinkler systems which shall actuate at 4 to 8 psig. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for the automatic transmittal to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and be designed for upright mounting (threaded connection down) either indoors or outdoors. Potter-Roemer PS10A Series, Reliable, Gem, Autocall, or equivalent acceptable product.

3. Low Water Pressure Supervisory Switches: Provide pressure actuated adjustable switches designed for use in automatic fire sprinkler systems water supply piping which shall actuate by a low pressure supervisory signal as indicated. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for the automatic transmittal to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant cover and be designed for upright mounting (threaded connection down) either indoors or outdoors. Potter-Roemer PS40 series, Reliable, Gem, Autocall, or equivalent acceptable product.

4. Flow Switches: Provide vane-type water flow switches designed for use on Schedule 10 to Schedule 40 steel pipe in wet-pipe automatic fire sprinkler systems. Each flow switch shall be equipped with plastic paddle. Alarm actuating device shall detect a flow of 10 gallons per minute or more, and have mechanical diaphragm controlled retard device adjustable from 10 to 90 seconds and shall instantly recycle. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for wiring to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and be designed for vertical or horizontal mounting either indoors or outdoors. Potter-Roemer VSR-F Series, Gem, Reliable, Autocall, or equivalent acceptable product. Flow switches shall be sized for the piping in which installed to ensure proper fit.

5. Tamper (Supervisory) Switches: Provide on all control valves, closed circuit supervisory tamper switches mounted in accordance with UL standard. Provide supervision against valve closure or tampering of valve. Provide two sets of snap action single pole double throw (SPDT) Form C contacts for wiring to the fire alarm system. Minimum contact ratings shall be 2.0 amps at 30 VDC. A signal shall be initiated during the first 1/5 of travel distance of the valve/stem from the full open position. Switches shall have NEMA 4 enclosure with tamper resistant fasteners and shall be suitable for indoor installation, and have sealed and gasketed enclosures. Potter-Roemer OSYSU Series, Gem, Reliable, Autocall, or equivalent acceptable product.

**2.05 - PIPE HANGERS AND SUPPORTS**

A. Provide in accordance with NFPA 13.

B. Attach to steel joists with MSS SP-58, Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

C. Hangers, supports, rods and fasteners shall be hot-dipped galvanized steel, except shall be Series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

**2.06 - SUPPLEMENTARY STEEL AND CHANNELS**

A. Unless otherwise indicated on the Structural Drawings, provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment and systems provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. Unless otherwise specified herein, all supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be hot dipped galvanized after fabrication. Unless otherwise specified herein, all channels shall be hot dipped galvanized. Supplementary steel and channels shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

**2.07 - PIPE SLEEVES**

A. Sleeves in Masonry and Concrete Walls, Floors, and Flat Roofs: Service weight cast iron or standard class ductile iron pipe, except shall be schedule 40 series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Where sleeves are cast into new concrete, sleeves shall be ASTM A 53, Schedule 40 or Standard Weight steel pipe, have 2-inch high annular ring water stop continuously welded all around the pipe sleeve, and be hot-dipped galvanized after fabrication, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

B. Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs: Hot-dip galvanized steel sheet, 26 gage minimum thickness, except shall be Series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

C. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and Series 300 stainless steel hardware.

**2.08 - IDENTIFICATION SIGNS**

A. Signage shall be safety sign manufacturer standard signs furnished and installed under this section. Comply with NFPA 13. Attach properly lettered and approved metal signs to each audible alarm, control valve and test valve. Permanently affix hydraulic design data nameplates to the riser of each system.

**2.09 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces of material and equipment furnished under this Section, a high solids epoxy with the following characteristics:

1. Solids by Volume: Minimum 69% (percent $\pm$2).
2. Type: Polyamidoamine, self-priming.
3. Dry Film Thickness: 4-8 mils per coat.
4. No. of Coats required: Two.
5. V.O.C. Requirement: 2.79 max.
6. Color: Safety Red.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Fire Protection Subcontractor's expense.

C. Verify all measurements at job site.

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - MANUFACTURER'S INSTRUCTIONS**

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project

**3.04 - INSTALLATION**

A. Installation, workmanship, inspection, and testing shall be in accordance with NFPA 13 and NFPA 24, with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other accepted methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Provide Teflon pipe thread paste on male threads.

B. Piping shall not be permitted in Electrical Rooms unless otherwise indicated.

C. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Install aboveground pressurized piping to permit draining of all sections of each piping systems without traps. Pitch piping back to system low points. Provide drain valves at all piping low points.

E. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Make provisions in buried piping for differential settlement. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment and structure.

F. Piping, General: Determine and establish measurements for piping at job site. Cut pipe to actual dimensions and assemble to prevent residual stress. Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted. Within buildings, run piping parallel to structure lines and conceal in finished spaces

G. Buried Piping:

1. Pipe bedding and compacted backfill shall be provided under Division 2. Depth of cover shall be as indicated.

2. Pipe bedding shall be minimum 6 inches deep. Bedding and compacted backfill shall be non-corrosive material such as cleaned, washed sand.

3. Install buried lines in a single trench. Trenches shall be wide enough to permit at least 6 inches spacing between lines and the sides and floor of the trench.

4. Terminate buried piping not more than 6 inches above finished ground surface or floor slab-on-grade.

5. Completely encase buried piping with polyethylene tube or sheet in accordance with AWWA C105.

6. Bury utility warning and identification tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

H. Sprinkler Heads Locations:

1. Sprinkler head locations shall be coordinated with all surface mounted items, such as cornices, curtains, low soffits and lighting fixtures and shall be located accordingly. Extended escutcheons may be utilized where heads cannot be moved, if accepted by the Engineer.

2. Sprinkler heads and piping locations shall be determined by actual field measurements. Care shall be taken to avoid obstruction of structural members, equipment, fixtures, lighting, ducts, other piping, ceiling tile supports, etc.

3. When sprinkler heads are shown on the reflected ceiling plan, they shall be so located. Unless specifically indicated otherwise, sprinkler heads shall be installed in the centers of tiles.

4. Sprinkler heads are to be provided above suspended ceilings in combustible concealed spaces with 6 inches or greater space between the bottom of joists and ceiling assembly. Sprinklers in these concealed spaces shall be located with deflectors a minimum of 1 inch and maximum of 6 inches below the bottom or the joists. Head spacing within these spaces shall not exceed 130 sq. ft. per head. Provide additional heads in concealed spaces not identified on the Contract Drawings or where ducts, equipment, etc. create obstructions.

I. Test Connections:

1. Inspector's Test Connections: Provide inspector's test valve approximately 6 feet above the floor in readily accessible location for each sprinkler system or portion of each sprinkler system equipped with a flow or pressure switch. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to a floor drain shall be permitted only if the drain is sized to accommodate full flow. Discharge to janitor sinks or similar fixtures shall not be permitted. Provide smooth bore corrosion resistant discharge orifice of same size as corresponding sprinkler orifice giving flow equivalent to one sprinkler. The penetration of the exterior wall shall be no greater than 2 feet above finished grade. Provide a precast concrete splash block under each exterior discharge orifice.

2. Backflow Preventer Test Connection: Provide test valves downstream of the backflow preventer assembly. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads "Test Valve."

J. Main Drains:

1. Provide separate drain piping to discharge at safe points outside each building or to sight drains or indirect wastes attached to building drains of adequate size to readily receive the full flow from each drain under maximum available system pressure. Indirect wastes shall be arranged for readily visible observation of flow. Provide auxiliary drains as required by NFPA 13. Provide precast concrete splash block under each exterior drain discharge. The penetration of the exterior wall shall be no greater than 2 feet above finished grade. Main drain pipe and valve shall support full flow at system demand.

K. Pipe Hangers and Supports:

1. The hanging and supporting of all piping and equipment shall conform to the requirements of NFPA 13 and the manufacturer's recommendations.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and contraction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers will be 6 inches clear from other piping, hangers, conduits, lighting fixtures, equipment, ceiling suspension systems, ductwork and other obstructions.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Contract Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Seismic Pipe Hanging Requirements:

a. Seismic protection of all fire suppression piping shall comply with the requirements of NFPA 13. Seismic bracing shall be provided for all piping larger than or equal to 2 1/2 inches. All feed mains regardless of size shall be braced.

b. The Fire Protection Subcontractor shall have the option of substituting alternate seismic supports and anchors provided their submittals are accompanied by shop drawings signed and sealed by the Fire Protection Engineer and a certified letter stating that anchor calculations were performed by a licensed professional Structural Engineer registered in the Commonwealth of Massachusetts. Do not submit calculations.

c. All mechanical materials and equipment including all pipes shall be supported and anchored to resist the external seismic forces. Force shall be resisted without failure or permanent displacement when it is applied in any direction, and shall conform to the specified Building Code. Site seismic criteria can be found on Drawing 00 S-001.

d. The ends or all branch lines shall be provided with an acceptable method of lateral restraint. The use of a wrap around "U" hanger, or band hanger at 45 degree angle is acceptable.

e. Acceptable manufacturers of seismic bracing are: TOLCO Incorporated; Corona, California.

f. All seismic braces shall be Listed for tension and compression service.

g. All braces shall utilize ordinary black steel piping as the prime support member.

h. Structural connection:

(1) All bracing shall be connected to the building's structural members.

(2) All means of connection to the building's structure and sprinkler pipe shall be Listed for the intended use.

i. At a minimum, the bracing shall be provided a maximum of 40 feet between lateral braces and 80 feet between longitudinal braces. However, if the pipe installation positioning selected by the Fire Protection Subcontractor requires additional bracing, these locations and types of braces shall be submitted for review and shall be provided as part of the base bid.

L. Pipe Through-Penetrations :

1. Provide pipe sleeves where pipe passes through walls, floors, ceiling, roofs, and partitions. In new construction, sleeves will be installed, secured in proper position and location during construction by the trade whose element will be penetrated. Such trades include concrete, masonry, drywall and/or plaster in the case of framed construction. In existing construction, pipe sleeves shall be furnished and installed under this Section. Core drilled holes in masonry and concrete may be provided by this Section in lieu of pipe sleeves, however cored drilled holes in masonry shall have cavities completely grouted smooth under this Section. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors and roofs.

2. Pipe Penetrations Through Building Exterior Construction: Provide a mechanically adjustable segmented elastomeric seal, with sleeve sized as recommended by seal manufacturer.

3. Pipe Penetrations Through Building Interior Construction: Provide not less than 1½-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with rock wool insulation.

a. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone.

b. For fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with UL listed fill, void, or cavity material to maintain fire resistive integrity. Install firestopping assembly in accordance with UL FRD systems, and as recommended by manufacturer. Completely fill voids flush with the surface. Firestopping for filling voids in floors in which smallest dimension of a void is 4 inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed firestoppings shall be replaced with new firestoppings as specified in this Section.

4. Extend sleeves in floor slabs 2 inches above the finished floor. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

5. Seismic-braced pipe:

   a. Proper clearances between penetrating sprinkler system piping, including drains and fire department connections, and any barrier shall be provided. The penetration holes shall be sized such that the hole diameter is 2 inches larger for pipe diameters 1-inch nominal to 3 1/2-inch nominal, and 4 inches larger for 4-inch and larger nominal diameter pipe.

   b. All open space around seismically braced through-penetrations shall be protected by a Listed, flexible through-penetration seal system.

M. Cross Connections and Interconnections:

1. No equipment, devices or piping shall be installed which will provide a cross or interconnection between a distribution water supply and a drainage, soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the water supply system.

**3.05 - FIELD QUALITY CONTROL**

A. After system installation has been completed and prior to initial operation, inspect piping and control wiring systems for compliance with Drawings, Specifications, and accepted submittals. Perform flushing and tests in compliance with NFPA 25 with the additions specified herein. Have piping tested, and approved by the Fire Protection Engineer, before concealing.

B. Test Procedures and Reports:

1. Test each new system to demonstrate compliance with the contract requirements. Tests shall be witnessed by the Engineer. Correct defects in the Work and repeat tests until Work is in compliance with contract requirements.

2. Prepare and submit procedures for all specified tests to the Engineer for acceptance prior to the planned preliminary tests. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case.

3. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide water, electricity, instruments, appliances, equipment, connecting devices, and personnel for the tests.

4. Gages used in pressure tests shall have been calibrated within the 6-month period preceding the tests. Leaks found during tests shall be repaired by replacing pipe and/or fittings and the system retested. Caulking of joints shall not be permitted

5. Repair defects disclosed by tests or, if required by the Engineer, replace defective work with new work without additional cost. If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted at no additional cost.

6. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing design deficiencies. State that no deficiencies are evident if that is the case.

7. When tests have been completed and corrections made, submit signed and dated test reports.

C. Preliminary Tests:

1. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide water, electricity, instruments, connecting devices, and personnel for the tests. Correct defects in the Work and repeat tests until the Work is in compliance with contract requirements.

2. Perform pressure tests as specified herein. Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated pressure gage in each system. In the event of leakage, locate and repair leak by remaking joints and/or replacing piping sections and repeat test. Pressure test each system hydrostatically at 200 psig for a 2 hour period with no leakage or reduction in pressure.

3. Provide alarm tests for each alarm initiating device and audible alarm. Test the audible alarms by flowing water through the inspector's test connection.

4. Provide flow tests for each alarm check valve riser, backflow preventer, and zone.

D. Backflow Preventers Test:

1. Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Engineer prior to placing the fire water system into operation.

E. Formal Tests and Inspections:

1. Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and accepted. Submit a written request for formal inspection at least 15 days prior to inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat any or all of the specified preliminary tests. Correct defects in Work, and repeat tests until Work is in compliance with contract requirements. Furnish equipment, water, electricity, instruments, connecting devices, and personnel for performing tests. The Authority Having Jurisdiction shall witness formal tests and approve systems before they are accepted. When tests have been completed and corrections made, submit a signed and dated test report, similar to that specified in NFPA 13.

F. Flushing:

1. After completion of testing and before placing in operation, flush all new sprinkler piping in accordance with Factory Mutual Loss Prevention Data Sheet 2-81, Fire Protection System Inspection, Testing and Maintenance, Section 3.1.5 using the hydraulic method. Use the permanent fire water service at its maximum available pressure for the source of flushing water. Flush piping through each sprinkler head outlet before sprinkler heads are installed. Flush until water runs clean. Discharge used water to sanitary sewer.

**3.06 - DISINFECTION**

A. In fire water piping systems, disinfect the new potable water piping and existing potable water piping affected by the Work under this Section in accordance with SECTION 15400, PLUMBING SYSTEMS.

**3.07 - PAINTING**

A. Shop painting of above ground piping shall be provided under this Section in accordance with SECTION 09940, SHOP PAINTING.

B. Provide additional shop paint coating materials to the site, for touch-up of coating per SECTION 09941, FIELD PAINTING, to be applied by the Painting Subcontractor.

C. Cover all sprinkler heads within areas in which any painting is to take place. Remove covers upon completion of painting.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15370**

**PROCESS PIPING AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. Provide and test process piping and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's certificates of conformance.
2. Submit certified copies of test reports.
3. Piping layouts in full detail.
4. Location of pipe hangers and supports.
5. Large scale details of wall penetrations and fabricated fittings.
6. Schedules of all pipe, fittings, special castings, flexible connectors, adapters, couplings, expansion joints, and other appurtenances.
7. Reports as required for welding certifications per ASME B31.1 Paragraph 127.6.
8. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.
9. Grooved joint couplings and fittings: Provide product submittals with products specifically identified by the manufacturer’s style or series designation.
10. Brochures and technical data on coatings and linings and proposed method for application and repair.
11. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
12. Shop drawing data for accessory items.
13. Manufacturer’s literature as needed to supplement certified data.
14. Operating and maintenance instructions and parts lists.
15. Schematic control and power wiring diagrams.
16. Shop and Field inspections reports.
17. List of recommended spare parts other than those specified.
18. Recommendations for short and long term storage.
19. Special tools.
20. Shop and field testing procedures and equipment to be used.
21. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
22. The latest ISO 9001 series certification or quality system plan.
23. Material Certification:
    a. Provide certification from the piping and equipment manufacturers that the materials of construction specified are recommended and suitable for the service conditions specified and as indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified. And indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Authority.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

24. A copy of the contract mechanical process, civil, structural, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

25. Failure to include all drawings applicable to the equipment specified in this section will result in submittal return without review.

26. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

27. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

28. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. During loading, transportation and unloading, prevent damage to pipes and coatings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to protect pipe, lining, and coating.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions for equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Welder Qualifications:

1. Qualify and certify welding procedures, welders, and operators in accordance with ANSI B31.1, for shop and project site welding of piping work.

2. Qualification for welders: Welding shall be performed by welders holding current certification for the welding procedures in use.

3. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect welds for defects exceeding tolerances allowed by code under which the weld was made. Repair all defects exceeding tolerance.

B. Provide all grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools used must be of the same manufacturer as the grooved components.

1. Provide all castings used for coupling housings, fittings, and valve bodies date stamped for quality assurance and traceability.

C. Job Conditions:

1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, and other equipment to be installed in piping system.

**1.08 - REFERENCES**

A. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
2. B16.3: Malleable Iron Threaded Fittings Classes 150 and 300
3. B16.5: AN Standard for Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
4. B16.9: Factory-Made Wrought Buttwelding Fittings
5. B16.15: Standard for Cast Bronze Threaded Fittings, 125 and 250 lb
6. B16.18: Standard for Cast Copper Alloy Solder-Joint Pressure Fittings
7. B16.22: Standard for Wrought Copper and Bronze Solder-Joint Pressure Fittings
8. B16.26: Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
9. B31.1: Power Piping

B. ASTM International (ASTM):

1. A36: Standard Specification for Carbon Structural SteelA47: Standard Specification for Ferritic Malleable Iron Castings
2. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A105: Standard Specification for Carbon Steel Forgings for Piping Applications
4. A139: Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
5. A181: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
6. A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
7. A194: Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
8. A197: Standard Specification for Cupola Malleable Iron
9. A216: Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
10. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
11. A256: Standard Method of Compression Testing of Cast Iron
12. A269: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
13. A278: Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C)
14. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

15. A312: Seamless and Welded Austenic Stainless Steel Pipe
16. A351: Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
17. A449: Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
18. A536: Ductile Iron Castings
19. B62: Standard Specification for Composition Bronze or Ounce Metal Castings
20. B75: Specification for Seamless Copper Tube
21. B88: Specification for Seamless Copper Water Tube
22. C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
23. C1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
24. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
25. D570: Standard Test Method for Water Absorption of Plastics
26. D638: Standard Test Method for Tensile Properties of Plastics
27. D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between-30 Degree C and 30 Degree C with a Vitreous Silica Dilatometer
28. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
29. D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
30. D1330: Standard Specification for Rubber-Sheet Gaskets
31. D1457: Standard Specification for Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials
32. D1599: Standard Test for Short-Time Rupture Strength of Plastic Pipe, Tubing and Fittings
33. D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
34. D1785: Standard Specification for Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Plastic Pipe, Schedules 40, 80 and 120
35. D2000: Rubber Products in Automotive Applications
36. D2105: Standard Test for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
37. D2412: Standard Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
38. D2467: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
39. D2564: Standard Specification for Solvent Cements for Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Plastic Pipe and Fittings
40. D2855: Standard Practice for Making Solvent Cemented Joints with Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Pipe and Fittings
41. D2996: Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
42. D3035: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
43. D3222: Standard Specification for Unmodified Polyvinylidene Fluoride (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings

44. D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
45. D5685: Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings
46. E84: Standard Test Method for Surface Burning Characteristics of Building Materials
47. F441: Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
48. F491: Standard Specification for Polyvinylidene Fluoride (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings
49. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
50. F1476: Standard Specification for the Performance of Gasketed Mechanical Couplings for Use In Piping Applications.

C. American Welding Society (AWS):
   1. B3.0: Welding Procedure and Performance Qualification

D. American Water Works Association (AWWA):
   1. C213: Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
   2. C219: Bolted, Sleeve-Type Couplings for Plain-End Pipe
   3. C606: Grooved and Shouldered Joints

E. Expansion Joint Manufacturers Association Standards.

F. Fluid Sealing Association - Technical Handbook.

G. Manufacturer's Standardization Society (MSS):
   1. SP-67: Butterfly Valves
   2. SP-69: Pipe Hangers and Supports - Selection and Application

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - DUCTILE IRON PIPE AND FITTINGS

A. Provide in accordance with SECTION 02615, DUCTILE-IRON PIPE AND FITTINGS.

### 2.02 - STAINLESS STEEL PIPE AND FITTINGS 2-1/2-INCH AND LARGER

A. Provide in accordance with SECTION 15066, STAINLESS STEEL PIPE AND FITTINGS.

### 2.03 - PVC PIPE AND FITTINGS

A. Schedule 80

B. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

C. Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

D. Provide pipe and fittings manufactured in the USA, using domestic materials, by an ISO 9002 certified manufacturer. Store all pipe shall be stored indoors after production at the manufacturing site until shipped from factory.

E. Provide standard lengths of pipe sizes 10-inch and larger beveled each end by the pipe manufacturer.

F. Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.

G. Joining:

1. Solvent cementing process.

2. Provide flanges at valves, pumps and equipment only or as indicated and specified.

3. Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochorite use titanium.

**2.04 - STAINLESS STEEL PIPE AND FITTINGS 1/2-INCH TO 2-INCH**

A. Provide either Pressfit, grooved or a socket welded system.

1. Provide a sufficient number of unions for Vic-Press and socket welded systems to allow removal of all valves and inline devices.

2. Provide threaded connections only where required.

B. Vic-Press Schedule 10S System:

1. Vic-Press system, 1/2-inch through 2-inch Schedule 10S comprised of stainless steel Vic-Press fittings, couplings and pipe.

2. Type 316 stainless steel Pressfit couplings and fittings and Type 316 stainless steel Pressfit pipe UL classified to ANSI/NSF 61 for cold +86 degrees F and hot +180 degrees F potable water service.

a. Maximum working pressure of 500 psi for water, and air and vacuum services.

3. Couplings, Fittings: Pressfit products formed of Type 316/316L stainless steel tubing including a self-contained o-ring seals molded of synthetic HNBR rubber suitable for water operating temperatures to +210 degrees F .

4. Valves 1/2-inch through 2-inch ball valves with Type 316 stainless steel plain ends for Pressfit assembly. Victaulic Series 569.

a. Pressure Rating: 300 PSI.

b. CF8M stainless steel body and ball

c. Type 316 stainless steel stem

d. PTFE seats.

5. Pipe: Type 316/316L ASTM A312 stainless steel

a. Schedule 10S.

C. Socket Welded System:

1. Schedule 40 Type 316L stainless steel pipe and fittings with socket welded connections.

D. Grooved System:

1. Schedule 10S type 316L stainless steel pipe and fittings with Type 316 stainless steel grooved end connections and couplings.

2. Fittings: ASTM A403 or be factory fabricated from ASTM A312 stainless steel pipe.

3. Provide couplings consisting of ductile iron or stainless steel housings, with pressure responsive elastomer gasket.

a. Rigid Type: Victaulic Style 489 (SS) or equal.

b. Flexible Type: Victaulic Style 77S (SS) or equal.

c. Installation-Ready, for sizes through 4 inches, with ductile iron housings. Victaulic Style 107H (rigid) and Style 177 (flexible) or equal.

d. 14-inch and Larger: AGS Series, with lead-in chamfer on housing key and wide width FlushSeal gasket. Victaulic Style W89 (rigid) or equal.

**2.05 - CHEMICAL TUBING AND FITTINGS**

A. Manufacturers:

1. New Age Industries
2. Nalge lnc.
3. Norton CompanyTubing:

B. Provide braided reinforced flexible PVC tubing resistant to the chemical specified.

1. Tubing to allow tight compression fittings for leak proof connections.
2. Tubing to comply with FDA standards.
3. Tubing to handle a maximum of 130 psi at 70 degrees F.

C. Fittings:

1. Provide no flow restriction compression fittings when connecting pieces are required.
2. Provide transition connections as detailed on the drawings.

**2.06- PRESSURE GAUGES**

A. Gauges:

1. Non-liquid filled type.
2. Helical wound bourdon tube, Inconel X-750.
3. Welded parts: Type 316 stainless steel.
4. Bearings: Precision Sapphire Type.
5. 1/2-inch NPT bottom male thread connection.
6. Accuracy: 1/2 percent of scale range.
7. 4-1/2-inch diameter with ABS plastic case.
8. Provide external adjustment.
9. Pipe and Fittings: Schedule 5 Pressfit or Schedule 40 threaded or socket welded, Type 316L stainless steel.
10. Pump Suction Gauges: Provide gauges with range to cover both the normal operating range and the range of pressures that will result from flushing.
11. Pump Discharge Gauges: Provide gauges with range to cover the normal operating range, above the pump shutoff head and the range of pressures that will result from flushing.

B. Pipe and fittings: Type 316L stainless steel, provide as specified herein.

C. Ball valves: General service stainless steel ball valves in accordance with SECTION15101, PROCESS VALVES AND APPURTENANCES.

D. Pressure Sensor Rings:

1. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-lb (Class 150) or 300-lb (Class 300) ANSI flanges as required.
2. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated.
3. Face to face length of the sensor: Conform to Specification MSS-SP67.
4. Type: Flow through design with flexible sleeve around full circumference. The center section shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.

5. Rigidly support all pressure instruments by a post at least 7/8 inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum, 1/4-inch NPT fittings are not acceptable.
6. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
7. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
8. Provide the needle fitting with both 1/4-inch NPT(F) threads and 1/2-inch NPT(M) threads.
9. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
10. Attach pressure instruments to the isolator with a hand tightened lock ring.
11. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
12. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
13. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum for all lines tested above 150 psi.
14. Provide gauges as specified herein. Provide all other types of instruments indicated and specified in accordance with SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM - GENERAL.
15. Materials:
    a. Pressure sensor/isolator rings: Provide materials suitable for the service conditions specified and indicated, as a minimum provide the following

| Service | Body & Plates | Sleeve |
|---|---|---|
| Wastewater | Type 316L Stainless Steel | Natural Rubber |
| Sludge | Type 316L Stainless Steel | Natural Rubber |
| Septage | Type 316L Stainless Steel | Natural Rubber |

**2.07 - PRESSURE GAUGE – CHEMICAL SERVICE**

A. Provide Plastomatic Gauge Guard, Model No. GGMU, or equal.

B. End Connections: Ture Union.

C. Size: As indicated in Contract Drawings.

D. Body Material: PVC.

E. Elastomer Material: Provide Viton for all chemical services.

F. Pressure Gauge: Liquid filled, center back mount.

G. All materials shall be compatible with chemical service.

**2.08 - PRESSURE AND FLOW INSTRUMENTATION**

A. Provide in accordance with SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM - GENERAL.

**2.09 - COUPLINGS-SLEEVE TYPE**

A. Manufacturers:

1. Romac
2. Smith Blair
3. Viking Johnson
4. Dresser

B. Provide couplings meeting AWWA C219

C. Couplings 12-inch and smaller:

1. End rings and center rings: ASTM A536 ductile iron, fusion bonded epoxy coated
2. Gaskets: Buna-N, NSF 61 approved
3. Hardware: Type 316 stainless steel

D. Couplings 14-inch and larger:

1. End rings and center rings: ASTM A36 steel, fusion bonded epoxy coated
2. Gaskets: Buna-N, NSF 61 approved
3. Hardware: Type 316 stainless steel

E. Bridles and tierods: Minimum 3/4-inch diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges.

1. Provide as indicated

**2.10 - COUPLINGS-BOLTED SPLIT SLEEVE TYPE:**

A. Manufacturers:

1. Victaulic Depend-O-Lok

B. Type: Bolted, split-sleeve type coupling consisting of four basic components; one piece housing, gaskets assembly, bolts and nuts, and restraint rings as required for restraint.

1. Provide split-sleeve with a double arch cross section closing around pipe ends that are smooth for expansion or contraction requirements or pipe ends with end rings affixed for pipe end restraint requirements. As the coupling housing closes, it confines the elastomeric gasket beneath the arches of the sleeve to create the radial seal. The axial seal is affected by the sealing plate at the closure plates as the bolts pull the coupling housing snug around the pipe.
2. Provide sealing members comprised of two “O” ring gaskets and an elastomer sealing pad bonded to the integral sealing plate.

C. Provide couplings designed for the type, size, and working pressure of the piping system as indicated in the Process Piping Schedule and specified.

D. Materials:

1. Split-sleeve:
    a. Carbon Steel and Ductile Iron pipelines: ASTM A36 Carbon Steel.
    b. Stainless steel pipelines, ASTM A240 Type 316L stainless steel.
    c. Provide stainless steel couplings where there is a transition for ductile iron to stainless steel piping.

2. Gaskets:

   a. Material: Elastomers in accordance with ASTM D2000.

      (1) Air Service: Silicone conforming to ASTM D2000 for air service up to 240 degrees F with intermittent exposure to 280 degrees F.

      (2) Liquid Service: Isoprene or Buna-N conforming to ASTM D2000 for service within the temperature range of -20 degrees F to 180 degrees F.

3. Bolts and Nuts:

   a. Bolts: Stainless steel conforming to ASTM F593 Type 316, minimum tensile strength 85,000 psi, (or threaded studs to ASTM A193, Class 2 Grade B8M Type 316)

   b. Nuts: ASTM F593 Type 316.

4. End Restraint Rings:

   a. Provide restraint rings of the same material as the coupling housing.

   b. Non-restrained (ExE) type couplings allows for up to 4 degree deflection. Provides for coupling joint where restraint is not required. If restraint is required, it must be provided independent of the coupling.

   c. Fixed x Expansion (FxE) type couplings: Allows for thermal expansion and contraction at the pipe joint. Provide one or two restraint rings fixed to one end of the pipe to keep coupling in the proper location. Where split sleeve coupling FxE for expansion is used provide the expansion side of the coupling with a combination of fixed and sliding supports for thermal movement.

   d. Fixed x Fixed (FxF) type couplings: Provides a fully restrained pipe joint. Provide one restraint ring welded to each of the pipe ends fitting beneath the coupling to prevent the pipe joint from pulling apart.

   e. Provide type as indicated and specified.

   f. Follow manufacturer's written recommendations and instructions for location dimensions and welding detail required to attach the restraint rings.

E. Provide a Type 316 stainless steel nameplate welded to each coupling with the following data:

   1. Manufacturer and date fabricated.

   2. Type of Coupling (ExE, FxE, FxF).

   3. Working Pressure in psi.

   4. Test Pressure in psi.

   5. Materials for coupling, hardware and gaskets.

F. Protective Coating: Prior to installation, couplings shall be coated on the I.D. and O.D. in accordance with SECTION 09940, SHOP PAINTING and SECTION 09941, FIELD PAINTING.

G. Couplings installed underground: Provide bitumastic coating or joint tape wrap.

H. Installation of couplings shall be in accordance with manufacturer's recommendation.

   1. The coupling housing shall be assembled pulling the closure plates together with the bolts tightened to assure snug coupling housing contact with the pipe OD. Follow the manufacturer's recommendation regarding the installation and tightening of the bolts.

**2.11 - EXPANSION JOINTS-ELASTOMERIC FLEXIBLE CONNECTION**

A. General: Provide flexible connectors as indicated, specified and as required for ductile iron, steel and stainless steel piping

1. At equipment connection: To eliminate vibration and stress on equipment.
2. Elsewhere: Designed for expansion/contraction.
    a. Hot Water Systems: 1.25 inch per 100 feet.
    b. All other Piping Systems: 0.5 inch per 100 feet .

B. Manufacturers:

1. Mercer Rubber Co.
2. General Rubber Co.
3. Garlock, Inc.
4. Proco.

C. Products:

1. Straight-through or tapered design as required.
2. Filled arch type for wastewater, sludge and scum applications
3. Furnish control rods for test pressures as indicated or required.
4. Materials: Suitable for service specified and indicated.
5. At expansion joints, provide guide supports located per manufacturer's recommendations.
6. Flanges: 125 lb (Class 125) drilling.
7. Provide Type 316 stainless steel retaining rings.

D. Install joints in their neutral position.

**2.12 - SAFETY SHIELDS-CHEMICAL SERVICE**

A. Provide shield type and materials for the service specified. Provide a written recommendation from the safety shield manufacturer.

B. Material: Non-porous teflon-impregnated glass cloth with a 5 mil (125 micrometre) thickness and sewn with 100 percent teflon thread and velcor closures and folded in a trifold design with an 0.82 mil (21 micromere) teflon cord inserted on the sides to act as a draw string tying on the flange neck. Provide for use with 150 lb ANSI (Class 150) flanges.

C. Draw string or cord: 100 percent virgin unbleached teflon fiber.

D. Provide a clear leak indicating window with a pH paper insert that will change color to indicate a leak.

E. Provide shields with a working temperature rating of 93 degrees C and a working pressure rating of 200 psi (1400 kPa).

F. Install safety shield for the following:

1. Expansion joints chemical services.
2. Flanged connections on chemical system pipe and fittings.

**2.13 - HOSE, HOSE FITTINGS AND ACCESSORIES**

A. Hose Manufacturers:

1. Goodrich, HPD Industries
2. Goodyear
3. United Rubber Supply
4. Goodall

B. Hose: 1-inch:

1. Provide 4-ply rubber-lined and rubber-covered water hose for 150 psi working pressure.
2. Nozzle:
    a. Shatter proof and UV resistant Lexan constant flow nozzle with bumper.

C. Hose Reels:

1. Type 316 stainless steel, mill finish.
2. Heavy duty square tubing frame.
3. Spring rewind with declutching arbor.
4. Stainless steel ball bearing swivel joint.
5. 1-inch female NPT.
6. 50 feet of hose.
7. Provide a flexible connector between the inlet pipe and inlet swivel joint.
8. Manufacturer: Hannay Model SS800 or acceptable equivalent product.

**2.14 - Y-PATTERN STRAINERS-CLEAR NON METALLIC**

A. Sizes: 1/2-inch through 2-inch

B. Materials:

1. Body and Cap: Clear Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.
2. Seals: Viton
3. Screen: PVC with 1/32-inch perforations

C. Ends: Socket

D. Pressure Rating: 150 psi at 70 degrees F.

**2.15 - WALL AND FLOOR SLEEVES**

A. Materials:

1. Floor Sleeves:
    a. Schedule 40 Galvanized steel ASTM A53 GRB
2. Wall Sleeves Between a Dry Area and a Wet Area (Tank, Channel etc)
    a. Schedule 40 Type 316L stainless steel
3. Wall Sleeves Between Dry Area or Between Dry Area and Ground
    a. Schedule 40 Galvanized steel ASTM A53 GRB

B. Water Stops: Provide water stops welded on both sides. Provide water stops 1/4-inch thick and 2-inch high and centered on the wall thickness.

C. Provide modular, mechanical type seals, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

D. Provide the elastomeric elements sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.

E. Temperature Range: -40 to +250 degrees F.

1. Material: EPDM, ATSM D2000 M3 BA510
2. Color: Black

F. Modular seal pressure plates: Molded of glass reinforced Nylon Polymer with the following properties:

1. Izod Impact – Notched: 2.05ft-lb/in. per ASTM D256
2. Flexural Strength @ Yield: 30,750 psi per ASTM D790
3. Flexural Modulus: 1,124,000 psi per ASTM D790
4. Elongation Break: 11.07 percent per ASTM D638
5. Specific Gravity:1.38 per ASTM D792

G. Hardware: Type 316 stainless steel.

**2.16 - DISMANTLING JOINTS**

A. Materials:

1. Flanged Spool: AWWA Class D steel ring flange compatible with ANSI class 125 and 150 bolt circles. Provide pipe of ASTM A36 plate 1 percent cold expanded to size.
2. End Ring and Body: ASTM A36 steel
3. Gaskets: ASTM 2000 Virgin NBR suitable for wastewater service
4. Bolts and Nuts: Type 316 stainless steel
5. Tie Rods: Type 316 stainless steel

B. Assembly Tolerance: 3 inches

C. Coating: Fusion bonded epoxy, NSF 61 certified

D. Pressure Rating: 150 psi working pressure

E. Manufacturers

1. Romac
2. Viking Johnson

**2.17 - INSULATION**

A. General:

1. Provide insulation where specified and indicated.
2. Provide pre-molded or pre-formed pipe insulation.
3. Provide insulation with a flame spread index of less than 25, and a smoke-developed index of less than 50 when tested in accordance with ASTM E84.
4. Provide insulation with a maximum thermal conductivity of 0.7 Btu-in/h-ft$^2$-degrees F at 75 degrees F mean temperature when tested in accordance with ASTM C177.

B. Insulation for systems with an operating temperature of 60 degrees F or higher:

1. Type:

a. Pre-Molded Fiberglass.

b. Provide All Service Jacket (ASJ) consisting of white draft paper bonded to aluminum foil with fiberglass reinforcement in accordance with ASTM C1136 Type 1.

c. Provide self sealing lap.

d. Provide insulation thickness as indicated on the Process Pipe Schedule.

2. Manufacturers:

a. Knauf Insulation.

3. Accessories:

a. Butt Strips: Provide self adhesive butt strips for sealing circumferential joints between insulation sections. Provide strips manufactured from white kraft paper bonded to aluminum foil with fiberglass reinforcement in accordance with ASTM C1136 Type 1.

b. PVC Fitting Covers: Provide pre-molded, insulated, white glass finish, suitable for inside and outside use. Provide fitting covers manufactured from PVC material having a flame spread index of less than 25, and a smoke-developed index of less than 50 when tested in accordance with ASTM E84, PVC material shall meet the requirements of ASTM D1784.

c. Vinyl Tape: Provide white, adhesive backed vinyl tape, minimum 1-inch wide for sealing PVC fitting covers to insulation.

d. Tacks: Provide white coated, stainless steel, barbed tacks.

e. Aluminum Protective Jacketing: Provide 0.020 inch Stucco Embossed Aluminum Jacketing.

f. Sound Barrier Jacketing: Provide a composite sound attenuating system comprised of an acoustic decoupler material laminated to 0.020 inch Stucco Embossed Aluminum Jacketing.

g. Stainless Steel Strapping: Provide Type 316 stainless steel strapping and wing seals. Provide strapping 1.2-inch wide or greater with a minimum thickness of 0.015-inch . Provide wing seals 1/2-inch wide or greater with a minimum thickness of 0.032 inches .

h. Sheet Metal Screws: Provide Type 304 stainless steel sheet metal screws.

C. Insulation for systems with an operating temperature below 60 degrees F.

1. Type: Pre-molded, Flexible Closed Cell Elastomeric Foam.

2. Provide self sealing lap for pipe sizes 6-inch and smaller. For pipe sizes above 6-inch and equipment provide Closed Cell Elastomeric Foam Sheets.

3. Manufacturers:

a. Armacell Engineered Foams, AP Armaflex SS and AP Armaflex.

4. Accessories:

a. Adhesive: Provide contact adhesive specifically designed for use with the insulation supplied.

b. Pipe support inserts: Provide a pre-fabricated insert designed to prevent damage to the insulation at the pipe support attachment point.

c. Provide an aluminum or stainless steel outer jacket, a foam inner core with plastic support and self sealing closure, or acceptable equivalent product.

**2.18 - CHEMICAL TOTE SCALES**

A. Manufacturers:

1. FORCE FLOW
2. Or an acceptable equivalent product.

B. Scale Schedule:

1. SH.SC-1 & 2, PACL.SC-1 & 2

a. Stationary 45” x 40” 275 gallon caged polyethylene storage tote.

b. Provide CHEM-SCALE, 50” x 50”, suitable for IBC tote bins.

c. Provide scale with a weight capacity capable of supporting and accurately weighing the caged storage tote and volume of liquid contained within.

d. Provide Solo G2 transmitter.

C. CHEM-SCALE platform

1. Single stainless steel strain gauge type load cell below a pivoting PVC platform.
2. Provide 4 adjustable hold down lugs on the platform to allow use of hold down straps for securing vessel to the platform.
3. Fasteners: 316 Stainless steel.
4. Apply specified coating to 316 stainless steel platform.

D. Coating

1. 2-part, 100% solids, thermoplastic, polyurea hybrid.
2. Minimum DFT of 80 mils.
3. Minimum density of 70 PCF per ASTM D1622
4. Minimum Taber abrasion resistance of 0.10% per 1000 cycles per ASTM D4060
5. Shore hardness of 45D per ASTM D2240

E. Weight Indicating Transmitters:

1. Force Flow model SOLO G2 or an acceptable equivalent product.
2. Provide 1 indicating transmitter per scale.
3. Contractor to coordinate required cable length, Splicing cables is not acceptable.

4. Inputs:
    a. 1 x 350 ohm load cell or
    b. 1 x summing box signal or
    c. 1 x 4-20 mA input
5. Outputs:
    a. 4-20 mA (current sourcing)
    b. 4 x programmable switching relays
6. Accuracy: 0.1 to 0.25% full scale
7. Increments: 0.1, 0.2, 0.5, 1, 2, 5
8. Display: 2 line, 16 digit LCD, 0.4-in characters, with bar graph showing % full
9. Power: 88-246 VAC, 60 Hz, 0.25 max amps
10. Enclosure Rating: Nema 4X, UL Listed
11. Communications: Modbus serial RS485 (ASCII protocol)

F. Manufacturer's Warranty:
1. 5 years, unconditional.

**2.19 - CHEMICAL INJECTORS**

A. Manufacturer:
1. SAF-T-FLO

B. Provide assemblies consisting of the following components:
1. Brass corporation stop with safety device to prevent release of solution tube under line pressure of Type 316 stainless steel ball valve.
2. Type 316 stainless steel flange tapped to accept the corporation stop or ball valve.
3. Solution Tube of the length indicated with a locking device to prevent release of the tube under line pressure.
    a. Ball check valve as specified in SECTION 15101, PROCESS VALVES AND APPURTENANCES.
    b. Type 316 stainless steel safety chain.
4. Chemical line connection to the assembly:
    a. Provide a section of flexible tubing or hose suitable for the service conditions specified and indicated.
    b. Isolation valve of the type indicated and specified.

**2.20 - SHOP PAINTING**

A. Provide in accordance with SECTION 09940, SHOP PAINTING.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION OF PIPE

A. Install pipelines parallel to building walls wherever possible. Install piping to lines and grades indicated and support. Where temporary supports are used, provide temporary supports as specified in SECTION 15056, PIPE SUPPORTS to prevent shifting or distortion of pipe. Provide for expansion.

B. Slope piping toward low points and provide for draining at low points.

C. Before assembly, remove debris from inside pipes and fittings.

D. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth burrs. Make up flanged joints tight, and prevent strain upon valves or other pieces of equipment.

1. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

E. Install grooved joints in accordance with the manufacturer's written recommendations.

1. Grooved ends: Clean and free from indentations, projections, or roll marks.

2. Gaskets: Molded and produced by the coupling manufacturer of an elastomer suitable for the service pecified and indicated.

3. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed.

F. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system as indicated, and at changes in direction or other places to prevent joints from pulling apart under pressures indicated in the Process Pipe Schedule.

G. Examine pieces for damage. Do not install pieces that are damaged according to Engineer. If any damaged piece should be discovered after having been installed, remove and replace with a sound piece at no additional cost to the Authority.

H. Handle pipe with equipment such as nylon slings and padded skids, designed to prevent damage to the coating. Repair abrasions and injuries to the coating prior to the application of insulation or prior to the application of final field coating.

I. Support piping laid in trenches in trench on bed of selected backfill material which maintains desired line and grade.

J. Use dielectric bushings or unions when ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere.

K. Welding in accordance with AN Standard B31 and AWS B3.0.

### 3.02 - PAINTING

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

### 3.03 - CLEAN UP

A. Prior to Start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

### 3.04 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

### 3.05 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

**3.06 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.07 - SPARE PARTS – NOT USED**

**3.08 - WALL SLEEVE SEALS**

A. Expand rubber against pipe and sleeve by tightening bolts when assembled around pipe and inserted in wall.

**3.09 - TEMPORARY PLUGS**

A. Close open ends of pipe with temporary plugs or caps when pipe installation is not in progress. Use watertight plugs for exterior, buried piping and if water or debris is in trench when work is resumed, do not remove until adequate provision has been made to prevent any water or debris entering pipe even if it necessitates dewatering trench.

**3.10 - PHYSICAL CHECKOUT, FIELD AND FUNCTIONAL TESTING**

A. Clean dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Water for testing provided by the Contractor.

C. Pressure and Leakage Tests:

1. Provide temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

2. Test pipelines in sections of acceptable length.

3. Fill section of pipe with water and expel air.

4. Pressure and leakage test consists of first raising pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to test pressures indicated in the Process Pipe Schedule.

5. No visible leakage in joint is acceptable.

6. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section has failed to pass test.

7. If section fails pressure and/or leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, and conduct additional tests and repairs until section passes test at no additional cost and without any time extensions.

D. Make piping connections to equipment with pipe in a free supported state and without application of vertical or horizontal forces to align piping with the equipment flanges.

E. Do not cover joints in underground piping with backfill material until piping has successfully passed pressure test.

F. Test pressures as indicated in Process Pipe Schedule.

G. Repair faulty joints even to extent of disassembling and remaking joint, remove defective pipe and fittings and replace in manner satisfactory to the Owner.

**3.11 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15400**

**PLUMBING SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended

B. A sub-bid submitted for the Work of DIVISION 15, PLUMBING shall include the complete Work specified in all of the following Sections:

1. SECTION 15195, NATURAL GAS PIPING
2. SECTION 15400, PLUMBING SYSTEMS
3. SECTION 15420, PLUMBING INSULATION

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so. Classes of work for which a listing is required in paragraph E of the Form for Sub-bid:

1. SECTION 15195, NATURAL GAS PIPING
2. SECTION 15420, PLUMBING SYSTEMS

D. Reference Drawings

1. The Work of DIVISION 15, PLUMBING is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 P-001 | 00 P-002 | 10 P-101 | 10 P-102 | 10 P-103 | 10 P-104 | 10 P-105 |
| 10 P-106 | 10 P-107 | 10 P-108 | 10 P-109 | 20 P-101 | 99 P-501 | 99 P-502 |
| 10 S-103 | 10S S-301 | 10S S-302 | 10 S-107 | 99 S-502 | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 15195, SECTION 15400 AND SECTION 15420

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. Provide plumbing systems as indicated and in compliance with Contract Documents, complete and ready for operation.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

C. Coordinate with the Local Water Utility as to any Local restrictions or requirements relative to backflow prevention devices and metering.

D. The General Contractor is to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints for Plumbing Work. This Work shall conform ot the requirements specified under the applicable sections of the specfications.

E. Hoisting, Scaffolding, staging and planking: The Plumbing Subcontractor shall provide, set up, and maintain all derricks, hoisting machinery, and shall do all hoisting required for their Work.

1. The Plumbing Subcontractor shall furnish, install, and maintain all scaffolding, staging and planking for their Work.

2. Scaffold shall have solid backs and floors to prevent dropping materials therefrom to the floor or ground.

F. Temporary Electricity: The Plumbing Subcontractor shall furnish all extension cords, sockets, motors, and accessories for their Work.

G. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. "Domestic water" shall mean potable drinking water.
11. "Service water" shall mean non-potable water downstream of a secondary backflow preventer originating from a potable water source and intended for washdown, hydronic heating system make-up, and process applications.
12. “Tempered water” shall mean domestic water heated to between 70 and 90 degrees F.
13. “Drain” piping shall mean floor drain piping and storm drain piping.
14. “Waste” piping shall mean sanitary waste piping.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTAL PROCEDURES and as specified herein:

1. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item.
    a. Pipe and fittings
    b. Cleanouts
    c. Drains
    d. Valves
    e. Water meters ( to be approved by the Town of Orleans Water Department)
    f. Strainers
    g. Pressure gauges
    h. Thermometers
    i. Water hammer arresters
    j. Backflow preventers
    k. Pipe hangers and supports
    l. Access panels
    m. Plumbing fixtures
    n. Domestic water heaters (gas-fired)
    o. Electric water heaters
    p. Pumps

2. Control Panel:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cutsheets for enclosure and control panel components.
    c. Front elevations of control panels showing dimensions, location of panel internal and panel exterior mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags indicated on the Contract plumbing, electrical and instrumentation drawings.
3. Certification - Submit documentation certifying completion of the following items in compliance with this Section.
    a. Flushing
    b. Disinfection
4. Test Reports - prepare as specified in Part 3 of this Section.
    a. Test procedures
    b. Pressure tests
    c. Backflow preventer tests
    d. Functional testing
5. Operation and Maintenance Manuals - Prepare manuals in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA.
    a. Valves
    b. Backflow preventers
    c. Plumbing fixtures
    d. Domestic water heaters (gas fired)
    e. Electric water heaters
    f. Pumps

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:
1. All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and so as to maintain equipment and material warranties.
2. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
3. Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.
4. Spare parts shall be delivered at same time as pertinent equipment. Deliver to Owner after completion of work.

C. Receiving:

1. All equipment, material and spare parts shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.

4. Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions:

1. Drawings and specification direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment, controls, or appurtenances.

2. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished to fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.

2. Install equipment that complies with state, local and federal codes and regulations.

D. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, Plumbing Subcontractor to prepare and submit for review, detailed structural, mechanical and electrical drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes are at no additional compensation.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American National Standards Institute (ANSI):

1. Z21.10.1: Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 BTU Per Hour or Less
2. Z21.10.3: Gas Water Heaters Vol. III, Storage Water Heaters with Input Ratings Above 75,000 BTU Per Hour, Circulating and Instantaneous
3. Z21.22: Relief Valves for Hot Water Supply Systems
4. Z124.2: Plastic Shower Units
5. Z358.1: Emergency Eyewash and Shower Equipment

D. American Society Of Heating, Refrigerating And Air-Conditioning Engineers (ASHRAE):

1. 90.1: Energy Standard for Buildings Except Low-Rose Residential Buildings

E. American Society of Mechanical Engineers (ASME):

1. A112.6.1M: Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
2. A112.18.1M: Plumbing Fixture Fittings
3. A112.19.1M: Enameled Cast Iron Plumbing Fixtures
4. A112.19.2M: Vitreous China Plumbing Fixtures
5. A112.19.3M: Stainless Steel Fixtures (Designed for Residential Use)
6. A112.19.5: Trim for Water-Closet Bowls, Tanks and Urinals
7. A112.21.1M: Floor Drains
8. A112.21.2M: Roof Drains
9. A112.36.2M: Cleanouts
10. B1.1: Unified Inch Screw Threads, (UN and UNR Thread Form)
11. B16.1: Cast Iron Pipe Flanges and Flanged Fittings
12. B16.3: Malleable Iron Threaded Fittings
13. B16.12: Cast Iron Threaded Drainage Fittings
14. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
15. B16.21: Nonmetallic Flat Gaskets For Pipe Flanges
16. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
17. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
18. B16.50: Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
19. B18.2.1: Square, Hex, Heavy Hex and Askew head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
20. B18.2.2: Nuts for General Applications: machine Screw Nuts, hex Square, hex flange, and Coupling Nuts (Inch Series)
21. B40.1: Pressure Gauges and Gauge Attachments
22. BPVC SEC IV: Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers
23. BPVC SEC VIII D1: Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

F. American Society of Sanitary Engineering (ASSE):

1. 1003: Water Pressure Reducing Valves
2. 1013: Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
3. 1014: Hand-Held Showers
4. 1017: Temperature Actuated Mixing Valves for Hot Water Distribution Systems
5. 1018: Trap Seal Primer Valves - Potable, Water Supplied
6. 1019: Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type

G. American Society for Testing Materials (ASTM):

1. A36: Standard Specification for Carbon Structural Steel
2. A47: Ferritic Malleable Iron Castings
3. A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. A74: Cast Iron Soil Pipe and Fittings
5. A126: Gray Iron Castings for Valves, Flanges and Pipe Fittings
6. A183: Carbon Steel Track Bolts and Nuts
7. A194: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
8. A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
9. A518: Corrosion-Resistant High-Silicon Iron Castings
10. A536: Ductile Iron Castings
11. B32: Solder Metal
12. B42: Seamless Copper Pipe, Standard Sizes
13. B88: Seamless Copper Water Tube
14. B306: Copper Drainage Tube (DWV)
15. B584: Copper Alloy Sand Castings for General Applications
16. C564: Rubber Gaskets for Cast Iron Soil Pipe and Fittings
17. D2000: Rubber Products in Automotive Applications
18. D2665: Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
19. F441: Standard Specification for Chlorinated Poly(Vinyl Chloride) (CVPC) Plastic Pipe, Schedules 40 and 80

H. American Water Works Association (AWWA):

1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water
4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. C151: Ductile-Iron Pipe, Centrifugally Cast, for Water

7. C209: Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
8. C500: Metal-Seated Gate Valves for Water Supply Service
9. C509: Resilient-Seated Gate Valves for Water Supply Service
10. C700: Cold-Water meters – Displacement Type, Bronze Main Case
11. C702: Cold-Water meters – Compound Type
12. D100: Welded Steel Tanks for Water Storage

I. American Welding Society (AWS):

1. A5.8: Filler Metals for Brazing and Braze Welding
2. BRH: Brazing Handbook

J. Cast Iron Soil Pipe Institute (CISPI):

1. 301: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
2. 310: Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
3. HSN-85: Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

K. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
2. SP-71: Gray Iron Swing Check Valves, Flanged and Threaded Ends
3. SP-80: Bronze Gate, Globe, Angle and Check Valves
4. SP-110: Ball Valves Threaded, Socket Welding, Solder Joints, Grooved and Flared Ends

L. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components

M. Plumbing and Drainage Institute (PDI):

1. WH 201: Water Hammer Arresters

N. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1. SMACNA Seismic Restraint Unit: Seismic Restraint Manual: Guidelines for Mechanical Systems

O. National Fire Protection Agency (NFPA):

1. NFPA 72: National Electrical Code (NEC)
2. NFPA 820: Standard for Fire Protection in Wastewater Treatment Collection Facilities.

P. Massachusetts Electrical Code (MEC).

Q. Underwriters Laboratories, Inc. (UL):

1. 795: Commercial-Industrial Gas Heating Equipment

R. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance information on location and size of all concrete pads, chases, frames, boxes, pits, sleeves, and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interferences, or for proper execution of specified work.

E. If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer before proceeding.

H. Attend regular coordination and job progress meetings required.

**1.10 - PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

A. Access panels shall be furnished under this Section and installed by the trade responsible for the appropriate Section of the Specifications for the surface upon which the panels are mounted. Prepare a schedule showing location, size and function of all required access panels and deliver schedule to representatives of all installing trades.

B. Prefabricated flashing for plumbing vents, and roof drains shall be furnished under this Section and installed under SECTION 07005, ROOFING AND FLASHING FILED SUB-BID.

C. Inserts and anchor bolts shall be furnished under this Section and installed under SECTION 03300, CAST-IN-PLACE CONCRETE. Prepare a schedule showing location, size and function of all required inserts and anchor bolts and deliver schedule to representative of the installing trade.

D. For new construction, pipe sleeves shall be furnished under this Section and installed by the trade whose finished interior surfaces will be penetrated. Prepare a schedule showing location, size and function of all required pipe sleeves and deliver schedule to representatives of all installing trades. For existing construction, pipe sleeves shall be furnished and installed under this Section.

**1.11 - PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION – Not Used**

**1.12 - ELECTRICAL WORK**

A. All power including wiring, conduit and connections to motors will be furnished and installed by Division 16. Motor starters indicated or specified to be factory-furnished shall be factory wired as an integral part of packaged plumbing equipment. Motor starters that are not integral with the plumbing equipment served will be furnished, mounted and wired by Division 16. Safety disconnect switches will be furnished, mounted and wired by Division 16.

B. All control devices as well as wiring, conduit and connections between control devices and plumbing equipment shall be furnished, mounted and wired by Division 15. Control wiring shall be 120 VAC or less.

C. All equipment furnished under this Section requiring motors shall have motors factory furnished and installed by the manufacturer of the equipment served and shall be mounted and aligned so as to run free and true. Provide motors and all associated internal wiring for plumbing equipment as an integral part of the equipment. Motor starters and contactors shall be factory-furnished and wired as an integral part of packaged plumbing equipment where indicated on the Drawings.

D. Motor starters shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Coordinate same with Division 16.

E. Provide wiring in conduit as specified in Division 16.

**1.13 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes, including but not limited to, the Massachusetts Plumbing Code, Massachusetts Building Code, and Massachusetts Fire Safety Code.
2. Massachusetts Department of of Public Health
3. Massachusetts Department of Environemental Protection
4. Local Fire Department
5. Local Water and Sewer Authority or Department
6. Occupational Safety and Health Authority (OSHA)
7. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and acceptance, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**1.14 - RECORD DRAWINGS**

A. Prepare and maintain record drawings in accordance with SECTION 01346, AS-BUILT DRAWINGS and as specified herein.

B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of record drawings at the job site at all times. On a daily basis, record work completed and all changes from original contract drawings clearly and accurately, including work installed as a modification or addition to the original design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.

C. Record drawings shall show as-built condition of pipe routing and sizes, valve locations, details, control changes and corrections to equipment schedules. Schedules shall show actual manufacturer and make and model numbers of installed equipment. Remove all superseded data to show the completed work. Accurately indicate the location, size, type, and elevation of new buried piping and their relationship to existing buried piping.

D. The record drawings will be used as a guide for determining the progress of the Work installed. They shall be inspected on a regular basis and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be acted upon until the record drawings are accurate and up-to-date.

E. At completion of Work prepare a complete set of CAD-drafted record drawings on bond paper showing all systems as actually installed. The Contract Drawing electronic CAD files will be made available for the Plumbing Subcontractor’s use to serve as backgrounds for the record drawings. Provide all drawings necessary to show the required record information. Submit CAD-drafted prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer. Submit final accepted Record Drawing electronic files in PDF format.

F. Certify the accuracy of the record drawings. Record drawings shall become the property of the Owner.

G. When required by jurisdiction, submit the record set for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

**1.15 - AMERICAN IRON AND STEEL ACT**

A. This Contract is subject to PL-113-76 the Consolidated Appropriations Act, 2014, Section 436 (American Iron and Steel Act), which requires the use of iron and steel products that are wholly manufactured in the United States for inclusion in the Work. It is understood that any iron and steel used on this project are to be produced in the United States, and produced in a manner which complies with the American Iron and Steel Requirement. Any melting, bending, coating, galvanizing, cutting, etc. process for manufacturing or fabrication will be in full compliance with the American Iron and Steel as mandated in the Environmental Protection Agency's State Revolving Fund Programs.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Branch piping to appliances or equipment shall be at least as large as the inlets thereof.

B. Where applicable, all products requiring approval by the Massachusetts Department of Public Safety shall be so approved. Where product types are available with Energy Star and/or Water Sense labeling, they shall be provided.

C. All potable water piping components shall comply with NSF 61.

D. Provide electrical equipment rated in accordance with the Area Classification Schedule on the Contract electrical drawing 00 E-603.

**2.02 - DRAIN, WASTE AND VENT (DWV) PIPING**

A. Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum piping size shall be 2-inch for buried piping and 1 1/2-inch for aboveground piping.

B. Buried Piping:

1. Cast-Iron Hub and Spigot Pipe and Fittings:

a. CISPI 301 with CISPI HSN-85 rubber compression gasket joints, service weight.

C. Aboveground Piping:

1. Cast-Iron Hubless Pipe and Fittings for Piping 1 1/2-inch and Larger:

a. CISPI 301, with CISPI 310 couplings composed of rubber sleeves and corrugated stainless steel bands and tightening devices.

2. Galvanized Steel Pipe (for Equipment Drainage Only):

a. ASTM A53, hot-dipped galvanized steel pipe, Schedule 40 with ASME B16.12 galvanized cast iron threaded drainage fittings.

3. Sump Pump Discharge:

a. For sizes 4-inch and larger aboveground: hot dipped galvanized steel pipe, Schedule 40, mechanical grooved (where acceptable by local codes) or flanged ends, with ASME B16.1 galvanized cast iron flanged fittings.

b. For sizes 2 1/2 to 3-inch aboveground: ASTM A53, hot dipped galvanized steel pipe, Schedule 40, with ASME B16.3 Class 150 threaded galvanized malleable iron fittings.

c. For sizes 2-inch and smaller aboveground: ASTM B88, Type L, hard drawn copper tubing with ASME B16.18 or ASME B16.22 solder joint fittings. Provide ASTM B42 copper pipe nipples with threaded end connections. Provide ASTM B32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

D. Flanges:

1. ASME B16.1, Class 125, for use in ferrous piping, with full face flat type synthetic rubber gaskets.

2. Flange Accessories:

a. Gaskets: Provide one piece, factory cut, 1/16-inch thick, gaskets resistant to the effects of fuel oil and manufactured of fire-resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

b. Bolting: Material for bolts and studs ASTM A307, Grade-B and for nuts ASTM A194/A194M, Grade-2. Dimensions of bolts, studs and nuts ASME B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type.

E. Cleanouts:

1. ASME A112.36.2M; provide threaded bronze cleanout plugs.

2. Floor Cleanouts:

a. Provide coated cast-iron or ductile-iron floor cleanout with anchor flange; threaded outlet; adjustable height polished bronze, nickel bronze, stainless steel, or chromium-plated copper alloy top and scoriated floor plate; and countersunk screws for installing floor plate flush with finished floor.

3. Wall Cleanouts:

a. Provide threaded bronze cleanout plugs and polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

F. Drains:

1. ASME A112.21.1M unless otherwise specified; coated cast-iron or ductile-iron drains with membrane clamp rings for use with membrane waterproofing.

2. Floor Drains:

a. Cast iron or ductile iron body with acid-resisting epoxy coating, double drainage flange with weep holes, non-puncturing flashing collar, 3/4-inch trap primer connection, and bottom outlet. Provide sediment traps where indicated.

b. Finished Spaces: Floor drains shall have threaded adjustable round top with nickel bronze strainer.

c. Unfinished Spaces: Floor drains shall have round top with heavy duty loose set slotted grate.

d. Provide deep seal P-traps for each floor drain.

3. Floor Drains with Funnel:

a. Provide as specified for floor drains above except furnished with 4-inch diameter round cast iron funnel for attachment to any flat grate by securing screws.

4. Shower Floor Drains:

a. Provide as specified for floor drains above without trap primer connection, except that finish shall be polished stainless steel or chromium-plated copper alloy. Shower drains shall be 2-inch size.

5. Trench Drains:

   a. Modular type system designed for placement in cast concrete floors, width and length as indicated. Channel sections shall be made of HDPE with interlocking ends and curved bottom. Channels shall be provided with 1 percent built-in slope. Minimum invert shall be 6 inches. Channel system shall have provisions for positioning and anchoring in concrete slab. System shall include acid resistant coated or stainless steel frame to distribute weight between grate and channel.

   b. Outlets shall be no-hub end or bottom outlet type, size as indicated.

   c. Grates shall be ductile iron with slotted or bar type pattern. Grates shall be Class E rated.

   d. Provide joint connectors.

6. Roof Drains:

   a. ASME A112.21.2M; Hot-dip galvanized cast-iron or ductile-iron drains, with minimum 10-inch, non-puncturing flashing clamp device with integral gravel stop and deck clamp, and removable cast-iron or ductile-iron locking dome. Coordinate with installing trade to install drain and trench drain flashing ring seat flush with adjacent roof deck, and secure rigidly in place with deck clamp.

   b. Downspout nozzles shall be cast bronze units with loose wall flange and no-hub inlet connection.

7. Trap Seal Flapper Valves:

   a. ASSE 1072, barrier type floor drain trap seal protection device designed to admit water entering floor drain and prevent sewer gas from exiting floor drain. Provide flapper valve at each floor drain and trench drain not equipped with an automatic trap primer device.

G. Backwater Valves:

1. Ball float type, cast iron body with corrosion resistant coating, plastic ball float with copper alloy bushing and replaceable neoprene seat, no-hub inlet by no-hub outlet.

**2.03 - SPECIAL WASTE AND VENT SYSTEMS**

A. Buried Pipe and Fittings:

1. Polyvinylidene (PVDF) or polypropylene (PE), Schedule 40 with electro-fusion joints.

B. Aboveground Pipe and Fittings:

1. Polyvinylidene (PVDF) or polypropylene (PE), Schedule 40, with electro-fusion joints, stainless steel mechanical joint clamps, or flanged joints.

C. Buried and aboveground piping shall be of the same material. Piping directly connected to the acid neutralization tank shall be provided with mechanical joints (clamp or flange) to facilitate removal of tank. Mechanical joint gasketing material shall be corrosion resistant against the waste carried and be compatible with the piping material. Aboveground piping shall be flame retardant.

D. Acid Neutralization Tanks:

1. Tanks shall be cylindrical high density polypropylene or polyethylene of capacity indicated with inlet, outlet and side vent of sized indicated. Tank shall have bolted down top access non-load bearing cover. Bolting hardware shall be stainless steel and gaskets shall be neoprene. Tank shall have fiberglass reinforced plastic (FRP) wrap for added strength to permit direct burial of the tank.

2. Provide FRP wrapped cylindrical high density polypropylene or polyethylene tank extension of length to suit depth of inlet/outlet pipes.

3. Provide a minimum of one initial fill of marble or limestone chips and two future fills.

E. Condensate Acid Neutralizing Tubes:

1. Provide condensate acid neutralizing tubes for high efficiency condensing type gas-fired domestic water heaters. Neutralizing tubes shall be constructed of PVC tubing complete with nylon barbed fitting connections, and floor mounting hardware. Size neutralizing tubes per manufacturer's recommendations. Provide a minimum of one initial fill of marble or limestone chips and two future fills. Condensate drain system shall be installed in strict accordance with condensate acidic neutralizing tube manufacturer instructions and local code. Neutralizing tubes shall be JJM Boiler Works Model JM or acceptable equivalent product.

**2.04 - TRAP PRIMER PIPING**

A. Buried and/or Embedded Piping:

1. ASTM F876/877, NSF 14 and 61, cross-linked polyethylene (PEX) tubing, minimum 150 psig and minimum75 degrees F rated for upper temperature limit, compression fitting or mechanical insert fitting joints.

2. Provide trap primer piping with no joints except at floor drain connection.

B. Aboveground Piping:

1. ASTM B88, Type L, hard drawn copper tubing with ASME B16.18 or ASME16.22 solder joint fittings. Provide ASTM B32, 95-5 tin-antimony solder.

**2.05 - DOMESTIC WATER PIPING AND SERVICE WATER PIPING**

A. Buried Piping:

1. Copper Tubing for Piping 2-inch and Smaller:

a. ASTM B88, Type K, soft annealed copper tubing with ASME B16.50 brazed joint fittings. Provide minimum number of joints in buried copper tubing.

(1) Joints shall be brazed. Brazing filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2. Copper Tubing for Piping 2 1/2 to 3-inch:

a. ASTM B88, Type K, hard drawn copper tubing with ASME B16.50 braze joint fittings. Provide minimum number of joints in buried copper tubing.

(1) Joints shall be brazed. Brazing filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

3. Ductile-Iron Piping for piping 4-inch and Larger:

a. AWWA C151 ductile-iron pipe, outside coated, AWWA C104 cement mortar lined, AWWA C111 rubber gasket joints, and AWWA C110 fittings. Provide concrete thrust blocks at the elbow where the buried piping turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Aboveground piping shall have flanged end connections conforming to AWWA C115 for flanged pipe and AWWA C110 for flanged fittings.

B. Aboveground Piping:

1. Copper Tubing:

a. ASTM B88, Type L, hard drawn copper tubing with ASME B16.18 or ASME B16.22 solder joint fittings. Provide ASTM B42 copper pipe nipples with threaded end connections. Provide ASTM B32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

C. Flanges:

1. ASME B16.22 or ASME B16.24 for use in copper tubing.

2. Flange Accessories:

   a. Gaskets: Provide one piece, factory cut, 1/16-inch thick, synthetic rubber gaskets suitable for use with potable water. Gaskets shall be rated for 32 to 180 degrees F service temperature. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

   b. Bolting: Material for bolts and studs ASTM A307, Grade-B and for nuts ASTM A194/A194M, Grade-2. Dimensions of bolts, studs and nuts ASME B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

D. Valves:

1. Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F water. Valves shall have flanged end connections, except sizes smaller than 2 1/2-inch may have threaded end connections with a union on all but one side of the valve, or solder end connections for connections between bronze valves and copper tubing. Ball valves may be provided in lieu of gate valves.

2. Gate Valves (3-inch and Smaller):

   a. MSS SP-80, Class 125 or 150, bronze valves.

3. Gate Valves (4-inch and Larger):

   a. AWWA C500 or AWWA C509. Unless otherwise specified, valves conforming to:

      (1) AWWA C500 shall be rising-stem type with solid-wedge gates and flanged ends.

      (2) AWWA C509 shall be rising-stem type with flanged ends.

4. Check Valves (3-inch and Smaller):

   a. MSS SP-80, Class 125 or 150, bronze swing check valve.

5. Check Valves (4-inch and Larger):

   a. MSS SP-71, Class 125, iron body swing check valve.

6. Ball Valves (3-inch and Smaller):

   a. MSS SP-110, full port or standard port design, copper alloy. Valves shall have lever handles, chrome plated steel ball, and PTFE seats and seals.

7. Safety Relief Valves:

   a. Combination Pressure and Temperature Relief Valves: ANSI Z21.22 and copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating.

   b. Pressure Relief Valves: ANSI Z21.22, copper alloy body, automatic reseating with test lever.

8. Vacuum Relief Valve (for Water Heater):

   a. ANSI Z21.22 copper alloy body with an integral protective cover, 15 psig WSP. Valve may be vertical or horizontal mounting type.

9. Trap Primer Valves:

   a. ASSE 1018 automatic trap primers; all bronze body with integral vacuum breaker, non-liming internal operating assembly, and gasketed bronze cover; plain finish.

10. Mixing Valves:

    a. General: Factory assembled and tested, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an acceptable type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Valves shall have 125 psig minimum rated inlet pressure.

    b. Emergency Eyewash/Shower Mixing Valves: ANSI Z358.1. Mixing valve shall control and maintain the temperature of the tempered water to plus/minus 3 degrees F. Unit shall be self-contained and include a thermostatic water mixing valve with adjustable high temperature limit stop factory set for 90 degrees F union angle checkstops on the inlets, top or bottom inlets and top outlet, bypass inlet, wall mounting bracket, and all piping and fittings for a complete unit. Unit shall be able to be set to the correct temperature for the specific contaminant but locked in place to prevent changing of the temperature by accident; unit shall be factory set for 85 degrees F outlet temperature. Unit shall be able to flow a minimum of 20 gpm at 30 psig. Unit shall close down upon failure of cold water supply and include cold water bypass capable of 20 gpm at 30 psig upon failure of hot water supply. Unit shall have temperature override protection via a redundant thermostatic control vale on the outlet that opens on temperature rise above 90 degrees F to introduce cold water and maintain tepid flow. Valves shall have rough bronze finish.

        (1) Valves shall have rough bronze finish without plating and a dial thermometer on the outlet, and shall be mounted in a exposed stainless steel cabinet.

    c. All Other Mixing Valves: ASSE 1017; adjustable high temperature limit stop factory set for 120 degrees F. Mixing valves shall maintain water temperature within 5 degrees F of any setting. Unit shall be able to pass a minimum of 0.5 gpm at 30 psig. Valves shall have integral wall support and cast lever handle.

        (1) Valves shall have rough bronze finish without plating.

11. Water Pressure Reducing Valves:

    a. ASSE 1003; non-sticking rolling diaphragm design; bronze body, replaceable stainless steel seat and elastomer disc, union connection, and integral stainless steel strainer; pressure gauge tapping; minimum 35 to 150 degree F operating temperature, 150 psi minimum rated inlet pressure, 25 to 75 psig adjustable outlet pressure. Parts shall be serviceable without removing the valve from the line.

E. Water Meters:

1. General: NSF 61 certified, conforming to requirements of local water authority, minimum 150 psig rated operating pressure and 35 to 100 degree F operating temperature, with registration measuring in gallons or cubic feet as required by the local water authority. Meter cases shall be no-lead copper alloy. Meter cases constructed of plastic shall not be accepted. Provide direct reading register at each meter. Register boxes and register box lids shall be bronze or an approved plastic material. Meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline. The manufacturer, model, and serial number shall be marked permanently on both meter casings and registers. Size and direction of flow through the meter shall be marked permanently on all meters. Provide strainer integral with meter or separate plate type strainer. Provide remote reading registration.

2. Meters: AWWA C702, compound meters consisting of a combination of a main-line meter of the turbine type for measuring high rates of flow and a disc type meter for measuring low rates of flow. Turbine meter shall be in-line, horizontal-axis, high-velocity type with AWWA Class II turbine measuring element. Disc meter shall be positive displacement type with nutating disc and magnetic drive. No oscillating-piston style meters will be accepted. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter. Both metering devices with sealed registers shall be contained in the same case.

3. Registers: Registers shall provide at least six-digit visual registration. The measuring units shall be printed on the face of the register. The register shall have a full test sweep hand or dial. All registers shall be removable without disassembly of the meter or depressurizing the service line. The register shall be free of openings to protect the internal electronics of the register. Lens covers shall be made of polycarbonate or other suitable engineering polymer for indoor installations and mineral glass for underground pit installations.

4. Plate Strainers: AWWA C702. All strainers provided shall have top access without blow down ports. Cases shall be bronze. Strainer plates shall be 18-8 stainless steel or bronze.

F. Strainers:

1. Strainers shall be wye type and have blow off outlet with pipe nipple and gate valve or ball valve with discharge pipe nipple. Copper alloy body. Provide stainless steel strainer element with 30 mesh perforations.

G. Pressure Gauges:

1. Pressure gauges shall be ASME B40.1, food grade glycerin-filled, 1 percent accuracy or better, minimum 2 1/2-inch dial.

2. Gauges shall have bronze bourdon tube and steel or brass case.

3. Gauge dial gradations shall read in “PSIG” and shall be such that the normal operating pressure of the system installed shall be indicated in middle 1/3 of the scale range.

4. Provide snubbers and ball valve shutoffs.

H. Thermometers:

1. Bi-metal dial type thermometers with stainless steel case, stem, and fixed thread connection; minimum 3-inch diameter dial with glass face gasketed within the case; accuracy within 2 percent of scale range. Dial gradation reading in "Degrees Fahrenheit" shall be such that the normal operating temperature is in middle 1/3 of scale range.

I. Dielectric Couplings:

1. Provide dielectric unions or flanges in all copper to ferrous transitions. Couplings shall have minimum 500 volts dielectric resistance. Couplings shall be rated for minimum 180 degrees F and 175 psig. ASTM F441, Schedule 80, CPVC threaded pipe nipples, 4-inch minimum length, may be provided for dielectric connections in pipe sizes 2-inch and smaller.

J. Water Hammer Arresters:

1. PDI WH 201, hydropneumatic cushion with stainless steel bellows.

K. Backflow Preventers:

1. Provide reduced pressure principle backflow preventer with OS&Y gate or ball valve on both ends and inlet strainer. Backflow preventers shall have replaceable seats and discs, bronze body or cast iron body with internal polymer coating, rated for minimum 35 to 150 degrees F and 175 psig. Reduced pressure principle backflow preventers shall be tested and certified under ASSE 1013 and be provided with test cocks and drainage air gap fitting.

L. Expansion Tanks:

1. NSF 61 diaphragm type expansion tanks designed for use in potable water systems; butyl diaphragm, polypropylene liner, welded steel shell; constructed, tested hydrostatically and certified in accordance with ASME BPVC SEC VIII D1. Tank shall be equipped with all necessary fittings including stainless steel system connection and welded air charge fitting with plastic cap. Tank and fittings shall have 125 psig minimum working pressure and 180 degrees F minimum operating temperature.

2. Tanks shall be factory pre-charged and field-adjusted to match incoming water pressure.

M. Hose:

1. Kink-resistant reinforced rubber hose, corrosion resistant metal couplings, size and length as indicated.

N. Electric Trap Primer:

1. Trap primer valve, air gap device and control all housed in moisture proof enclosure complete with UL listed electrical assembly consisting of circuit breaker, test switch, timer, and solenoid valve designed to operate on 115 VAC, single phase power. Unit shall be rated for minimum range of 32 to 120 degrees F and 20 to 125 psig minimum 2 ounces water at 20 psig per trap served. Inlet and outlet piping connections shall be 1/2-inch NPT.

2. Provide distribution unit to serve up to four (4) traps where required.

**2.06 - PIPE HANGERS AND SUPPORTS**

A. Provide MSS SP-58, Type 1 or Type 7 as indicated with adjustable type steel support rods.

B. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and flat washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

C. Provide Type 40 insulation protection shields for insulated piping.

D. Hangers, supports, insulation shields, rods and fasteners shall be hot-dipped galvanized steel, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Hangers and supports in contact with bare copper tubing shall be copper-plated or PVC coated.

**2.07 - SUPPLEMENTARY STEEL AND CHANNELS**

A. Unless otherwise indicated on the Structural Drawings, provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment and systems provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. Unless otherwise specified herein, all supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be hot dipped galvanized after fabrication. Unless otherwise specified herein, all channels shall be hot dipped galvanized. Supplementary steel and channels shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

**2.08 - PIPE SLEEVES AND PREFABRICATED FLASHING**

A. Sleeves in Masonry and Concrete Walls, Floors, and Flat Roofs: Service weight cast iron or standard class ductile iron pipe, except shall be schedule 40 series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Where sleeves are cast into new concrete, sleeves shall be ASTM A 53, Schedule 40 or Standard Weight steel pipe, have 2-inch high annular ring water stop continuously welded all around the pipe sleeve, and be hot-dipped galvanized after fabrication, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

B. Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs: Hot-dip galvanized steel sheet, minimum 26 gage thickness, except shall be Series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

C. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and Series 300 stainless steel hardware.

D. Prefabricated flashing for sloped shingled roofing shall be manufactured from EPDM rubber or silicone with square or round flexible aluminum base. Design shall form watertight, weatherproof seal around pipe and allow flashing to adjust to any roof pitch. Flashing shall be marked to allow accurate trimming for required pipe size.

**2.09 - PIPE ESCUTCHEONS**

A. General: Provide pipe escutcheons at all pipe penetrations where penetration is exposed to view as specified herein with inside diameter closely fitting pipe outside diameter. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, wall, or ceilings; and pipe sleeve extension, if any. Escutcheons shall be held in place by internal spring tension or set screws.

B. Provide pipe escutcheons in finished spaces. Pipe escutcheons shall be of stainless steel, anodized aluminum or chrome-plated brass, solid or split hinged.

**2.10 - DRIP PANS**

A. Examine all Drawings and in cooperation with the Electrical Trade confirm the final location of all new electrical equipment to be installed in the vicinity of new and existing piping. All overhead piping containing liquid or vapor shall be no closer than 3 feet from a vertical line to electrical equipment including, but not limited to, electric motors, controllers, switchboards, panelboards, and similar equipment. Piping is not permitted in Electrical Rooms and stairwells.

B. Where the installation of new and existing plumbing systems piping does not comply with the requirements of the foregoing paragraph, where feasible the piping shall be relocated. Where not feasible, provide drip pans as specified below, except as otherwise indicated on the Drawings.

C. Provide drip pans fabricated from 14 gauge steel sheet and with edges turned up 2-1/2-inches. Reinforce top edge, either by structural angles or by rolling top over 1/4-inch rod made of same material as drip pan sheet metal. Provide hole and 1-inch threaded half coupling for low point drain. Provide hanging brackets of sufficient quantity made of same material as drip pan sheet metal for connecting threaded rods used for suspended drip pans. All joints shall be welded watertight and entire and welded assembly sandblasted, degreased and hot dipped galvanized after fabrication.

D. Locate drip pans under piping passing over or within 3 feet horizontally of material and equipment defined above, and elsewhere as indicated. Hang from structure with rods and building attachments, fasten rods to brackets on sides of drip pan. Carefully pitch to the drip pan low point for drainage. Brace to prevent sagging or swaying. Drip pans shall be installed within 12 inches below piping.

E. Provide 1-inch schedule 40 PVC drain line from each drip pan and terminate 6 inches above the floor at nearest floor drain.

**2.11 - ACCESS PANELS**

A. Access panels shall give access to each valve and cleanout in concealed parts of the system. Access panels shall be located where indicated, or where otherwise require accessibility for the proper inspection, operation and maintenance of the system.

B. Access panels shall be Milcor Type M, 16-inch by 16-inch minimum, as manufactured by Inryco, Inc., or equal. Door shall be constructed of 18 gage galvanized steel with frame constructed of 16 gage galvanized steel. Casing bead shall be galvanized steel. Hinges shall be steel concealed spring type with steel pin. Locks shall be flush, screwdriver operated, with metal cam. Prime coat shall be factory applied rust-inhibitive paint.

**2.12 - PLUMBING FIXTURES**

A. See Contract Plumbing Drawings.

**2.13 - DOMESTIC WATER HEATERS (GAS-FIRED SEALED COMBUSTION/DIRECT VENT)**

A. Domestic water heaters shall be UL listed, NSF certified, natural gas-fired of sealed combustion/direct vent design, minimum 94 percent thermal efficiency condensing type, and certified for 150 psig maximum working pressure. Water heaters shall have low NOx emissions and designed for zero clearance to all combustible surfaces.

B. Domestic water heaters shall be constructed of series 300 stainless steel requiring no anode rods. The primary condensing heat exchanger shall be constructed of 90/10 cupronickel or stainless steel. Tank insulation shall be ASHRAE 90.1 compliant and jacketed. All components shall be located in the front of the water heater and accessible through a removable cover. All related hardware shall be constructed of corrosion resistant studs and nuts.

C. The control panel shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of water temperature, set point and differential. Temperature set point minimum range shall be from 100 to 160 degrees F.

D. Each water heater shall be supplied with a AGA/ASME rated combination pressure/temperature safety relief valve sized per the domestic water heater manufacturer's recommendations.

E. Combustion system shall be complete with control board, control well and electric cut-out (ECO), transformer, gas burner, gas valve, hot surface ignitor, flame probe, combustion blower, vent over-temperature sensor, reset switch, and pressure switch.

F. All related intake air and exhaust gas piping shall be acceptable for zero clearance to any combustible surface. Intake air, exhaust gas, and condensate drain piping shall be installed in strict accordance with domestic water heater manufacturer instructions and local code.

**2.14 - ELECTRIC WATER HEATERS**

A. Provide tappings for hot and cold water, pressure temperature relief, and drain. All units shall be factory wired.

B. UL listed electric water heaters with heat input, recovery, storage capacity, and power characteristics as indicated, removable low watt density heating elements with titanium sheath and high temperature cut-off switch with manual reset, 150 psig rated working pressure lightweight composite tank (anodes not required), foam-insulated with standby heat loss conforming to ASHRAE 90.1, high density polyethylene jacket, adjustable range thermostat for each heating element to allow hot water settings between 110 and 160 degrees F minimum.

**2.15 - WATER PUMPS**

A. Provide centrifugal pumps, of capacities types and configurations shown on schedules. Pumps shall meet the requirements of this Section and the performance requirements shown on the schedules (with equal or less horsepower requirement than the pump shown on the schedules).

B. Pumps shall be designed specifically for intended classes of service, with non-overloading characteristics throughout the design curve. Motors shall not operate in their service factor. Impeller shall be statically and dynamically balanced. Impeller size shall be no more than 90 percent of casing size.

C. Each pump casing shall be designed to withstand the discharge head plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pumps shall be rated for continuous operation between 35 and 225 degrees F. Pumps shall be factory tested at operating conditions, thoroughly cleaned, and painted prior to shipment. Installation instructions shall be included with pump at time of shipment.

D. Bearing frame and pump internals shall be serviceable without disturbing motor or connected piping. Provide plugged tappings for pressure gauges at inlet and discharge nozzles of pumps. Provide plugged tappings for vent and drain ports in volute.

E. Bearings shall be ball-bearings or roller-bearings.

F. Seals shall be mechanical type. Seals shall be designed for continuous operation to 225 degrees F.

G. Motors shall be open drip-proof enclosure of horsepower, voltage and phase indicated, with heavy-duty grease lubricated ball bearings.

H. Pump and motor shall be factory aligned, and shall be realigned after installation, prior to start-up.

I. In-Line Centrifugal Pumps:

1. In-line pumps shall be close coupled direct driven and have all-bronze construction, including bronze casings, alloy steel shafts with copper alloy shaft sleeves, and bronze impellers. Impeller shall be statically and dynamically balanced. Bearings shall be either sleeve type or sealed ball bearings. Shaft seals shall be mechanical seals. Provide casing wear rings, drain and vent connections with threaded plugs, suction and discharge pressure gage tappings with threaded plugs, and flexible coupling or direct drive connection between pump and motor. If the scheduled pump includes ball bearings and a direct drive motor to impeller connection, the submitted pump shall not have sleeve bearings or a flexible coupling between pump and motor.

J. Wet Rotor Pumps:

1. Pumps shall be single stage. Pumps shall have cast iron casing, ceramic shaft, carbon bearings, EPDM O-rings and gaskets, and non-metallic impellers. Pumps shall have replaceable bronze cartridge containing all moving parts of the pump. Pumps shall be self-lubricating with no mechanical seal. Pumps shall have thermally protected permanent split capacitor motor and stator housing. Provide anti-condensate baffle with ambient air flow to protect motor windings against condensate buildup.

K. Flexible Connectors:

1. Provide flexible connectors at pumps. All connectors shall be installed on the equipment side of shutoff valves, horizontal and parallel to shafts whenever possible. Connectors shall be manufactured of nylon tire cord and EPDM rated at 250 psig/170 degrees F, dropping in a straight line to 170 psig/250 degrees F for sizes 1 1/2 to 12-inch. Neoprene in lieu of EPDM shall not be acceptable. Straight connectors to have two (2) spheres reinforced with a molded-in, external ductile iron ring between the spheres.

2. Connectors shall be pre-extended per manufacturer's recommendation to prevent elongation under pressure. Connectors bolted to gate, butterfly of check valves to have a minimum 5/8-inch flange spacer installed between the connector and the coupling flange. Minimum safety factor of 3.6 at a maximum pressure rating shall be certified by test reports.

3. Connectors shall be Mason Ind. Super-Flex type MFTNC or NFTFU, or acceptable equivalent product.

**2.16 - SUMP PUMPS (SUBMERSIBLE TYPE)**

A. UL/CSA listed, factory assembled and tested submersible type pumps for operation under water up to maximum 120 degrees F or higher and capable of passing minimum 3/4-inch spherical solids. Pump shall be complete with cast-iron casing with corrosion resistant finish, cast iron or bronze impeller, stainless steel shaft, carbon/ceramic mechanical seals, sealed heavy-duty ball bearings, water-cooled hermetically-sealed motor, built-in automatic reset thermal protection, stainless steel lift handle, and waterproof three-conductor cables and grounded plugs. Pumps shall have single or double seal design as indicated.

B. Provide adjustable/variable level float switches complete with waterproof three-conductor cable and grounded plug. Plug shall be designed for piggybacking into pump grounded plug. Float shall have plastic encased variable level switch designed for use in minimum 18-inch diameter sump. Variable level control switch shall be normally open when hanging down vertically above sump liquid level, and close when it reaches a few degrees above the horizontal position.

C. Select the pump so that the operating point is in the middle one half of the characteristic performance curve for the pump to be furnished.

D. Provide equipment rated in accordance with the Area Classification schedule on the Contract Electrical Drawings.

E. Sump Pump Control Panel:

1. Provide a UL listed Sump Pump Control Panel rated for a single 480VAC/3 phase/60 Hz power connection with integral step down transformers as required. The Sump Pump Control Panel shall provide 480VAC power for both pumps.

2. Provide motor starters for the sump pumps integral to the control panel.

3. Provide dedicated Hand/Off/Auto selector switches for each pump.

4. All switches, buttons, and lights to be LEDs. Provide dry contacts for remote indication and LED indicating lights for the following:
    a. Pump Running – Green (typical of 2)
    b. Pump Off – Red (typical of 2)
    c. Pump Fault – Amber (typical of 2)
    d. General Fault - Amber
    e. Level Alarm High – Amber
5. All wires inside the panel to land at terminal blocks. Wiring directly between devices is not acceptable. Use one side of the terminal block for local terminations and the other for remote. All wires to be tagged at each end and shall match the shop drawings.
6. Provide device power from the Sump Pump Control Panel for all instruments and equipment associated the sump system.
7. Provide panel complete with high water alarm light, high water alarm horn with alarm test and horn silence switch, 115 VAC auxiliary dry high level alarm contacts, general fault contacts, and NEMA 4X thermoplastic enclosure.

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Plumbing Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

### 3.02 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

### 3.03 - MANUFACTURERS INSTRUCTIONS

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project.

### 3.04 - INSTALLATION

A. Installation, workmanship, inspection, and testing shall be in accordance with the specified Plumbing Code, Energy Conservation Code, and Building Code with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other acceptable methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration. Plastic DWV piping shall not be permitted in more than two-story buildings. Cast-iron DWV piping only shall be provided in more than two-story buildings. Copper tube extracted joints shall not be permitted.

B. Piping shall not be permitted in Electrical Rooms and stairwells.

C. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Install aboveground pressurized piping to permit draining of all sections of each piping systems without traps. Pitch piping back to system low points. Provide drain valves at all piping low points.

E. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment and structure.

F. Piping, General: Determine and establish measurements for piping at job site. Cut pipe to actual dimensions and assemble to prevent residual stress. Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted. Within buildings, run piping parallel to structure lines and conceal in finished spaces.

G. Buried Piping:

1. Pipe bedding and compacted backfill to a point 12 inches above crown of buried pipe shall be provided under this Section of the Specifications in accordance with the requirements of SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2. Pipe bedding shall be 6 inches deep. Bedding and compacted backfill shall be non-corrosive material such as cleaned washed sand, and contain no stones, metal, rubbish of any kind, frozen material, organic matter, or any other material capable of damaging piping or coating, and/or of settling.

3. Where feasible, install buried lines in a single trench. Trenches shall be wide enough to permit at least 6 inches spacing between lines and the sides and floor of the trench.

4. Terminate buried piping not more than 6 inches above finished ground surface or floor slab-on-grade, or from foundation wall inside surface.

5. Make provisions in buried piping for differential settlement.

6. Completely encase buried copper tubing, ductile-iron piping, and cast iron piping with polyethylene tube or sheet in accordance with AWWA C105.

H. Threaded Connections:

1. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil. Do not thread metal pipe into plastic piping.

I. Soldered Connections:

1. Soldering shall be performed in accordance with best soldering practice. Before soldering copper tubing joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Provide suitable flux for use with solder. Surplus soldering material shall be removed at all joints. Piping shall be supported prior to soldering and not be sprung or forced.

2. For solder end valves, remove stems and washers and other items subject to damage by heat during installation. Reassemble valve after soldering is complete. Valves without heat sensitive parts do not require disassembly but shall be fully opened during soldering.

J. Brazed Connections:

1. Brazing of copper tubing joints shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be continuously purged with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Piping shall be supported prior to brazing and not be sprung or forced.

K. Flanged Connections:

1. Flanges shall be faced true, and made square and tight.

L. Valves:

1. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to pipes.

2. Shutoff Valves

a. Provide shut-off valve at connection to each fixture, appliance or equipment and where otherwise indicated.

M. Pipe Hangers and Supports:

1. Selection, application and installation of piping hangers and supports shall conform with MSS SP-58, unless otherwise indicated.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and contraction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers will be 6 inches clear from other piping, hangers, conduits, lighting fixtures, equipment, ceiling suspension systems, ductwork and other obstructions. Where insulation or other covering is provided, minimum clearance shall take into account such covering.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Rod Sizes, MSS SP-58.

6. Piping to Receive Insulation

a. Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under SECTION 15420, PLUMBING INSULATION.

7. Maximum Spacing Between Supports

a. Support piping within one foot on either side of flanged valves, in-line pumps, and changes in direction. Support within 2 feet of wall penetrations.

b. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support plastic and piping at each floor and at midpoint between floors, but at not more than 5 foot intervals. Support within 2 feet of floor and roof penetrations and within 2 feet of offsets and 90 degree turns.

c. Horizontal Piping: Support cast-iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Locate supports within one foot of each change of direction, and within 18 inches of joints for straight runs. Support plastic piping at 4 foot intervals and support plastic piping at each change of direction. Support steel piping and copper tubing as follows:

| Maximum Spacing Feet | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size (inches) | ≤ 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 4 | 5 | 6 | 8 |
| Steel Pipe | 7 | 7 | 9 | 10 | 11 | 12 | 14 | 16 | 17 | 19 |
| Copper Tube | 5 | 7 | 8 | 8 | 9 | 10 | 12 | 13 | 14 | - |

8. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load.

9. Pipe hangers, inserts and supports shall conform to MSS SP-58, except as specified as follows:

   a. Types 5, 12, and 26 shall not be used.

   b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

   c. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

   d. Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.

   e. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

   f. Type 35 guides using steel, reinforced PTFE or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions and bearing loads encountered. Where steel slides do not require provision for restraint or lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate. Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

   g. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

N. Seismic Bracing Requirements:

1. Piping and equipment shall be supported and braced to resist seismic loads and the seismic restraints shall be designed in accordance with the SMACNA Seismic Restraint Unit.

2. Conform to the seismic design requirements of the specified Building Code. Site seismic criteria can be found on Drawing 00 S-001 of the contract drawings.

O. Pipe Through-Penetrations:

1. Provide pipe sleeves where pipe passes through walls, floors, ceiling, roofs, and partitions. In new construction, sleeves will be installed, secured in proper position and location during construction by the trade whose element will be penetrated. Such trades include concrete, masonry, drywll and/or plaster in the case of framed construction. In existing construction, pipe sleeves shall be furnished and installed under this Section. Core drilled holes in masonry and concrete may be provided by this Section in lieu of pipe sleeves, however cored drilled holes in masonry shall have cavities completely grouted smooth under this Section. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors and roofs.

2. Pipe Penetrations Through Building Exterior Construction: Provide a mechanically adjustable segmented elastomeric seal, with sleeve sized as recommended by seal manufacturer.

3. Pipe Penetrations Through Building Interior Construction: Provide not less than 1½-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with rock wool insulation.

   a. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone.

   b. For fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with UL listed fill, void, or cavity material to maintain fire resistive integrity. Install firestopping assembly in accordance with UL FRD systems, and as recommended by manufacturer. Completely fill voids flush with the surface. Firestopping for filling voids in floors in which smallest dimension of a void is 4 inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed firestoppings shall be replaced with new firestoppings as specified in this Section.

4. Extend sleeves in floor slabs 2 inches above the finished floor, except sleeves are not required where drain, waste and vent piping passes through concrete floor slabs located on grade. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

5. Seismic-braced pipe

   a. Proper clearances between penetrating gas system piping and any barrier shall be provided. The penetration holes shall be sized such that the hole diameter is 2 inches larger for pipe diameters 1-inch nominal to 3-inch nominal, and 4 inches larger for 4-inch and larger nominal diameter pipe.

   b. All open space around seismically braced through-penetrations shall be protected by a Listed, flexible through-penetration seal system.

P. Cross Connection and Interconnections:

1. No equipment, devices or piping shall be installed which will provide a cross or interconnection between a domestic water supply and a drainage, soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the domestic water supply system.

**3.05 - FIELD QUALITY CONTROL**

A. After system installation has been completed and prior to initial operation, inspect piping and control wiring systems for compliance with Drawings, Specifications, and accepted submittals. Perform flushing and tests in compliance with the specified Plumbing Code with the additions specified herein. Have piping accepted by the Engineer before insulating or otherwise concealing.

B. Test Procedures and Reports:

1. Test each new system to demonstrate compliance with the contract requirements. Tests shall be witnessed by the Engineer. Correct defects in the Work and repeat tests until Work is in compliance with contract requirements.

2. Prepare and submit procedures for all specified tests to the Engineer for acceptance prior to the planned preliminary tests. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case.

3. Material and equipment used in testing shall be subject to inspection by the Engineer. Provide water, electricity, instruments, appliances, equipment, connecting devices, and personnel for the tests.

4. Gages used in pressure tests shall have been calibrated within the 6-month period preceding the tests. Leaks found during tests shall be repaired by replacing pipe and/or fittings and the system retested. Caulking of joints shall not be permitted.

5. Repair defects disclosed by tests or, if required by the Engineer, replace defective work with new work without additional cost. If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted at no additional cost.

6. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing design deficiencies. State that no deficiencies are evident if that is the case.

7. When tests have been completed and corrections made, submit signed and dated test reports.

C. Tests:

1. Any equipment not capable of withstanding test pressures shall be suitably isolated from the test pressure. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking, or remelting and adding more solder or brazing material, shall not be acceptable.

2. Domestic Water Piping and Service Water Piping Pressure Tests: Before applying insulation, and before the installation of fixtures, cap ends of each system and hydrostatically test each piping system at not less than 100 psig for a period of time sufficient for inspection of every joint in the system but in no case less than 2 hours. During the pressure test, there shall be no leakage or reduction in pressure.

3. Drain, Waste and Vent Piping Pressure Tests: Before the installation of fixtures, provide Drainage and Vent Water Test or Air Test in compliance with the specified Plumbing Code. Each test shall be for a period of time sufficient for inspection of every joint in the system but in no case less than 30 minutes. During the pressure test, there shall be no drop in water level or air pressure.

4. Backflow Preventer Tests: Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Engineerr prior to placing the domestic water system into operation.

5. Functional Testing: All control devices and signaling devices shall be tested individually to demonstrate proper operation. Test all control panel functions to demonstrate proper operation. Test all control system functions to demonstrate proper operation in accordance with the specified control sequences. Monitoring signals to the facility Supervisory Control and Data Acquisition (SCADA) system shall be verified.

D. Flushing:

1. After completion of testing and before placing in operation, flush all new piping including water feed mains of all foreign matter. Use the permanent water service at its maximum available pressure as the source of flushing water. Remove integral strainer screens, aerators, shower heads, hose end vacuum breakers, and other devices susceptible to clogging prior to flushing and re-install upon completion. Flush piping through each fixture outlet, strainer blowdown and equipment drain valve. Discharge used water to sanitary sewer. System shall be drained prior to final filling.

2. The system shall be thoroughly flushed, in no case for less than 15 minutes at the design flow rate, of all foreign matter until a white linen bag installed in a strainer basket shows no evidence of contamination. The white linen bag shall be in the strainer basket during the entire flushing operation prior to its being presented to the Engineer acceptance. The Engineer will inspect the linen bag prior to completion of flushing and approve the flushing operation.

**3.06 - DISINFECTION**

A. Disinfect new potable water piping and existing potable water piping affected by the Work in accordance with this paragraph unless otherwise directed by the local health authority. The piping system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet. With system valved off, fill piping system with not less than 50 ppm chlorine solution and allow solution to stand for 24 hours. Following the required standing time, flush solution from the system with potable water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of potable water supply. Obtain at least two consecutive satisfactory bacteriological samples from water piping, analyzed by a certified laboratory, and submit results prior to the water piping being placed into service.

B. Where it is not possible to disinfect a potable water storage tank as specified above, the entire interior of the tank shall be swabbed with a solution which contains 200 ppm of available chlorine; and the solution shall than be allowed to stand 3 hours before the tank is flushed and returned to service.

C. For a potable water filter or similar device, the dosage shall be determined by the Department of Health.

**3.07 - PAINTING**

A. Field painting of above ground piping shall be provided under SECTION 09941, FIELD PAINTING by the Painting Subcontractor.

B. Field Painting shall not be applied until after installation and testing is complete.

**3.08 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**G. END OF SECTION**

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**SECTION 15420**

**PLUMBING INSULATION**

**(Filed Sub-Bib Required)**

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## PART 1 - GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of SECTION 15420, PLUMBING INSULATION is a part of DIVISION 15, PLUMBING whhich requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. DIVISION 15, PLUMBING. See SECTION 15400, PLUMBING SYSTEMS.

B. A sub-bid submitted for the Work of DIVISION 15, PLUMBING shall include the complete Work specified in all of the following Sections:

1. SECTION 15195, NATURAL GAS PIPING
2. SECTION 15400, PLUMBING SYSTEMS
3. SECTION 15420, PLUMBING INSULATION

**1.01 - SCOPE**

A. Provide new field-applied insulation for new piping as indicated and in compliance with Contract Documents.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025 - MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS and as specified herein.

1. Product Data - Annotate descriptive data to show the specific manufacturer, material and specifications, thicknesses, etc. of each item.

a. Piping insulation and jackets

**1.05 – PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All material shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and maintain material warranties.

C. Receiving:

1. All material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard material in accordance with manufacturer's recommendations.

4. Store material protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions - Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, performance, and reliability equal to that specified. Materials shall be the product of a single manufacturer insofar as possible.

C. Workmanship and Design - Install products that comply with state, local and federal codes and regulations.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American Society for Testing Materials (ASTM):

1. A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

2. A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications

3. C195: Mineral Fiber Thermal Insulating Cement

4. C547: Mineral Fiber Pipe Insulation

5. C1136: Flexible, Low Permeance Vapor Retarders for Thermal Insulation

6. D1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

7. E 84: Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

1. 255: Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL):

1. 723: Test for Surface Burning Characteristics of Building Materials

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the approval of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If Work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Attend regular coordination and job progress meetings required.

**1.10 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes, including but not limited to, Massachusetts Building Code.
2. Massachusetts Department of Environmental Protection.
3. Local Fire Department
4. Occupational Safety and Health Administration (OSHA)
5. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Architect, Owner, Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and approval, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Packaging and Labeling:

1. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer’s stamp or label attached giving name of manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

B. Surface Burning Characteristics:

1. Materials shall be plenum-rated having flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

C. Recycled Materials:

1. Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this Section. The minimum recycled material content of the following insulation types are:

a. Rock Wool: 75 percent slag by weight

b. Fiberglass: 20 to 25 percent glass cullet by weight

c. Plastic Rigid Foam: 9 percent recovered material

**2.02 - PIPING INSULATION**

A. Insulation material shall conform to Table 15420-1. Mineral fiber insulation shall be minimum 3.5 pounds per cubic foot density, minimum 500 degrees F rated, and maximum 0.24 R-factory at 75 degrees F. Insulation thickness shall be as listed in Table 15420-2. Insulate all ping listed in these tables. Where piping is located in unheated spaces such as ceiling spaces and crawl spaces or outdoors, provide insulation thickness one inch greater than indicated in Table 15420-2. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

B. Fittings Insulation - Factory pre-molded insulation inserts for pipe fittings, flanges and valves shaped to fit the specific fitting to be insulated. Inserts shall be of same material as the straight pipe. Inserts shall be of same thickness as the straight pipe insulation.

C. Piping Insulation Jackets:

1. All-Purpose Jacket: Insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2. PVC Jackets: ASTM D1784 polyvinyl chloride (PVC) jackets, minimum 20 mil thick, factory pre-molded PVC fitting covers, UV-resistant, gloss white finish.

3. Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage, and factory pre-molded fitting covers, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface.

D. Lavatory Kits - Kits specifically designed for insulating lavatory waste and supply finish piping for ADA compliance, fabricated from UV resistant PVC, with tear-to-fit trim grooves, internal ribs and internal fasteners, and vent slots to keep air space between covers and piping dry, glossy white finish. Manufactured by Truebro or accepted equal.

**2.03 - ADHESIVES, SEALANTS, AND COATING COMPOUNDS**

A. Lagging Adhesive: Fire resistant, for pipe insulation.

1. Provide appropriate class recommended by insulation manufacturer for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation.

2. Provide appropriate class for attaching fibrous glass insulation to metal surfaces.

B. Insulation and Vapor Barrier Adhesive: ASTM C916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

C. Mineral Fiber Insulation Cement: ASTM C195.

D. Vapor Barrier Coating: Provide in accordance with insulation manufacturers' recommendations.

E. Weatherproof Coating: For outside applications, provide in accordance with insulation and jacket manufacturer's recommendations.

**2.04 - ACCESSORY MATERIALS**

A. Staples: ASTM A167, Type 304 or 316 stainless steel outside-clinch type.

B. Insulation Bands: 1/2-inch wide; 26 gage Type 304 or 316 stainless steel.

C. Vapor Barrier Materials: ASTM C1136. Resistant to flame, moisture penetration, and mold growth, color white.

D. Fibrous Glass Cloth and Tape: 20 by 20 maximum size mesh. Tape shall be 4 inch wide rolls. Tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Plumbing Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

D. Do not insulate the following:

1. Unions
2. ASME stamps
3. Cleanouts or handholes
4. Manufacturer’s nameplates
5. Chrome plated pipes
6. Flexible connectors

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - PIPING INSULATION**

A. Insulation (Except Cellular Glass and Calcium Silicate Insulation):

1. Place sections of insulation around pipe and joints tightly butted into place.
2. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 15420-1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating, or manufacturer’s weatherproof coating for outside service, unless pipe insulation is supplied with factory-applied self-seal lap. Apply coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1-1/2 inches past the break in both directions. At penetrations by pressure gages, thermometers, etc. fill voids with coating. Seal with a brush coat of the same coating.

B. Cellular Glass and Calcium Silicate Insulation:

1. Provide in accordance with manufacturer’s printed instructions.

C. Piping Insulation Jackets:

1. All Purpose Jackets

a. Provide all-purpose jackets to cover straight pipe runs. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center and ½ inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inch wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inch. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

2. Polyvinyl Chloride (PVC) Jackets:

a. Provide PVC jacketing system to cover all pipe fittings, flanges and valves of services to be insulated except as noted herein. Do not provide PVC jacketing where exposed to weather. Provide PVC jacketing only in ambient temperatures below 150 degrees F. Do not provide PVC jacketing at insulated pipe through-penetrations.

b. Secure jacketing with jacket manufacturer's solvent welding adhesive to seal all lap joints in the system. For services where vapor barrier is required, provide vapor retarder mastic compatible with PVC as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer.

3. Stainless Steel Jackets:

a. Provide stainless steel jacketing system to cover all straight runs, pipe fittings, flanges and valves of services to be insulated where exposed to weather or exposed to ambient temperatures 150 degrees F and above. Provide stainless steel jacketing at insulated pipe through-penetrations.

b. Provide insulation bands to secure jackets to insulation. Provide factory prefabricated metal covers for insulation on fittings, valves, and flanges. For services where vapor barrier is required, provide vapor retarder mastic as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with insulation bands at not more than 9 inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer.

D. Hangers and Anchors:

1. Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide insulation protection shields.

2. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, molded mineral fiber, rigid foam or other approved material, all minimum 15 psi compressive strength, of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable.

3. Where anchors are secured to piping carrying medium less than 60 degrees F that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

E. Through-Penetrations:

1. Where interior wall is penetrated, extend a stainless steel jacket 2 inches out on either side of wall and secure on each end with an insulation band. Where floor is penetrated, extend a stainless steel jacket from a point flush with the bottom of the floor slab to a point 10 inches above floor with one insulation band at the floor and one not more than 1 inch from end of stainless steel jacket. Where exterior wall is penetrated, extend stainless steel jacket through sleeve to a point 2 inches beyond interior surface of wall and secure on each end with an insulation band.

2. Provide insulation inserts beneath the stainless steel jacket. Insulation inserts shall be of calcium silicate or cellular glass of the same thickness as adjacent insulation. Insulation inserts shall cover full pipe circumference and be not less in length than the stainless steel jacket. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating.

F. Flanges, Unions, Valves and Fittings for Piping:

1. Factory fabricated removable and reusable insulation covers shall be used. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2-1/2 inches, elbows insulated using insulation segments shall not have less than three segments per elbow. Place and join segments with manufacturer's recommended water-vapor resistant, fire retardant adhesive appropriate for the temperature limit of the service. Overlap tape seams 1 inch. Total dry film thickness shall be not less than 1/16-inch. Unions are not to be insulated; taper insulation to union at a 45 degree angle.

2. PVC Fitting Covers: Install factory premolded one-piece PVC fitting covers over insulation.

3. Stainless Steel Fitting Covers: Install factory-fabricated one-piece fitting covers over insulation. Secure covers with no less than 3 insulation bands per cover.

G. Piping Exposed to Weather:

1. Stainless Steel Jackets: Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with insulation bands at not more than 9 inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Cover circumferential strips with butt joints, not less than 4 inches wide, of material identical to the jacket material. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

2. Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches.

**3.04 - FIELD QUALITY CONTROL**

A. Except as otherwise permitted herein, Plumbing systems shall be cleaned and tested prior to application of insulation. Obtain Engineer's approval of systems before applying field insulation. Visually inspect to ensure that insulation materials provided conform to Specifications. Inspect installation of insulation for compliance with requirements.

1. Piping systems shall not be insulated before systems pressure testing and related inspections.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

**See Attached Tables**

**TABLE 15420-1**
**INSULATION MATERIAL FOR PIPING**

| Service | Material | Spec | Type | Class | Vapor Barrier Required |
|---|---|---|---|---|---|
| Plumbing Domestic Hot Water & Tempered Water, and Recirculating Piping (Maximum 200 degrees F) | Mineral Fiber | ASTM C547 | I | | No |
| Plumbing Domestic Cold Water Piping and Service Water Piping | Mineral Fiber | ASTM C547 | I | | Yes<br>Yes |
| Water Cooler Drain Piping (to sewer tie-in) | Mineral Fiber | ASTM C547 | | 1 | Yes |

**TABLE 15420-2**
**PIPING INSULATION THICKNESS (INCH)**

| Service | Material | Tube and Pipe Size (Inches) | | | | |
|---|---|---|---|---|---|---|
| | | 1/8 - 7/8 | 1 – 1 1/4 | 1 1/2 - 3 | 4 – 6 | 8 – 10 |
| Plumbing Domestic Hot Water & Tempered Water, and Recirculating Piping (Maximum 140°F) | Mineral Fiber | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |
| Plumbing Domestic Cold Water Piping and Service Water Piping | Mineral Fiber | 1/2 | 1/2 | 1 | 1 | 1 |
| Water Cooler Drain Piping (to Sewer Tie-In) | Mineral Fiber | - | 1/2 | 1 | - | - |

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**SECTION 15500**

**HEATING, VENTILATING AND AIR CONDITIONING**

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**PART 1 - GENERAL**

**1.00 - SUB-BID REQUIREMENTS**

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended

B. A sub-bid submitted for the Work of DIVISION 15, HEATING, VENTILATING AND AIR CONDITIONING shall include the complete Work specified in all of the following Sections:

1. SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING
2. SECTION 15520, HVAC INSULATION
3. SECTION 15900, HVAC CONTROL SYSTEMS
4. SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so. Classes of work for which a listing is required in paragraph E of the Form for Sub-bid:

1. SECTION 15520, HVAC INSULATION
2. SECTION 15900, HVAC CONTROL SYSTEMS
3. SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING

E. Reference Drawings

1. The Work of DIVISION 15, HEATING, VENTILATING AND AIR CONDITIONING is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 M-001 | 00 M-002 | 00 M-003 | 00 M-004 | 00 M-005 | 00 M-006 | 00 M-007 |
| 00 M-008 | 00 M-009 | 10 M-101 | 10 M-102 | 10 M-103 | 10 M-104 | 10 M-105 |
| 10 M-106 | 10 M-107 | 10 M-108 | 20 M-101 | 30 M-101 | 99 M-501 | 99 M-502 |
| 99 M-503 | | | | | | |

F. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left hand corner of the envelope:

Name of Subbidder: _____

Subbid for: SECTION 15500, SECTION 15520, SECTION 15900, and SECTION 15950

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

G. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. Provide new heating, ventilating and air conditioning systems as indicated and in compliance with Contract Documents, complete and ready for operation.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this section of the Specifications, the Drawings, and the codes and standards listed herein.

C. The HVAC Subcontractor shall provide, set up, and maintain all derricks, hoisting machinery, and shall do all hoisting required for his Work.

D. The HVAC Subcontractor shall furnish, install, and maintain all scaffolding, staging and planking for his Work.

1. Scaffold shall have solid backs and floors to prevent dropping materials therefrom to the floor or ground.

E. Temporary Electricity: The HVAC Subcontractor shall furnish all extension cords, sockets, motors, and accessories required for his Work.

F. Louvers are provided under SECTION 10200, LOUVERS.

G. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTAL PROCEDURES and as specified herein:

1. Shop Drawings:
   a. Ductwork and accessories fabrication and assembly details.
2. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item.
   a. Pipe and fittings
   b. Valves
   c. Water piping accessories
   d. Refrigerant piping and accessories
   e. Pipe anchors and guides
   f. Hangers and supports
   g. Pressure gauges and thermometers
   h. Hot water boilers
   i. Expansion tanks
   j. Air separators
   k. Pumps
   l. Air conditioning condensate pumps
   m. Air conditioning units (split system type)
   n. Dehumidifiers
   o. Air-cooled condensing units
   p. Heat pumps
   q. Hot water coils (duct mounted)
   r. Hot water unit heaters and cabinet unit heaters
   s. Hot water fin tube radiation
   t. Gas fired unit heaters
   u. Electric unit heaters

v. Ductwork

w. Flexible duct

x. Ductwork accessories

y. Diffusers, registers, and grilles

z. Fans

aa. Vibration isolation

bb. Glycol

cc. Water treatment equipment

3. Certification - Submit documentation certifying completion of the following items in compliance with this Section.

   a. Flushing

   b. Water treatment

   c. Equipment inspections by authorized factory engineers

4. Test Reports - prepare as specified in Part 3 of this Section

   a. Test procedures

   b. Water piping pressure tests

   c. Refrigeration systems tests

   d. Equipment tests

5. Operation and Maintenance Manuals - Prepare manuals in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA.

   a. Valves

   b. Water piping accessories

   c. Refrigerant piping and accessories

   d. Hot water boilers

   e. Expansion tanks

   f. Air separators

   g. Pumps

   h. Air conditioning condensate pumps

   i. Air conditioning units (split system type)

   j. Dehumidifiers

   k. Air-cooled condensing units

   l. Heat pumps

   m. Hot water unit heaters and cabinet unit heaters

   n. Gas-fired unit heaters

   o. Electric unit heaters

p. Ductwork accessories

q. Fans

r. Water treatment equipment

6. Closeout Submittals

a. Record Drawings - Prepare as specified in Part 1 of this Section.

**1.05 – PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and to maintain equipment and material warranties.

2. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

3. Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

4. Spare parts shall be delivered with pertinent equipment. Deliver to Owner after completion of work.

C. Receiving:

1. All equipment, material and spare parts shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.

4. Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions:

1. Drawings and Specifications direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment or appurtenances.

2. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished shall fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.

2. Install equipment that complies with state, local and federal codes and regulations.

D. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, HVAC Subcontractor to prepare and submit for review, detailed structural, mechanical and electrical drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes are at no additional compensation.

**1.07 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. Air Conditioning, Heating and Refrigeration Institute (AHRI):

1. 210/240: Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
2. 270: Sound Rating of Outdoor Unitary Equipment
3. 340/360: Standard for Commercial and Industrial Unitary Air-Conditioning Equipment and Heat Pump Equipment
4. 350: Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
5. 410: Forced-Circulation Air-Cooling and Air-Heating Coils
6. 430: Central-Station Air-Handling Units
7. 440: Room Fan-Coils
8. 550/590: Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle
9. 880: Air Terminals
10. ARI Guideline D: Application and Installation of Central Station Air-Handling Units

D. Air Movement and Control Association International (AMCA):

1. 99: Standards Handbook
2. 210: Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
3. 500: Laboratory Methods of Testing Louvers for Rating

E. American National Standards Institute (ANSI):

1. Z21.13: Gas-Fired Low Pressure Steam and Hot Water Boilers
2. Z21.22: Relief Valves for Hot Water Supply Systems

F. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

1. 15: Safety Standard for Refrigeration Systems
2. 33: Method of Testing Forced Circulation Air Cooling and Air Heating Coils
3. 34: Designation and Safety Classification of Refrigerants
4. 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
5. 68: Laboratory Method of Testing to Determine the Sound Power in a Duct

G. American Society of Mechanical Engineers (ASME):

1. B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)
2. B16.4: Cast Iron Threaded Fittings

3. B16.5: Pipe Flanges and Flanged Fittings
4. B16.9: Factory-Made Wrought Steel Butt- Welding Fittings
5. B16.11: Forged Fittings, Socket-Welding and Threaded
6. B16.15: Cast Copper Alloy Threaded Fittings
7. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
8. B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
9. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
10. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
11. B16.39: Malleable iron Threaded pipe Unions
12. B18.2.1: Square and Hex Bolts and Screws (Inch Series)
13. B18.2.2: Square and Hex Nuts (Inch Series)
14. B31.1: Power Piping
15. B31.3: Process Piping
16. B31.5: Refrigeration Piping and Heat Transfer Components
17. B31.9: Building Services Piping
18. B40.1: Pressure Gauges and Gauge Attachments
19. BPVC SEC VIII D1 Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

H. American Society of Sanitary Engineers (ASSE):

1. 1003: Water Pressure Reducing Valves

I. American Society For Testing and Materials International (ASTM):

1. A36: Carbon Structural Steel
2. A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A106: Seamless Carbon Steel Pipe for High Temperature Service
4. A123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
6. A193: Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
7. A194/A194M: Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
8. A234: Wrought Carbon Steel Pipe Fittings
9. A307: Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
10. A312: Specification for Seamless and Welded Austenitic Stainless Steel Pipes
11. A653: Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
12. A924: General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
13. B88: Seamless Copper Water Tube
14. B117: Operating Salt Spray (Fog) Apparatus

15. B209: Aluminum and Aluminum-Alloy Sheet and Plate
16. B280: Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
17. B395: Standard Specification for U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
18. C177: State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
19. C533: Cellulosic Fiber Insulating Board
20. C411: Hot-Surface Performance of High-Temperature Thermal Insulation
21. C423: Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
22. D402: Standard Test Method For Distillation Cut-Back Asphaltic (Bituminous) Products
23. D520: Zinc Dust Pigment
24. D1384: Test Method for Corrosion Test for Engine Coolants in Glassware
25. D1654: Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
26. D1785: PolyVinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
27. D2235: Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
28. D2466: PolyVinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
29. E84: Surface Burning Characteristics of Building Materials
30. E96: Water Vapor Transmission of Materials
31. F104: Standard Classification System for Nonmetallic Gasket Materials
32. F1282: Polyethylene/Aluminum/Polyethylene (PE/AL/PE) Composite Pressure Pipe
33. G21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

J. American Welding Society (AWS):

1. A5.8/A5.8M: Filler Metals for Brazing and Braze Welding
2. BRH: Brazing Handbook

K. Copper Development Association (CDA):

1. A4015: Copper Tube Handbook

L. Manufacturers Standardization Society Of The Valve And Fittings Industry (MSS):

1. SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
2. SP-67: Butterfly Valves
3. SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends
4. SP-71: Gray Iron Swing Check Valves, Flanged and Threaded Ends
5. SP-80: Bronze Gate, Globe, Angle and Check Valves
6. SP-85: Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
7. SP-110: Ball Valves Threaded, Socket Welding, Solder Joints, Grooved and Flared Ends

M. National Electrical Manufacturers Association (NEMA):

1. ICS 2: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

2. ICS 6: Enclosures
3. MG 1: Motors and Generators

N. National Fire Protection Association (NFPA):

1. 70: National Electrical Code
2. 90A: Installation of Air Conditioning and Ventilating Systems
3. 90B: Installation of warm Air Heating and Air-Conditioning Systems
4. 211: Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

O. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1. HVAC Duct Const Stds: HVAC Duct Construction Standards - Metal and Flexible
2. HVAC Install Fire Damper: Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
3. Seismic Restraint Mnl: Seismic Restraint Manual: Guidelines for Mechanical Systems

P. Underwriters Laboratories, Inc. (UL):

1. 94: Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
2. 181: Factory-Made Air Ducts and Air Connectors
3. 1995: Heating and Cooling Equipment
4. 441: Safety for Gas Vents
5. 508: UL Standard for Safety Industrial Control Equipment
6. 555: Fire Dampers
7. 555S: Smoke Dampers
8. 705: Power Ventilators
9. 723: Test for Surface Burning Characteristics of Building Materials
10. 726: Safety Oil-Fired Boiler Assemblies
11. 795: Commercial-Industrial Gas Heating Equipment
12. 900: Air Filter Units
13. FRD Fire Resistance Directory

Q. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - AMERICAN IRON AND STEEL ACT**

A. This Contract is subject to PL-113-76 the Consolidated Appropriations Act, 2014, Section 436 (American Iron and Steel Act), which requires the use of iron and steel products that are wholly manufactured in the United States for inclusion in the Work. It is understood that any iron and steel used on this project are to be produced in the United States, and produced in a manner which complies with the American Iron and Steel Requirement. Any melting, bending, coating, galvanizing, cutting, etc. process for manufacturing or fabrication will be in full compliance with the American Iron and Steel as mandated in the Environmental Protection Agency's State Revolving Fund Programs.

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance information on location and size of all concrete pads, chases, frames, boxes, sleeves, and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interferences, or for proper execution of specified work.

E. If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section of the Specifications will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer before proceeding.

H. Attend regular coordination and job progress meetings required.

**1.10 - PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

A. Access panels shall be furnished under this Section and installed by the trade responsible for the appropriate Section of the Specifications for the surface upon which the panels are mounted. Prepare a schedule showing location, size and function of all required access panels and deliver schedule to representatives of all installing trades.

B. Inserts and anchor bolts shall be furnished under this Section and installed under SECTION 03300, CAST-IN-PLACE CONCRETE. Prepare a schedule showing location, size and function of all required anchoring inserts and deliver schedule to representative of the installing trade.

C. For new construction, pipe sleeves shall be furnished under this Section and installed by the trade whose finished interior surfaces will be penetrated. Prepare a schedule showing location, size and function of all required pipe sleeves and deliver schedule to representatives of all installing trades. For existing construction, pipe sleeves shall be furnished and installed under this Section.

**1.11 - PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION**

A. Duct smoke detectors, control valves, control dampers, and thermowells for immersion temperature sensors shall be installed under this Section. Duct smoke detectors will be furnished under Division 16. Control valves, control dampers and thermowells will be furnished under SECTION 15900, HVAC CONTROL SYSTEMS.

**1.12 - ELECTRICAL WORK**

A. All power including wiring, conduit and connections to motors and packaged equipment will be furnished and installed by the Electrical Subcontractor under Division 16. Motor starters indicated or specified to be factory-furnished shall be factory wired as an integral part of packaged mechanical equipment. Motor starters that are not integral with the mechanical equipment served will be furnished, mounted and wired by Division 16. Safety disconnect switches will be furnished, mounted and wired by Division 16.

B. All equipment furnished under this Section requiring motors shall have motors factory furnished and installed by the manufacturer of the equipment served and shall be mounted and aligned so as to run free and true. Provide motors and all associated internal wiring for mechanical equipment as an integral part of the equipment. Motor starters and contactors shall be factory-furnished and wired as an integral part of packaged mechanical equipment where indicated on the Drawings.

C. Motor starters shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Coordinate same with Division 16.

**1.13 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform to the governing edition of the following regulations, and agency requirements.

1. State Local Building Codes including, but not limited to, the Massachusetts Building Code, Massachusetts Electrical Code, Massachusetts Mechanical Code, and Massachusetts Fire Safety Code**.**
2. Massachusetts Department of Public Health
3. Massachusetts Department of Environmental Protection
4. Local Fire Department
5. Occupational Safety and Health Authority (OSHA)
6. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No Work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Architect, Owner, Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and acceptance, pay costs of uncovering and reinstalling the covering, whether it meets Contract requirements or not.

**1.14 - RECORD DRAWINGS**

A. Prepare and maintain record drawings in accordance with SECTION 01346, AS-BUILT DRAWINGS and as specified herein.

B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of drawings at the job site at all times. On a daily basis, record work completed and all changes from original contract drawings clearly and accurately, including work installed as a modification or addition to the original design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.

C. Record drawings shall show as-built condition of ductwork and pipe routing and sizes, valve locations, details, control changes, and corrections to equipment schedules. Schedules shall show actual manufacturer and make and model numbers of installed equipment. Remove all superseded data to show the completed work.

D. The record drawings will be used as a guide for determining the progress of the Work installed. They shall be inspected on a regular basis and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be accepted until the record drawings are accurate and up-to-date.

E. At completion of Work prepare a complete set of cad-drafted record drawings on bond paper showing all systems as actually installed. The Contract Drawing electronic CAD files will be made available for the HVAC Subcontractor's use to serve as backgrounds for the record drawings. Provide all drawings necessary to show the required record information. Submit cad-drafted prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer. Submit final accepted Record Drawing electronic files in PDF format.

F. Certify the accuracy of the record drawings. Record drawings shall become the property of the Owner.

G. When required by jurisdiction, submit the record set for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Branch piping to appliances or equipment shall be at least as large as the inlets thereof.

B. Where applicable, all products requiring approval by the Massachusetts Building Code Commission shall be so approved. Where product types are available with Energy Star labeling, they shall be provided.

**2.02 - NAMEPLATES**

A. Major equipment including boilers, pumps, tanks, unit heaters, air handling units, air conditioning units, air-cooled condensing units, heat pumps, electric heaters, fans, and motors shall have the manufacturer's name, address, model and serial number on a factory-furnished and installed aluminum plate secured to the item of equipment.

B. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

**2.03 - PIPE AND FITTINGS**

A. Non-Pumped Air Conditioning Condensate Drain Piping: Schedule 40 polyvinyl chloride (PVC) pipe conforming to ASTM D1785. Drain piping shall have Schedule 40 PVC socket fittings conforming to ASTM D2466. All joints between pipe and fittings shall be solvent cemented joints conforming to ASTM D2235 and ASTM D402. Provide protection for PVC piping exposed to weather from ultraviolet radiation.

B. Pumped Air Conditioning Condensate Tubing: Polyethylene resin tubing conforming to ASTM F1282.

C. Condensing Hot Water Boiler Condensate Drain Piping: Same as Non-Pumped Air Conditioning Condensate Drain Piping.

D. Hot Water Pipe 2 1/2-inch and Larger: Pipe shall be ASTM A53 black steel, Grade B, Type E, Schedule 40, beveled end.

E. Hot Water Pipe and Cold Water Make-Up Pipe 2-inch and Smaller: Pipe shall be ASTM B88, Type L hard tempered copper tubing.

F. Fittings for Hot Water and Cold Water Make-Up Pipe: Provide fittings compatible in all respects (material, size, pressure, and temperature limitations) with the pipe being used and within any further limitations of ASME B31.1.

1. Fittings for Steel Pipe 2 1/2-inch and Larger:

a. ASME B16.9, buttwelding or ASME B16.5, flanged; Class 150. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2. Fittings for Copper Tubing 2-inch and Smaller:

a. ASME B16.22 or ASME B16.18, copper solder joint pressure fittings.

G. Unions for Copper Tubing 2-inch and Smaller:

1. Threaded union, solder joint end type, copper alloy.

H. Flanges: Remove the raised faces on flanges when used with flanges having a flat face.

1. Steel Flanges for Steel Pipe 2 1/2-inch and Larger:

a. ASME B16.5, cast or forged steel, weld neck type; Class 150. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2. Copper Alloy Flanges for Copper Tubing 2-inch and Smaller:

a. ANSI B16.24, solder joint end.

3. Flange Accessories:

a. Gaskets: Provide one piece, factory cut, 1/16-inch thick, gaskets resistant to the effects of chemically treated water and/or glycol solution. Gaskets shall be rated for 32 to 250 degrees F service temperature. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

b. Bolting: Material for bolts and studs ASTM A 307, Grade-B and for nuts ASTM A 194/A 194M, Grade-2. Dimensions of bolts, studs and nuts ASME B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

**2.04 - VALVES**

A. Shut-off valves for hot water piping shall be either ball, gate or butterfly type as shown. Shut-off valves for cold water make-up piping shall be either ball or gate type. Make valve stem packings of non-asbestos material. All carbon steel (iron body) valves shall be factory-painted (epoxy).

B. Valves shall have name of manufacturer and guaranteed working pressure cast or stamped on bodies. Valves of similar type shall be by single manufacturer. Valves shall be installed with their stems horizontal to or above the main body of the valve.

C. Gate Valves 2 1/2-inch and Larger:

1. MSS SP-70, flanged ends, iron body with bronze trim, outside screw and yoke, bolted bonnet, tapered solid wedge disc, Class 125 or Class 150.

2. Provide chain-wheel operators where specified.

D. Gate Valves 2-inch and Smaller:

1. MSS SP-80, soldered ends, bronze body, bronze trim, union bonnet, Class 125 or Class 150.

E. Globe and Angle Valves 2 1/2-inch and Larger:

1. MSS SP-85, flanged ends, iron body, bronze trim, bolted bonnet, Class 125/Class 150.

F. Globe and Angle Valves 2-inch and Smaller:

1. MSS SP-80, soldered ends, bronze body, bronze trim, union bonnet, Class 125/Class 150.

G. Butterfly Valves 2 1/2-inch and Larger:

1. MSS SP-67, wafer type for mounting between specified flanges, 200 psig working pressure, iron body, aluminum bronze or stainless steel disc, stainless steel stem, and positioning type lever. Provide resilient EPDM seats rated for minimum 15 to 245 degrees F temperature range. Provide gear operators for all valves 6-inch and larger.

2. Provide chain-wheel operators where specified.

H. Ball Valves 2-inch and Smaller:

1. MSS SP-110, soldered ends, rated minimum 600 psi WOG, bronze-body with full port or standard port design, chrome plated steel ball, reinforced PTFE seats and seals, and quarter-turn lever handles. Valves with ball seals held in place by spring washers shall not be acceptable. All valves shall have adjustable packing glands. Valves on insulated piping shall have 2-inch extended stems.

I. Check Valves 2 1/2-inch and Larger:

1. MSS SP-71, swing check, iron body, bronze trim, bolted cap, replaceable seat.

J. Check Valves 2-inch and Smaller:

1. MSS SP-80, swing check, soldered ends, bronze body, bronze trim, PTFE disc, threaded cap, regrindable seat.

K. Safety Relief Valves:

1. Combination Pressure and Temperature Relief Valves: ANSI Z21.22, copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating.

2. Pressure Relief Valves: ANSI Z21.22, copper alloy body, automatic reseating with test lever.

L. Manual Vent Valves:

1. Provide ball valves as specified above except with hose thread connection, cap and chain.

M. Drain Valves:

1. Drain valves 1/2-inch or 3/4-inch size shall be hose bibbs or ball valves. Drain valves 1-inch, 1 1/4-inch or 1 1/2-inch size shall be ball valves.

    a. Hose bibbs shall be angle type, copper alloy, with removable handwheel. Inlet shall have soldered end. Outlet shall have National Standard male hose threads.

    b. Ball valves used as drain valves shall comply with the ball valve specification of this Section and have National Standard male hose thread adapter with cap and chain.

N. Calibrated Balancing Valves:

1. General: Valves shall be capable of being installed horizontally and vertically without affecting flow measurement and shall provide the following functions:

    a. Flow measurement

    b. Flow balancing

    c. Positive drip-tight shut-off.

    d. Valves shall be line size unless flow rate and pressure drop are indicated that require smaller size.

    e. Valves shall be rated for minimum 32 to 250 degrees F service and 150 psig minimum close-off (dead-tight) pressure differential.

    f. Each valve shall have two metering ports, one on each side of the valve seat with Nordel or EPDM check valves and gasketed caps. Two additional connections with plugs shall be provided on the opposite side from the metering ports for use as drain connections. Drain connections and metering ports shall be interchangeable to allow for measurement flexibility when valves are installed in tight locations. Ports shall be supplied with extensions for valves on insulated piping.

    g. An integral pointer shall register degree of valve opening. Valves shall be calibrated so that flow in gpm can be determined when valve opening in degrees and pressure differential across valve is known.

2. Valves 2-inch and Smaller: Y-pattern style, copper alloy, with soldered ends. Valves shall have four (4) 360 degree adjustment turns. Pressure rating shall be minimum 200 psig.

3. Valves 2 1/2-inch and 3-inch: Y-pattern style, ductile iron body with all other metal parts of copper alloy. End connections shall be flanged. Valves shall have eight (8) 360 degree adjustment turns. Pressure rating shall be minimum 200 psig.

4. Valves 4-inch and Larger: Eccentric plug style, MSS SP-71 ductile iron body, nickel seat and ductile iron plug (no facing). End connections shall be flanged. Pressure rating shall be ANSI Class 150.

5. Hand-wheels: Valves shall be equipped with hand-wheels. Hand-wheels on valves 3-inch and smaller shall plastic or metal, direct connected, and have digital indicators. Hand-wheels on valves 4-inch and larger shall be metal with gear operator. Hand-wheels shall have memory lock feature that shall provide a means for locking the valve position after the system is balanced.

6. Manufacturers: Valves shall be manufactured by Tour & Anderson, Bell & Gossett, Mepco, Flowset, Taco, Nexus, or Armstrong; except valves 4-inch and larger shall be manufactured by DeZurik.

O. Water Pressure Reducing Valves:

1. ASSE 1003, adjustable pressure reducing valves on the city water supply to the hot water heating system as shown. Valves should be equal to a Bell & Gossett No. B7, Amtrol, Armstrong or accepted equal, adjustable from 10 to 25 psig and set as shown. All valves shall be brass and shall have replaceable brass strainer baskets.

P. Triple Duty Valves:

1. Straight pattern valve designed to perform the functions of a non-slam check valve, throttling valve, shutoff valve and calibration balancing valve. The valve shall be a heavy-duty cast iron construction with ANSI class 125 flanged connections, and rated for minimum 175 psig at 250 degrees F. The valve shall be fitted with a bronze seat, replaceable bronze disc with EPDM seat insert, stainless steel stem, and chatter-preventing spring and calibrated nameplate. The valve design shall permit repacking under full system pressure. The valve shall be equipped with brass readout valve (with integral check valve) for taking differential pressure readings across the orifice for accurate system balance. Valve shall be line size.

Q. Chain-Wheel Operators:

1. Provide chain-wheel operators for 6-inch and larger gate valves and butterfly valves located in unfinished spaces and greater than 9 feet above the finished floor.

2. Chain-wheel operators shall include valve operating wheel, chain and chain guides. Provide chain that reaches to within 3 feet of the operating floor level. For valves with gear operator, mount with chain-wheel in the vertical position. Provide secondary safety restraint system.

3. Materials (in outdoor locations, in indoor chemical areas, in indoor areas with exposed water surfaces such as water channels, in indoor areas with exposed sludge, and in otherwise corrosive areas):

   a. Chainwheels: Sprocket type wheel, Type 316 stainless steel.

   b. Chain: Type 316 stainless steel connecting link chain.

   c. Hardware and Attachments: Type 316 stainless steel.

   d. Safety Restraint Cables and Hardware: Type 316 stainless steel

4. Materials (in all other locations):

   a. Chainwheels: Sprocket type wheel, ductile iron.

   b. Chain: Galvanized steel connecting link chain.

   c. Hardware and Attachments: Galvanized steel.

   d. Safety Restraint Cables and Hardware: Type 316 stainless steel

**2.05 - WATER PIPING ACCESSORIES**

A. Automatic Air Vents:

1. Furnish and install where indicated, automatic air vents on the hot water system. All units shall be cast brass, rated for 150 psig and 270 degrees F operating temperature. Units to include non-ferrous floats, stainless steel linkage and a Viton seal which closes against a brass spring operated seat. Alternate units shall be high capacity cast iron type with brass shut-off valve if using other than Viton, spring operated type air release. Alternates shall be rated for 150 psig working pressure and 250 degrees F operating temperature.

B. Strainers:

1. Strainers 2-inch and smaller shall be Class 125, bronze body, stainless steel screen with 20 mesh screen opening, Y-pattern, screwed ends.

2. Strainers 2 1/2-inch and larger shall be Class 125, cast iron body, factory-painted, stainless steel screen with 1/16-inch screen openings, Y-pattern, flanged.

3. Provide blow-off ball valve on each strainer.

C. Pump Suction Diffusers:

1. Cast iron body, factory painted, with orifice plate and stainless steel strainer, maximum 175 psig working pressure, 250 degree F maximum operating temperature. Unit shall have adjustable support to carry weight of suction piping and prevent eccentric load on pump flange.

D. Dielectric Couplings:

1. Provide dielectric unions or flanges in all copper to ferrous transitions. Couplings shall have minimum 500 volts dielectric resistance. Couplings shall be rated for minimum 180 degrees F and 175 psig.

**2.06 - REFRIGERANT PIPING AND ACCESSORIES**

A. Refrigerant piping shall be type L hard drawn copper tubing cleaned, dehydrated and capped for refrigerant service conforming to ASTM B280. Refrigerant piping shall have wrought copper brazed joint pressure fittings conforming to ASME B16.22. All joints shall be made using a brazing alloy containing silver or using a copper-phosphorous alloy. Brazing filler metal shall have a minimum of 1,100 degrees F melting temperature and shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

B. Filter dryer in the liquid line shall consist of a steel cylinder filled with a suitable desiccant that will not plug, cake, rust, channel or break down and shall remove both water and acid from the refrigerant. The dryer shall be constructed so that none of the desiccant will pass into the refrigerant lines. The filter dryer shall be the replaceable core type "catch all" as manufactured by either Sporlan or Alco.

C. Provide all accessories and appurtenances to provide a complete and properly functioning refrigerant system under all conditions of operation. The complete refrigerant system shall be designed for use with the refrigerant employed at its maximum operating pressure.

D. Install all refrigerant piping in accordance with the requirements of ASME Standard B31.5, refrigerant piping; and ASHRAE Standard 15, standard safety code for mechanical refrigeration. All refrigerant piping shall be installed to ensure that all oil returns to the compressor. Suction line piping shall be sized on a pressure drop between the evaporator and compressor equal to an equivalent temperature of not greater than 2 degrees F, with a velocity in the vertical rise of not less than 1,000 fpm. Liquid line piping shall be sized on a pressure drop not to exceed 5 psig. Provide the minimum number of piping joints to limit refrigerant leaks.

E. Refrigeration system installation shall be in accordance with all state and local codes.

**2.07 - PIPE ANCHORS**

A. General: Select anchor rating for four times the reaction force calculated. Anchors shall be pre-insulated type where such type is available in pipe size and load rating required, otherwise pipe anchors shall be field-insulated type.

B. Pre-Insulated Anchors: No metal to metal (pipe to anchor) contact, carbon steel construction with split housing with feet for bolting or welding to building structure, factory-painted (epoxy), minimum 900 psi compressive strength calcium silicate insulation with vapor barrier and galvanized steel insulation shield. Insulation shall comply with surface burning characteristics of SECTION 15520, HVAC INSULATION. Metraflex Model PAPI, Pipe Shields Inc., Piping Technology & Products, Inc. or equal.

C. Field-Insulated Anchors: I-beam support, carbon steel construction with feet for bolting or welding to building structure. Metraflex Model PAI, or field-fabricated.

**2.08 - PIPE GUIDES**

A. Pre-insulated spider type pipe guides, minimum 4 inches axial movement, no metal to metal (pipe to guide) contact, carbon steel construction with split housing and feet for bolting or welding to building structure, factory-painted (epoxy), minimum 100 psi (690 kPa) compressive strength calcium silicate insulation with vapor barrier and galvanized steel insulation shield. Insulation shall comply with surface burning characteristics of SECTION 15520 – HVAC INSULATION. Guides shall provide lateral stability to the pipe to prevent "bowing" and to ensure axial pipe movement. Metraflex Model PG-PRE, Pipe Shields Inc., Piping Technology & Products, Inc.or equal.

**2.09 - HANGERS AND SUPPORTS**

A. Pipe Hangers:

1. Comply with MSS SP-58. Provide Type 1, Type 7, or Type 41 as indicated with adjustable type steel support rods.

2. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and flat washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

3. Provide Type 40 insulation protection shields for insulated piping.

4. Hangers, supports, insulation shields, rods and fasteners shall be hot-dipped galvanized steel, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Hangers and supports in contact with bare copper tubing shall be copper plated or PVC coated.

B. Duct Hangers:

1. Duct hangers shall be in accordance with the "HVAC Duct Construction Standards" published by the Sheetmetal and Air Conditioning Contractors National Association, Incorporated (SMACNA).

2. All hanger rods shall be supported from the building structure same as specified for pipe hangers.

3. Support components in direct contact with ductwork shall be hanger straps with material matching the duct material, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Supports, rods and fasteners shall be hot-dipped galvanized steel, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Provide minimum 1/8-inch thick neoprene rubber pads between dissimilar metals.

C. Where support points are required to avoid other work, provide a system of supplementary steel and/or channels between support points. Provide all necessary supports and cross framing. No part of piping, ductwork, breeching, equipment, and the building shall be stressed beyond its normal allowable working strength.

**2.10 - SUPPLEMENTARY STEEL AND CHANNELS**

A. Unless otherwise indicated on the Structural Drawings, provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment, piping and ductwork provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. Unless otherwise specified herein, all supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be hot dipped galvanized after fabrication. Unless otherwise specified herein, all channels shall be hot dipped galvanized. Supplementary steel and channels shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

**2.11 - PIPE SLEEVES**

A. Sleeves in Masonry and Concrete Walls, Floors, and Flat Roofs: Service weight cast iron or standard class ductile iron pipe, except shall be schedule 40 series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Where sleeves are cast into new concrete, sleeves shall be ASTM A 53, Schedule 40 or Standard Weight steel pipe, have 2-inch high annular ring water stop continuously welded all around the pipe sleeve, and be hot-dipped galvanized after fabrication, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

B. Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs: Hot-dip galvanized steel sheet, minimum 26-gauge thickness, except shall be Series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

C. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and Series 300 stainless steel hardware.

**2.12 - PIPE ESCUTCHEONS**

A. General: Provide pipe escutcheons at all pipe penetrations where penetration is exposed to view in finished spaces. Inside diameter shall be closely fitting pipe outside diameter. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, wall, or ceilings; and pipe sleeve extension, if any. Escutcheons shall be held in place by internal spring tension or set screws.

B. Pipe escutcheons shall be of stainless steel, anodized aluminum or chrome-plated brass, solid or split hinged.

**2.13 - DRIP PANS**

A. Examine all Drawings and in cooperation with the Electrical Trade confirm the final location of all new electrical equipment to be installed in the vicinity of new and existing piping. All overhead piping and equipment containing liquid or vapor shall be no closer than 3 feet from a vertical line to electrical equipment including, but not limited to, electric motors, controllers, switchboards, panelboards, and similar equipment. Piping is not permitted in Electrical Rooms and stairwells unless otherwise indicated.

B. Where the installation of new and existing piping and equipment does not comply with the requirements of the foregoing paragraph, where feasible the piping and equipment shall be relocated. Where not feasible, provide drip pans as specified below, except as otherwise indicated on the Drawings.

C. Provide drip pans fabricated from 14-gauge steel sheet and with edges turned up 2 1/2 inches. Reinforce top edge, either by structural angles or by rolling top over 1/4-inch rod made of same material as drip pan sheet metal. Provide hole and 3/4-inch threaded half coupling for low point drain. Provide hanging brackets of sufficient quantity made of same material as drip pan sheet metal for connecting threaded rods used for suspended drip pans. All joints shall be welded watertight and entire and welded assembly sandblasted, degreased and hot dipped galvanized after fabrication.

D. Locate drip pans under piping and equipment passing over or within 3 feet horizontally of material and equipment defined above, and elsewhere as indicated. Hang from structure with rods and building attachments, fasten rods to brackets on sides of drip pan. Carefully pitch to the drip pan low point for drainage. Brace to prevent sagging or swaying. Drip pans shall be installed within 12 inches below piping and equipment.

E. Provide 1-inch schedule 40 PVC drain line from each drip pan and terminate 6 inches above the floor at nearest floor drain or as otherwise indicated.

**2.14 - AIR CONDITIONING UNIT CONDENSATE OVERFLOW PROTECTION**

A. Provide a method of condensate overflow protection for all equipment containing cooling coils where damage to any building components could occur as the result of overflow from the equipment primary condensate removal system. Condensate overflow protection shall take the form of a secondary drain pan. Secondary drain pans shall be placed under the entire unit, except for built-up air handling units or similar units, shall be placed under the unit's coil section primary drain pan. In lieu of a secondary drain pan, provide a primary drain pan with both a primary and overflow drain connection. The overflow drain line shall connect to the primary drain pan at a higher level than the primary drain connection.

B. Secondary drain pans shall have a minimum depth of 1 1/2 inches, shall not be less than 3 inches larger than the overall unit dimensions or unit's coil section primary drain pan dimensions as applicable, and shall be constructed of corrosion-resistant material. Material minimum thickness shall be in accordance with local code requirements. Pans shall be rigid and have reinforced top rim. Joints shall be water-tight. Provide a drain hole at the low point for a water-tight connection to the secondary condensate drain line. In lieu of a drain hole, the drain hole may be omitted where a water-level detection device is provided.

C. The top rim of the secondary drain pan shall be positioned no less than 2 inches and no greater than 6 inches directly below the bottom of the unit or unit's coil section primary drain pan as applicable. Supports located inside the pan to support the equipment above shall be constructed of corrosion-resistant material. Hang pan from structure with rods and building attachments, and securely attach rods to sides of the pan. Brace the pan to prevent sagging or swaying. For drain pans with drain line connections, pitch the pan to the low point for drainage.

D. Drain lines from secondary drain pans and primary drain pan overflow drains shall discharge to a conspicuous point of disposal to alert occupants in the event of stoppage of the primary drain. For secondary drain pans without a drain connection, provide a water-level detection device in the pan that will shut off the associated air conditioning equipment prior to overflow of the pan. For downflow air conditioning units and all other cooling coils that do not have provisions to install a secondary drain pan or overflow in the primary drain pan, provide a water-level detection device in the primary drain pan that will shut off the associated air conditioning equipment prior to overflow of the pan.

E. Unless otherwise indicated to be larger size, minimum drain line sizes shall be in accordance with local code requirements.

F. Comply with any additional local code requirements.

**2.15 - ACCESS PANELS**

A. Access panels shall give access to each valve in concealed spaces above non removable (hard) suspended ceilings, and to all other concealed parts of the system. Access panels shall be located where indicated on the Drawings, or where otherwise require accessibility for the proper inspection, operation and maintenance of the system.

B. Access panels shall be Milcor Type M, 16-inch by 16-inch minimum, as manufactured by Inryco, Inc., or equal. Door shall be constructed of 18-gauge galvanized steel with frame constructed of 16-gauge galvanized steel. Casing bead shall be galvanized steel. Hinge shall be continuous steel with stainless steel pin. Locks shall be flush, screwdriver operated, with metal cam. Galvanized steel sleeve shall be welded to panel for access to cam lock control. Prime coat shall be factory applied rust-inhibitive paint.

**2.16 - PRESSURE GAUGES AND THERMOMETERS**

A. Provide pressure gauges where indicated.

1. Pressure gauges shall be ASME B40.1, liquid-filled, 1 percent accuracy or better, minimum 2 1/2-inch dial.

2. Gauges shall have bronze bourdon tube and steel or brass case.

3. Gauge dial gradations shall read in “PSIG” and shall be such that the normal operating pressure of the system installed shall be indicated in middle 1/3 of the scale range.

4. Provide snubbers and ball valve shutoffs.

B. Provide separable well thermometers where indicated.

1. Thermometers shall have brass, malleale iron or aluminum alloy case and frame, clear protective face, and permanently stabilized glass tube with an indicating fluid column, +/- 1 scale division accuracy or better, white face, black numbers, and minimum 9-inch scale.

2. Thermometers shall have straight or adjustable angle rigid stem. Stems shall have expansion heads to prevent breakage at extreme temperatures. On rigid stem thermometers, the space between bulb and stem shall be filled with a heat transfer medium.

3. Range shall be 30 to 240 degrees F with 2 degree F divisions.

**2.17 - HOT WATER BOILERS (GAS-FIRED CONDENSING TYPE)**

A. Provide condensing type, Category IV sealed combustion boiler/burner units for forced hot water heating service arranged for automatic operation firing natural gas. Boiler/burner units shall AHRI Certified.

B. Construction

1. Each Boiler shall be factory assembled and fire-tested, requiring only connection to the water circulating system, fuel and electric utilities, condensate drain, sealed combustion air vent, and flue gas vent.

2. Boiler heat exchanger and combustion chamber shall be constructed of 316L stainless steel. Each boiler shall be capable of full modulation firing down to 20 percent or less of rated input.

3. Each boiler shall bear the ASME "H" stamp for 160 PSI working pressure and shall be National Board listed where applicable. The combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly.

4. Each boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The boiler shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The boiler shall be capable of normal operation and shall operate in a safe condition with gas supply pressures as low as 4.00 inches W.C. and shall automatically compensate for fluctuations of gas supply pressure between 4.00 inches W.C. and 14 inches W.C. inlet gas pressure. If inlet gas pressure exceeds 13 inches W.C., a 100 percent lock-up type gas pressure regulator of adequate size shall be installed in gas supply piping and adjusted to prevent pressure in excess of 13inches W.C.

5. Integral Boiler Management Control System shall utilize a 120V/24 VAC control circuit and components, incorporating a line voltage terminal strip, integral 120V/24V transformer, and low voltage terminal strip equipped with ModBus Card and as follows:

   a. Pump contacts;

   b. Outdoor air temperature sensor contacts (for boiler/burner enabling);

   c. Outdoor air temperature sensor contacts (for hot water supply temperature reset);

   d. System hot water temperature sensor contacts;

   e. Runtime contacts;

   f. Flow switch contacts;

   g. Alarm on any failure alarm contacts (for connection to the SCADA system);

   h. 24VAC auxiliary device relay and proving switch contacts.

6. Control system shall include a graphical liquid crystal color display with soft keys, multi-function encoder knob and USB port for PC connection. Screens shall provide real-time run display of: Percent of fire, system hot water supply and return temperature, and outdoor air temperature; lockout mode; and service/maintenance due.

7. Control System shall feature:

   a. 0-10VDC system pump signal input; 0-10VDC heat demand input; 0-10VDC variable speed system pump input signal; and 0-10VDC input to enable/disable call for heat; 0-10VDC boiler rate output; 0-10VDC signal to control boiler circulator.

   b. Night setback; anti-cycling; ramp delay and boost temperature and time.

   c. Adjustable parameters for continuous system pump operation; adjustable parameters for freeze protection; Installer adjustable display of service contact and telephone number.

8. Control system shall provide dual level password security, data logging and boiler diagnostics, outdoor air reset, pump delay with freeze protection, and pump exercise. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The control system shall include Modbus RTU protocol. The control system shall be fully integrated into the burner control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. Using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperatures and warm weather shut down or building automation system remote start/stop commands. All components shall be easily accessed and serviceable from the front of the boiler.

9. The boiler shall be equipped with a system supply sensor; outdoor sensors; temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 PSI; outlet water temperature sensor; return water temperature sensor; flue temperature sensor; low water cut off with manual reset and a condensate trap for the heat exchanger condensate drain.

10. Each Boiler shall be installed and vented as shown on the Plans and as specified below:

    a. Direct vent vertical system with a vertical rooftop termination of the vent and combustion air with the manufacturer's specified vent termination. A separate pipe shall supply combustion air directly to each boiler from the outside. The air inlet pipe and the exhaust vent pipe materials shall be as indicated and in accordance with the manufacturer's requirements. The air inlet must terminate on the roof top with the manufacturer's specified air inlet cap. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet. Foam core plastic pipe shall not be permitted for exhaust piping.

11. Provide a condensate neutralizing box complete with limestone granules. A condensate trap assembly shall be furnished if a condensate collection tray is not provided by the boiler manufacturer. The trap shall allow condensate to drain from the sump while retaining flue gases in the boiler. The trap shall have a factory installed overflow switch, which shuts down the boiler in the event the drain line becomes obstructed, preventing proper condensate removal.

**2.18 - EXPANSION TANKS**

A. ASME BPVC SEC VIII D1 constructed, accepted and stamped bladder-type expansion tank with replaceable butyl rubber bag designed and tested for maximum allowable working pressure of 125 psig, maximum operating temperature of 240 degrees F. The tank shall be constructed of carbon steel with threaded ports for drain, charging and system connections, base ring for floor mounting, lifting rings, and prime painted.

**2.19 - AIR SEPARATORS**

A. Provide tank constructed of steel, prime painted, designed for not less than 125 psig, and constructed and tested in accordance with the requirements of ASME BPVC SEC VIII D1. Provide tangential inlet and outlet connections, flanged for sizes 2 1/2-inch and larger. Each unit shall have an internal design suitable for creating the required vortex and subsequent air separation. Provide with automatic air release device and stainless steel strainer.

**2.20 - PUMPS**

A. Provide centrifugal pumps, of capacities types and configurations shown on schedules. Pumps shall meet the requirements of this Section and the performance requirements shown on the schedules (with equal or less horsepower requirement than the pump shown on the schedules).

B. Pumps shall be designed specifically for intended classes of service, with non-overloading characteristics throughout the design curve. Motors shall not operate in their service factor. Impeller shall be statically and dynamically balanced. Impeller size shall be no more than 90 percent of casing size.

C. Each pump casing shall be designed to withstand the discharge head plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pumps shall be rated for continuous operation between 35 and 225 degrees F. Pumps shall be factory tested at operating conditions, thoroughly cleaned, and factory painted (epoxy) prior to shipment. Installation instructions shall be included with pump at time of shipment.

D. Bearing frame and pump internals shall be serviceable without disturbing motor or connected piping. Provide plugged tappings for pressure gauges at inlet and discharge nozzles of pumps. Provide plugged tappings for vent and drain ports in volute.

E. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

F. Seals shall be mechanical type. Seals shall be designed for continuous operation to 225 degrees F.

G. Motors shall be open drip-proof enclosure of horsepower, voltage and phase indicated, with heavy-duty grease lubricated ball bearings.

H. Pump and motor shall be factory aligned, and shall be realigned after installation, prior to start-up.

I. In-Line Centrifugal Pumps:

1. Pumps shall be in-line type, close-coupled, single stage design, for installation in vertical or horizontal piping. Pumps shall be capable of being serviced without disturbing piping connections.

2. Pump volute shall be cast iron and impeller shall be cast iron or bronze, enclosed type, keyed to the shaft and secured by locking capscrew or nut. Shafts shall be alloy steel, with copper alloy shaft sleeves, or shall be Series 300 stainless steel, turned and ground. Bearings shall be either permanently lubricated or regreasable ball bearings. Provide casing wear rings. If the scheduled pump includes ball bearings and a direct drive motor to impeller connection, the submitted pump shall not have sleeve bearings or a flexible coupling between pump and motor.

J. Base-Mounted End Suction Centrifugal Pumps:

1. Pumps shall be base-mounted, single stage, end suction design.

2. Pump volute shall be cast iron with integrally cast pedestal support. The impeller shall be cast iron or bronze, enclosed type, keyed to the shaft and secured by locking capscrew or nut. Provide casing wear rings.

3. Pump bearing housing assembly shall have heavy-duty regreaseable or permanently lubricated ball bearings, replaceable without disturbing piping connections. Shafts shall be alloy steel, turned and ground, with copper alloy shaft sleeves.

4. Pump coupling guard, and motor shall each be bolted to a base plate which shall have bolt holes for securing base to supporting surface. Baseplate shall be structural steel or fabricated steel channel configuration fully enclosed at sides and ends and include securely welded cross members. A flexible type coupler with OSHA guard, capable of absorbing torsional vibration, shall be employed between the pump and the motor

K. Provide flexible connectors for all pumps.

**2.21 - AIR CONDITIONING CONDENSATE PUMPS**

A. UL listed; fully automatic with float, linkage and snap-action switch; leakproof, high impact plastic reservoir with drain holes and removable top; centrifugal type pump with plastic volute and impeller, and stainless steel shaft; removable 3/8-inch barbed check valve; and motor with thermal overload protection, safety switch, and 6 foot power cord with 3-pronged plug. Unit shall be corrosion-resistant, acid-resistant and flame retardant. Condensate pump model selection shall be by air conditioning unit manufacturer.

**2.22 - AIR CONDITIONING UNITS (SPLIT SYSTEM TYPE)**

A. ARI 430 with sound rating in accordance with ASHRAE 68, as indicated. Include filter section, coil section, supply fan section, and access sections. Filters and coils shall be completely removable from the unit without having to dismantle the unit or adjacent equipment. Provide mixing box section with dampers where indicated.

B. Casings

1. Construct casings of galvanized steel or aluminum on channel base coated externally with manufacturer's standard paint finish. Casings shall be double wall, including floors, walls and roof, with minimum R13 insulation sandwiched between the inner and outer liner.

2. Provide access doors for each section of the air handling unit. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Each section shall have flanged ends for connection to adjacent sections.

C. Mixing Box Sections

1. Provide with factory mounted dampers of galvanized steel blades, in galvanized frame, in parallel blade arrangement with non-slip keyed connecting rods and linkages. Permanently secure damper blades on a single shaft with self-lubricating bearings. Position damper blades across short air opening dimension. Dampers shall have blade and jamb seals with maximum leakage of 2 percent at 4 inch water gage differential pressure when sized for 2000 fpm face velocity. Provide safety grate for floor openings.

D. Filter Sections

1. Provide visible identification on media frames showing model number and air-flow direction. Provide means of sealing to prevent bypass of unfiltered air. Except extended media with self-supporting cartridge and high efficiency particulate filters, performance shall be determined in accordance with ASHRAE 52.1.

2. Throwaway air filters shall be UL 900, Class 1, those which, when clean, do not contribute fuel when attacked by flame and emit only negligible amount of smoke, throw-away frames and media, thickness and efficiency as indicated.

3. Filter housing shall have minimum thickness, 14 gage steel with baked finish inside and out. Joints shall be continuously welded. Flange shall have a fixed air sealing gasket with hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Provide two 3/8 inch flare connection differential pressure test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test ports shall not penetrate to filter frame or media.

E. Access Sections

1. Provide access sections as required to ensure access to all internal parts of air handling units.

F. Supply Fan Sections

1. Centrifugal fan shall be painted steel construction of forward-curved blades or air foil blades with V-belt drive motor and ground and polished steel fan shafts. Wheels shall be statically and dynamically balanced. Fan bearings shall be mechanically sealed against dust and dirt and shall be self-aligning, grease-lubricated ball-bearing type, and lubrication extension.

2. For the entire fan, motor and drive assembly, provide minimum one inch nominal deflection spring vibration isolators, internally mounted at the factory together with fan discharge flexible connection and thrust restraint springs.

3. Motors shall be heavy-duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors shall be readily accessible for maintenance. Motors shall be premium efficiency or electronic-commuted motors (ECM).

4. Belt drive frames shall be formed steel channels. Drive frames shall be bolted construction or welded construction. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be variable pitch, sized for minimum 130 percent of the installed motor horsepower. Belts shall be oil and heat resistant, non-static type. Provide motor and belt guards.

G. Coil Sections

1. Coil Pressure and Temperature Ratings: Coils shall be designed for the following minimum fluid operating pressures and temperatures.

   a. Hot water: 200 psig, 250 Degrees F

   b. Volatile refrigerant: 200 psig, 300 Degrees F

2. Coil Casings: Coil casing shall be mill-galvanized, 16-gage minimum unless otherwise specified herein, sheet metal with not less than 1.25 ounces of zinc per square foot of two-sided metal surface conforming to ASTM A 653. Where coils are stacked, casing shall be of double-bend construction. Coil mounting within housing shall be either fixed or slide-out type, except as otherwise specified. Coils shall be slide-out type for ceiling-suspended package units, and for other package units whose capacity exceeds 15,000 cubic feet per minute.

3. Coil Headers: Coil headers shall be cast iron, brass, copper, or aluminum casting. Direct expansion (DX), volatile refrigerant coils shall have copper or brass headers with necessary control connections. Water coil headers shall be fitted with plug drains and vent petcocks. Automatic vents shall be provided where indicated.

4. Coil Tubing: Coils shall be constructed of copper or aluminum tubing with aluminum or copper fins. Helical coil fins shall be wound tight to the tubes and solder-coated. Plate fins shall have spacer collars in metallic contact with the adjacent fin, and fins shall be mechanically bonded to the tube. No bare tube surface shall be visible within the finned portion of the coil. Coil tubes in water and volatile refrigerant service shall be parallel and shall have sufficient intermediate full coil depth supports to prevent sagging of unsupported span due to working fluid pressures and temperatures and summer and winter coil-ambient conditions. Provisions for expansion and contraction shall be adequate to preclude sagging and distortion under thermal loads applied in indicated or specified service. Tubes shall be sloped to be free draining. Tubes shall be straight, turns shall be made through headers or return U-bends, and connections and joints shall be brazed, except as otherwise specified.

5. Coil Circuiting: Standard or full-circuited water coils shall have as many full-length tubes in each circuit as the number of tubes in the depth of the coil face; double-circuit water coils shall have twice as many as standard coils; and half-circuit water coils shall have half as many as standard coils and to the next larger whole number where odd numbers are involved. Coils more than two rows deep shall be counterflow type, except that in the case of double- or half-circuit coils, reasonable deviation from counterflow arrangement will be permitted, provided the pressure drop and capacity requirements are met.

6. Drainable Coils: Drainable coils shall be capable of being purged free of water with compressed air. Self-draining coils shall have a drain point at the end of every tube and shall be pitched to that point. Drain provisions shall include: drained headers; U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Each tube shall drain substantially dry by gravity alone when drains and vents are open. Where necessary, the coil shall be filled with water to the end of the manufacturer's header connections and drainage volume shall be checked against the manufacturer's data.

7. Coil Types: Provide removable coils per ARI 410 with access to both sides. Enclose coils in a common or individual casing with headers and return bends fully contained within casing. Seal coils to casing to prevent leakage of air around coils.

    a. Hot-water heating coils shall be continuous circuit type, drainable type, limited to two rows depth.

    b. Volatile refrigerant cooling coils shall be Type DX counterflow type, designed for use with refrigerant indicated, with equal length circuiting arrangement, and shall be used in a refrigerant circuit or circuits with a matching air-cooled condensing unit. Number of distributors provided shall suit indicated refrigerant and shall eliminate trapping of refrigerant and oil. Coil capacity shall be obtained with expansion valve set for not less than 8 degrees F of superheat. Refrigerant distributor shall be furnished and installed by the coil manufacturer. Tube OD shall be either 5/8 inch or 3/4 inch. Refrigerant distributor shall be suitable for the thermostatic expansion valve recommended by the manufacturer for the service and capacity specified or indicated. Arrangement shall be capable of stable operation down to 40 percent or less of design capacity.

8. Drain Pans: Provide a drain pan beneath cooling coils to collect condensate. The drain pan shall extend sufficiently downstream of cooling coils to capture moisture carry over due to air velocity through the coil. Pans shall be insulated stainless steel and positively sloped in all directions for complete condensate drainage without pooling.

**2.23 - DEHUMIDIFIERS**

A. Unit Enclosure:

1. The unit shall be a minimum of 20-gauge galvanized panels.

2. Base shall be constructed of 16-gauge galvannealed steel.

3. Removable panels shall be provided to allow easy access to all internal parts and components. The electrical control box and switch panel shall be enclosed in a separate compartment.

4. Service Access - the unit shall be designed for complete access for service and maintenance from the front side and one side only. The unit's service requirement on the side is for easy removal of the filters. Left hand service access is standard.

5. The electrical control panel shall be in its own separate compartment.

B. Refrigeration System:

1. Refrigerant: The system's operating refrigerant shall be R-410A.

2. Hot Gas Bypass: The unit shall include hot gas bypass for each system compressor set. The hot gas bypass shall be used for the prevention of coil freeze up and not for compressor unloading.

3. Receiver: The unit shall include a high-side refrigerant receiver.

4. Evaporator Dehumidifier Coils:

    a. Fins: Fins shall be die-formed, raised lanced aluminum, and damage resistant. Extruded fin collars provide maximum heat transfer. Fin spacing shall be 10 fins per inch (FPI). The coils shall be a maximum of 30 inches in height.

    b. Tubes: Coil shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coil shall be a minimum of six (6) rows deep. The use of smooth tube coils will require an 8-row coil to equal the performance of the above-referenced coil.

    c. Coils shall be leak tested with nitrogen and UL listed.

5. Refrigerant Condenser Coils:

a. Air-Cooled Condenser (Reheat Coil):

(1) Fins: Fins shall be die-formed, raised lanced aluminum and damage resistant. Fin spacing shall be 12 FPI (fins per inch).

(2) Tubes: Coil shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coils shall be a minimum of two (2) rows deep. Coils shall be leak tested and UL listed.

(3) The reheat coil shall be positioned with a minimum of 5 inches of clearance from the evaporator coil to prevent water re-evaporation. Direct connection of the reheat coil to the DX coil is not allowed.

C. Auxiliary Heater

1. Hot water coils shall conform to paragraph entitled “Hot Water Coils (Duct-Mounted)” of this Section..

2. The heater shall be controlled by dehumidifier's controller.

D. Unit Location: The unit shall be designed for indoor installation.

E. Electrical Control Panel: The electrical control panel shall be easily accessible. It shall be of adequate size to house all electrical controls and devices. The unit shall be provided with single point power connection to serve controls, fans, electrical auxiliary heater, and compressors, factory wired to the power connection lug set. The electrical controls shall include low voltage transformers to supply 24 VAC control power, and clearly labeled high- and low-voltage terminal strips. Electrical panels will house a control system that provides high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low-pressure cutout), anti-short-cycling timer to protect against compressor cycling, and all operational controls that command unit function and modes.

F. Control System:

1. A digital control system shall be used to accurately and precisely control the dehumidification system and the supply air temperature requirements.

2. Controller: The controller shall provide precise system control and feature an easy-to-read control mounted display which indicates actual operating and set points.

3. The unit shall include factory-mounted temperature and humidity sensors in the filter section, pre-wired to controller in panel for actuation of compressor when intake temperatures at evaporator coil are above the programmed design dewpoint or above the supply air temperature setpoint.

4. Supply Air Temperature Sensor: The system shall include a supply air temperature sensor used to control the supply air temperature +/- 0.2 degrees F of supply air temperature setpoint under steady state conditions.

5. BMS Compatibility: The unit's controller shall have BMS compatibility:

G. Condensate Drain Pan: The drain pan shall be 20-gauge stainless steel, sloped, and positioned under the dehumidifier coil. The drain pan shall be TIG welded and securely attached to the evaporator endplates to avoid shifting. The drain pan shall be fitted with a minimum 1-inch non-corrosive plastic drain connection. The drain pan shall meet all the requirements of ASHRAE Standard 62.

H. Supply Air Blower Assembly:

1. 4 - 15 Ton Units: The blower housing shall be made of galvanized steel and mounted on permanently lubricated sealed ball bearings. The blower assembly shall be forward curved, centrifugal; it shall be dynamically and statically balanced with a stainless steel fan shaft. The blower housing shall be vibration isolated.

2. 20 - 30 Ton Units: The blower housing shall be made of heavy gauge welded steel einforced with steel stiffeners and painted with an anticorrosive paint. The shaft bearings shall be self-aligning, deep groove ball type, in pillow block housings. The blower assembly shall be an airfoil impeller with backward inclined airfoil shaped blades; it shall be dynamically and statically balanced. The fan shaft shall be made with hardened steel, precision ground and polished, and incorporates keyways for the wheel hub and sheaves.

3. Blower Discharge: The unit's air discharge shall be as shown on the Drawings.

4. Blower Pulley Assembly: The driver pulley and the blower pulley shall be made of cast iron. The motor sheave shall be a variable pitch type to allow for field adjustment of CFM and external static pressure, and shall be dynamically and statically balanced. The drive service factor shall be a minimum of 1.4.

5. Blower Motor: Unless otherwise specified, blower motors 7.5 hp and less shall be TEFC; 10 hp and above shall be ODP class B insulated, continuous-duty, 40 degrees C ambient, three-phase overloads. The motor shall be UL listed. All motors greater than 3 hp shall be premium efficiency to comply with E.I.S.A where applicable.

I. Air Filters: The system shall be provided with MERV 11 disposable filters consisting of 4-inch pleated filter.

J. Outdoor Condenser:

1. Cabinets: G90 galvanized steel cabinet with venturi fan panels and fully baffled fan cells.

2. Coils: Round tube coils-enhanced tubing with advanced sinusoidal fin design. Fins shall be die-formed, raised lanced aluminum and damage resistant. Tubes shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coils shall be a minimum of two (2) rows deep. Coils shall be leak tested and UL listed.

   a. Provide optional, ElectroFin E-Coat uniform, flexible coating over the entire coil.

3. Fans: Corrosion-resistant vertical upblast propeller fans with guard.

4. Motors: Direct drive external rotor motors with enclosed motor lead raceways to protect wiring.

5. Electrical: Provide corrosion-resistant, weatherproof electrical enclosure with door switch interlock. Enclosure shall include main terminal block for motor lead termination, main disconnect switch, and class J fuses.

**2.24 - AIR-COOLED CONDENSING UNITS**

A. Provide outdoor-mounted, factory-assembled, single piece, air-cooled condensing unit consisting of an air-conditioning compressor assembly, an air-cooled coil, propeller-type condenser fans, and a control box. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant holding charge, and all accessories indicated. Unit shall have single or multiple independent refrigeration circuits as is furnished standard by the manufacturer. Unit shall discharge cooling air vertically upward. Unit shall be used in a refrigeration circuit matched with a packaged fan coil unit.

B. Unit shall be rated in accordance with ARI Standard 210/240 or 365 as applicable. Unit construction shall comply with ANSI/ASHRAE 15 safety code latest revision and comply with NEC. Unit shall be constructed in accordance with UL standards and shall carry the UL label.

C. Unit Cabinet:

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a pre-painted baked enamel finish. Unit cabinet shall be capable of withstanding 500 hour salt spray exposure per ASTM B117 (scribed specimen).

2. A heavy-gage roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging. Unit shall have hinged or removable panels for service access to all components.

D. Fans:

1. Condenser fans shall be direct driven, propeller-type with fan blades statically and dynamically balanced. Condenser fan discharge openings shall be equipped with wire safety guards constructed of coated steel or corrosion resistant metal. Condenser fan and motor shaft shall be corrosion resistant.

E. Compressors:

1. Compressors shall be of the hermetic scroll type or semi-hermetic reciprocating type and be mounted on vibration isolators. Compressors shall be equipped with overload protection, and factory-installed crankcase heater to control oil dilution. Reciprocating type compressor speed shall not exceed 1,750 rpm and scroll type compressor speed shall not exceed 3,500 rpm. Unloading compressors shall unload using pressure-operated suction cutoff unloading.

F. Condenser Coils:

1. Condenser coils shall be air-cooled and circuited for integral subcooler. Coils shall be constructed of aluminum fins or copper fins mechanically bonded to internally grooved seamless copper tubes which are then cleaned, dehydrated, and sealed. Condenser coils shall be leak tested and pressure tested.

2. Coils shall be protected by a sheet metal casing to eliminate the need for wind baffles and avoid damage due to the elements and vandalism.

G. Refrigeration Components:

1. Refrigeration circuit components shall include liquid line service valve, suction line service valve, automatically reversible oil pump, a full charge of compressor oil, and a holding charge of refrigerant. Units with semi-hermetic compressors shall have oil-level sight glass and muffler.

H. Controls and Safeties:

1. Minimum control functions shall include:

a. Power and control terminal blocks.

b. Time delay protection to prevent compressor short-cycling.

c. Compressor lockout on auto-reset safety until reset from thermostat.

d. Head pressure control to fixed ambient temperature set point between 50 to 55 degrees F (unless otherwise indicated for low ambient controller) by fan cycling. One condenser fan shall be cycled by ambient temperature to maintain proper head pressure.

e. Capacity control on the lead compressor shall be by suction cutoff unloaders in response to compressor suction pressure.

2. Minimum safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:

   a. High discharge pressure cutout.

   b. Low suction pressure cutout.

   c. Compressor high discharge temperature cutout where required.

   d. Compressor oil pressure switches.

   e. Condenser fan motors protection against overload or single-phase condition by internal overloads.

   f. Electrical overload protection through the use of definite-purpose contactors and calibrated, ambient-compensated, magnetic trip circuit breakers. Circuit breakers shall open all 3 phases in the event of an overload in any one of the phases or a single-phase condition.

I. Electrical Requirements:

1. Unit electrical power shall be single-point connection. Unit control circuit shall contain a 24-volt transformer for unit control.

**2.25 - HEAT PUMPS (SPLIT SYSTEM TYPE)**

A. General:

1. Air source heat pump units, split system type, factory made assembly, consisting of an indoor section and an outdoor section, designed to work together to provide year round space heating and cooling functions. The separate sections shall be standard commercial products of the same manufacturer, and shall have ratings based on their being used as matched assemblies. Refrigerant type shall be as indicated. Provide capacity, electrical characteristics, and operating conditions as indicated.

2. Units shall be certified as complying with provisions of ARI 210/240, ARI 270, ARI 340/360, and UL 1995, as applicable. Minimum Coefficient of Performance (COP) and/or Energy Efficiency Ratio (EER) shall be in accordance with the required levels stated in the specified Energy Code. Rating shall be at unit maximum speed.

B. Indoor Section:

1. Indoor section shall be factory assembled duct-free, direct-expansion, heat pump unit with matching air-cooled outdoor section. Unit shall be complete with heating/cooling coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Where wall-mounted, unit shall be furnished with integral wall-mounting bracket and mounting hardware.

2. Cabinet: Cabinet discharge and inlet grilles shall be styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

3. Filter: Unit shall have filter rack with factory-supplied cleanable filters.

4. Fan: Fan shall be centrifugal blower type with air intake in the bottom rear of the unit and discharge in the front.

5. Fan Motor: Motors shall be permanently lubricated ball bearing with inherent overload protection. Fan motors shall be multi-speed.

6. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. Coils shall be cleaned, dehydrated, and sealed. Drip pan under the coil shall have a drain connection to remove condensate.

7. Controls: Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 64 to 84 degrees F or similar. A time delay shall prevent compressor restart in less than 3 minutes.

C. Outdoor Section:

1. Outdoor section shall be a factory assembled, single piece, air-cooled unit consisting of outdoor coil, propeller type fan arranged for vertical or horizontal discharge, refrigerant circuit with filter-dryer, and hermetically sealed compressor with crankcase heater, internal overload protection and pressure relief valve, all contained in a weather resistant outer casing. Defrost controls, and necessary tubing, piping, controls, control circuits, and required accessories shall be provided. Time delay relays shall be provided for sequence starting where two or more compressors are used, and to prevent short cycling or rapid restart after shut down. System shall be factory pre-charged with oil and refrigerant. Outer casing shall be provided with lifting attachments and have easily removable panels for access to all parts of the equipment.

2. Cabinet: Cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish that can withstand 500 hours salt spray under ASTM B117 test method. Unit access panels shall be removable and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall have built-in vibration isolation and have an acoustic lining.

3. Fan: Outdoor fan shall be direct-drive propeller type. Shaft shall have inherent corrosion resistance. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.

4. Fan Motor: Outdoor fan motor shall be totally-enclosed, single-phase with class B insulation and permanently-lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.

5. Compressors: Compressors shall be fully hermetic reciprocating or scroll type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil. Scroll compressors shall be equipped with crankcase heaters and also have high discharge gas temperature protection if required. Compressor assembly shall be installed on rubber vibrations isolators and shall have internal spring isolation. Compressors shall be single-phase or 3-phase as indicated on the Drawings.

6. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes which are cleaned, dehydrated, and sealed. Coils shall be cleaned, dehydrated, and sealed.

7. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, bi-flow filter drier, pressure relief, reversing valve, and heating mode metering device.

8. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested.

D. Electrical Requirements: Power and control connections shall have terminal block connections

**2.26 - HOT WATER COILS (DUCT MOUNTED)**

A. Water coils shall be continuous circuit type, drainable type, with number of rows to meet performance requirements. Water coils shall have plugged drain and vent taps. Water coils shall be pitched down toward the drain end. Each tube shall drain substantially dry by gravity alone when drains and vents are open. Coils shall be capable of being purged free of water with compressed air. Coils more than two rows deep shall be counterflow type, except that in the case of double- or half-circuit coils, reasonable deviation from counterflow arrangement will be permitted, provided the pressure drop and capacity requirements are met.

B. Coil Ratings: Coils shall be ASHRAE 33 tested. Water coils shall be rated for minimum 200 psig and 32 to 250 degrees F. Coils shall be tested at minimum 300 psig air pressure without leaks.

C. Coil Casings: Casing and tube support sheets shall be galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Casings shall have welded seams, duct flange connections for duct-mounting and threaded connections for vertical hanger rods.

D. Coil Headers: Coil headers shall be cast iron, brass, or copper casting. Water coil headers shall be fitted with a plugged vent and drain connection extending through the unit casing.

E. Coil Tubing: Coils shall be fin-and-tube type constructed of seamless copper serpentine tubes and aluminum or copper fins mechanically bonded or soldered to the tubes.

**2.27 - HOT WATER UNIT HEATERS**

A. Unit heaters shall be ASHRAE 33 tested for heating coils, UL listed for motor and controls and factory assembled. Control circuit shall be 115 VAC.

B. Casing:

1. Casings shall be steel with welded seams and shall have threaded connections for vertical hanger rods.

2. Either removable access panels shall be provided or a means to facilitate removing, servicing, and maintaining major components.

3. Unit heaters shall have adjustable steel discharge louvers.

4. Fan guards shall be provided on unit heaters.

5. Casings shall be factory-painted after fabrication.

C. Coil:

1. Coil shall have seamless copper serpentine tubes and aluminum or copper fins mechanically bonded to the tubes. Coils shall be ASHRAE 33 tested. Water coils shall be rated for minimum 150 psig and 300 degrees F. Coils shall be tested at minimum 200 psig air pressure without leaks.

D. Fan and Motor:

1. Fan blades shall be aluminum or steel, statically and dynamically balanced at factory.

2. Electric motor shall have integral overload protection and shall be mounted away from coil and heated air stream. Provide prewired fan motor contactor.

3. Motor and fan shall be separated from heater by resilient vibration isolators.

E. Unit heaters for use in chemical rooms shall be coated with corrosion resistant coating.

**2.28 - HOT WATER CABINET UNIT HEATERS**

A. Provide blower-convector type with cabinet heater finned heating elements, two or more centrifugal fans, motor, filters and appurtenances mounted in self-supporting 16-gauge minimum pressed steel cabinet with inlet and outlet grilles, arrangement as indicated.

B. Provide 1-inch thick throwaway filters.

C. All hydronic units shall have piping end pockets.

D. Hydronic coils shall be tested for 200 psi working pressure.

E. The unit shall have a unit mounted motor speed control switch, with high, medium, low and auto positions.

F. Blowers shall be centrifugal DWDI, forward curved type and provided with a disconnect switch, type as required for the area the unit is to be located.

**2.29 - GAS-FIRED UNIT HEATERS (SEPARATED COMBUSTION TYPE)**

A. High-efficiency, separated-combustion, power vented, gas-fired unit heaters. The unit shall be designed for use in a building with negative pressures up to 0.15" w.c. and for use in a building with a non-explosive atmosphere, that is dust laden and/or contains mildly corrosive fumes.

B. Burner:

1. Unit shall be equipped for use with natural gas. Gas connection shall be external to the cabinet.

2. One piece burner assembly with a single orifice. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior, with a single venture tube and orifice supplying fuel to a one-piece burner housing. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.

C. Heat Exchanger: Heavy-gauge 316 stainless steel heat exchanger. Each heat exchanger shall use balanced draft induction to maintain optimum flame control.

D. Controls:

1. Controls shall include a 24-volt control transformer; gas control system, fan and limit safety controls, including an energy cut off device and a combustion air differential switch to verify proper vent flow before allowing operation of the gas valve. Fan motors shall be provided with internal overloads.

2. Controls shall include a two-stage gas valve; direct spark multi-try ignition with electronic flame supervision with 100% lockout. The control board shall also incorporate diagnostic lights, DIP switches for fan overrun settings, and a relay for fan only operation. All units shall be equipped with a safety limit switch.

3. All controls shall be enclosed in the sealed control compartment.

E. Combustion Air and Venting:

1. The unit shall have a factory installed power venter device to draw combustion air from outside of the building. The outside air shall enter the unit through a factory-installed inlet air terminal. The control compartment shall be sealed and the access door shall be gasketed to prevent contaminants present in the heated space from entering the unit. The control compartment door shall be equipped with a safety interlock switch to prevent operation when the door is open.

2. The combustion air supply pipe and flue exhaust pipe shall be run in parallel from the heater to a factory supplied concentric adapter assembly, which allows for a single wall or roof penetration, to the air inlet and vent terminal.

3. The combustion air/venting system shall include a vibration isolated power venter motor and wheel assembly and a combustion air pressure switch.

F. Fan: Balanced propeller-type fan directly mounted to motor shaft mounted on vibration-absorbing support and dynamically balanced. Provide full safety fan guard.

G. Provide combination gas valve which consists of a combination pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff and manual shutoff all in one body.

H. Cabinet:

1. Pressed steel casing with adjustable louvers on discharge opening. Cabinet finished with manufacturer's customary lacquer or enamel.

2. The unit shall be designed with a full opening service access panel complete with screw closure attachment and lifting handle for removal. Service panel shall be fully gasketed and equipped with a safety interlock switch. All components in the gas train, all standard electrical controls, and the power venter shall be within the sealed service compartment.

I. Electrical: All internal wiring, both line and 24 volt control voltages, shall be terminated by insulated terminal connectors. All units will be equipped with a built-in disconnect switch.

J. Provide concentric air/vent kit including concentric adapter

**2.30 - ELECTRIC UNIT HEATERS (STANDARD)**

A. UL listed; wattage, voltage, phase, and number of steps as indicated. Provide control-circuit terminals and single source of power supply. Heaters 5 kW and larger shall be three-phase, with load balanced on each of the three phases. Limit leaving air temperature below 140 degrees F at 60 degrees F entering air. Conform to NEMA MG 1, NEMA ICS 2, and NEMA ICS 6.

B. Casing:

1. The cabinet shall be made of minimum 21 gage die formed steel.
2. Individual adjustable louvers with 30 degrees downward stops shall be furnished to provide desired control of discharge air.
3. All metal surfaces of the enclosure shall be phosphate coated to resist corrosion and finished in baked enamel.
4. Mounting brackets designed for either ceiling or wall swivel mounting shall be furnished.

C. Heating Element:

1. Nickel-chromium heating wire element, free from expansion noise and 60 Hertz hum. Embed element in magnesium-oxide insulating refractory. Seal element in high-mass steel or corrosion-resisting metallic sheath with fins. Enclose element ends in terminal box. Space fins at maximum six fins per inch. Limit fin surface temperature 550 degrees F at any point during normal operation.

D. Controls:

1. Include limit controls for thermal overheat protection of heaters. For remote thermostatic operation, provide contactor rated for 100,000 duty cycles.
2. Provide a control transformer to supply 120-volt thermostat control circuit for each heater.
3. Provide room thermostat for pilot duty.
4. Provide fan switching devices to independently operate fan motor for summer ventilation and winter heat recovery as indicated in the schedules.

E. Wiring:

1. Completely factory-prewired to terminal strips, ready to receive branch circuit and control connections for 140 degrees F copper or aluminum wiring.

F. Fan and Motor:

1. Provide aluminum fans with ball or roller bearings for motors over 1/8 hp and sleeve bearings for motors 1/8 hp and under. Provide sleeve bearings with oil reservoir, if not permanently lubricated.
2. Provide continuous-duty motor with built-in automatic reset thermal overload protection.
3. For motor 1/2 hp and larger, use three-phase. Provide single-phase motor of permanent split capacitor or capacitor start. Limit motor speed at 1,800 rpm. Wire motor to heater power supply source.

**2.31 - SHEETMETAL DUCTWORK**

A. Provide all ductwork consisting of ducts, plenums and sleeves as required for the various air systems. Except for in chemical storage areas, all ductwork shall be sheetmetal ductwork as specified herein. Ductwork in or serving chemical storage areas and specific process areas as identified on the Drawings shall be fiberglass reinforced plastic conforming to SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

B. Unless otherwise indicated to be galvanized steel or stainless steel, ductwork shall be constructed of aluminum conforming to ASTM B 209 alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and barstock. Galvanized steel ductwork shall conform to ASTM A924 and ASTM A653, Designation G90, lock-forming quality. Stainless steel ductwork shall conform to ASTM A 167. All ductwork, except where specified otherwise herein, shall be fabricated in accordance with the "HVAC Duct Construction

Standards for Metal Ducts" published by the Sheetmetal and Air Conditioning Contractors National Association, Incorporated (SMACNA). Apply SMACNA aluminum thickness adjustment to Pressure Class tables.

1. Rectangular Duct Construction: Provide 2-inch w.g. positive/negative pressure class.
2. Round Duct Construction: Provide 2-inch w.g. negative pressure class.
3. All ductwork transverse joints, longitudinal seams, and duct penetrations shall be sealed in conformance with SMACNA seal classification A

C. Ductwork shall be true to the inside dimensions indicated. Cross break all duct panels over 12 inches wide. Support ducts rigidly and securely. Support horizontal ducts not over 8 feet on center. Ductwork shall be straight and smooth on the inside with neatly finished joints.

D. Elbows narrower than 16 inches shall be full radius elbows with inside radius equal to the dimension of the duct in the plane of the elbow or offset. Elbows wider than 16 inches may be full radius elbows or square elbows with air foil section turning vanes (Duct Manual Figure 2-3) and 6-inch inside radius. Vanes shall be "Runner" type 2, 3 1/4-inches on centers. Install outside vane flush against the outside of the elbow.

E. Transitions in ductwork shall be made with a 20 degree maximum angle projected from the straight duct side on a diverging transition and a 30 degree maximum angle projected from the straight duct side on a converging transition. Any conditions requiring deviations from the above shall be brought to the attention of the Engineer for acceptance. Duct aspect ratios shall not exceed 4 to 1.

F. All notches for connecting sections of duct, including longitudinal seam notches, shall not be cut any deeper than 1 7/8-inches to ensure tight corners in 2-inch deep slip joints.

G. Slips shall be at least two gauges heavier than the ductwork and all joints shall be made in a neat and workmanlike manner and in all cases shall be tight. All ductwork shall have all joints sealed with EC-800 as manufactured by 3M, hardcast or accepted equal. Sealing tapes shall not be permitted.

H. Sheet metal screws shall be stainless steel.

I. Welding hood fume exhaust ductwork shall be ASTM A167 304 stainless steel, minimum 14 gauge (0.064 inch thick) single wall round duct, smooth wall longitudinal seam. Round duct male ends shall be facing downstream. All joints shall be sealed with EC-800 as manufactured by 3m, hardcast or approved equal. Sealing tapes shall not be permitted. Sheet metal screws shall be stainless steel.

**2.32 - FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK**

A. Ductwork in or serving chemical storage and specific process areas as identified on the Drawings shall be fiberglass reinforced plastic ductwork in accordance with SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

**2.33 - FLEXIBLE DUCT**

A. Flexible duct shall be used only at connections to supply air diffusers. Length shall not exceed 3 feet.

B. Flexible duct shall be pre-insulated, factory fabricated, and comply with NFPA 90A and UL 181 with maximum 25/50 flame spread/smoke developed rating per ASTM E-84. Duct shall be 16 inch wg. positive and 1 inch wg. negative pressure rated and maximum 5000 fpm rated air velocity. Flexible duct shall have multi-ply metalized polyester core or equal with wire helix, minimum R-5 flexible insulation, and vapor barrier jacket. Insulation material shall not be exposed to the air stream

**2.34 - DUCTWORK ACCESSORIES**

A. Duct Flexible Connectors: Provide flexible connectors at fan and unit inlets and outlets. Flexible connectors shall be coated fabric with corrosion resistant metal edge designed for fastening to adjoining ductwork. Flexible connectors shall be UL listed, maximum 25/50 flame spread/smoke developed rating complying with NFPA 90 A, -40 to 200 degrees F temperature range or wider range, waterproof, mildew resistant, and airtight. Flexible connectors shall be minimum 6-inch wide. Leave 1-inch minimum slack (this means 1/2-inch standing fold). Duct openings shall be lined up on either side of flexible connections.

B. Wire Mesh Screens: 1/2-inch by 1/2-inch woven wire mesh. Weld screen to frame constructed of two (2) sheets with the screen sandwiched between the sheets. Frame shall have provisions and attachment components for mating to round and/or rectangular duct end-flange. Materials shall match adjoining ductwork material except shall be series 300 stainless steel in outdoor locations, in indoor chemical areas, in indoor areas with exposed water surfaces such as water channels, in indoor areas with exposed sludge, and in otherwise corrosive areas.

C. Volume Dampers:

1. Provide volume dampers in all outside air ducts connected to return air ducts; in all branch take-offs to diffusers, registers and grilles; and where otherwise indicated.

2. Dampers shall be manually adjustable single blade and/or multi-blade dampers for rectangular ductwork. Dampers shall be manually adjustable round butterfly dampers for round ductwork.

3. Brackets shall be secured to ductwork with sheet metal screw with locking quadrant arms. Provide 2-inch handle extension for all dampers on externally insulated ductwork.

4. Damper materials shall match the ductwork materials in which installed.

D. Fire Dampers:

1. Provide horizontal and vertical UL labeled, dynamic type fire dampers with rating to suit the barrier penetrated. Assembly shall be of the fully enclosed type with duct collars and dampers that consists of formed steel blades with 100 percent interlocking joints to form a continuous steel curtain when closed. Assembly shall be suitable for horizontal and vertical air flow. Dampers shall meet NFPA 90A requirements.

2. Provide 16-gauge galvanized steel duct sleeves for dampers in ducts with maximum height dimension of 24 inches and maximum width dimension of 36 inches, and 14-gauge sleeves for larger ducts. Depth of sleeve shall be sufficient to install perimeter angles attached to the sleeve on both sides of the wall or floor opening as required by UL-555. Sleeves and housings shall be constructed and installed in accordance with SMACNA HVAC Install Fire Damper, Case 2 or Case 3 of Figure 5 and Case 2 or Case 3 of Figure 6. Connection of duct to the fire damper sleeve or housing shall be rigid and sealed air tight.

3. Fire dampers shall be designed and constructed so that the blade stack in the open damper position is completely outside of the air stream.

4. Where duct pass through fire walls or partitions, the spaces around the duct sleeves shall have the necessary clearance for expansion in conformance with the UL approval. Installation shall conform to all UL-555 requirements.

5. For fire dampers in corrosive air streams or corrosive areas, provide stainless steel fire dampers.

E. Counter-Balanced Backdraft Dampers:

1. Frame shall be extruded aluminum channel. Blades shall be extruded aluminum with extruded vinyl blade edge seals mechanically locked into blade edge. Adhesive or clip on type seals shall be unacceptable. Blades shall include field adjustable, zinc plated steel counter balance weights to allow pressure relief between 0.01 and 0.05 inch w.g. Bearings shall be dustproof ball type for low pressure operation. Linkage shall be tie-bar connected to stainless steel pivot pins. Dampers shall be designed for maximum 3500 fpm spot velocities and minimum 4 inches w.g. back pressure.

F. Sheet Metal Access Doors:

1. Provide access doors of the proper size and at all locations in ductwork necessary to service fire dampers, control devices, fan bearings and to service all systems.

2. Access doors shall have foam gasketing, fixed hinges and compression type latches as furnished by Ventlock, Duro-Dyne or equal. Access doors for insulated ducts shall be insulated with minimum 1-inch thick coated duct liner.

3. Where sizes of duct access doors are not indicated, provide sizes in accordance with the following table. The edge of duct access doors nearest to the device which it serves shall be within 12 inches of such device. Install access doors in long side of duct in accessible location. Where dimension of short side of duct is 14 inches or greater, access doors may be located in duct short side subject to accessibility requirements of the pecifications.

| **Dimension of Long Side of Duct Inches** | **Duct Access Door Size Inches** |
|---|---|
| 8 | 6x6 |
| 10 | 8x8 |
| 12 | 10x10 |
| 14 or greater | 12x12 |

**2.35 - DIFFUSERS, REGISTERS AND GRILLES**

A. Provide factory-furnished diffusers, registers and grilles with white baked-on enamel finish of material, styles, borders and sizes indicated. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Provide sponge-rubber gasket between flanges and wall or ceiling. Diffusers, registers and grilles material of construction shall match the duct system, 316 stainless steel for corrosive areas, unless specified otherwise.

B. Manufacturer certified sound pressure level rating of inlets and outlets shall conform with NC 30 maximum.

C. Ceiling Diffusers shall be equipped with baffles or other devices required to provide proper air distribution pattern as indicated. Provide factory-fabricated, single key, volume dampers. Internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

D. Supply registers shall be adjustable double-deflection supply registers.

E. Exhaust and return grilles shall have a set of fixed face bars or vanes.

**2.36 - CENTRIFUGAL IN-LINE FANS**

A. UL 705, centrifugal belt driven in-line type. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

1. Where indicated, units shall be “All-Aluminum” construction consisting of aluminum housing, stainless steel fan shaft, and stainless steel fasteners. Motors, bearings, drive sheaves, and their related fasteners shall be standard steel construction.

B. The fan housing shall be of the square design constructed of galvanized steel (standard) or aluminum and shall include square duct slip fit mounting collars, stationary discharge conversion vanes, internal and external belt guards and adjustable motor mounts. Casing shall be welded. Air shall enter and leave the fan axially. Inlet shall be streamlined and conversion vanes shall eliminate turbulence and provide smooth discharge air flow. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels shall be of sufficient size to permit easy access to all interior components.

C. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include an aluminum hub and a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. Enclose fan bearings and drive shafts, and isolate from the air stream. Fan bearings shall be mechanically sealed against dust and dirt and shall be self-aligning, pillow block ball or roller type.

D. Motors shall be heavy-duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.

E. Belt drive frames shall be formed steel channels. Drive frames shall be bolted construction or welded construction. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be variable pitch, sized for minimum 130 percent of the installed motor horsepower. Belts shall be oil and heat resistant, non-static type. Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks.

**2.37 – TUBE AXIAL IN-LINE FANS**

A. Tube axial type with cast aluminum airfoil propellers statically and dynamically balanced. The housing shall be constructed of continuously welded steel and include integral punched inlet and outlet flanges to prevent air leakage. The housing, bearing support, and motor base shall be constructed of structural members to prevent vibration and rigidly support the shaft, bearings, and motor. Bearings shall be cast iron pillow block, grease lubricated, and self-aligning. Bearings shall be selected for an L(10) life, per ABMA standards, in excess of 40,000 hours. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 25 percent over the maximum operating speed for each level of construction. Steel housings and structural components shall have factory-applied painting system. Fan performance shall be based on tests conducted in accordance with AMCA Standard 210. All fans shall be licensed to bear the AMCA Certified Ratings Seal for Air Performance.

**2.38 - SIDEWALL PROPELLER FANS**

A. Belt driven, axial type sidewall propeller fans.

B. Propellers shall be constructed with fabricated steel or fabricated aluminum. Propellers shall be securely attached to fan shafts. All propellers shall be statically and dynamically balanced.

C. Motors shall be permanently lubricated, heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure.

D. Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase. Fan Shaft shall be ground and polished solid steel with an anti-corrosive coating. Bearing shall be cast iron pillow block with grease fittings. Bearings shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed. Bearing shall be air handling quality and 100% factory tested by bearing manufacturer. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

E. Drive Assembly: Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower. Belt: Static free and oil resistant, readily accessible for maintenance. Fully machined cast iron pulleys, keyed and securely attached to the wheel and motor shafts. The motor pulley shall be adjustable for final system balancing.

F. Drive Frame: Bolted structural steel channel construction shall be galvanized steel with one piece drawn venturi.

G. The axial exhaust fans shall bear the AMCA Certified Ratings Seals for both sound and air performance.

**2.39 - VIBRATION ISOLATION (NON-SEISMIC)**

A. General:

1. Provide field-installed vibration isolation as specified herein. Isolators shall be selected by the isolator manufacturer, so as to produce uniform deflection. Furnish load data to the isolator manufacturer for the equipment to be supported indicating loads (weights) at each support point for the equipment.
2. Vibration isolation shall limit vibration transmissibility to a maximum 5 percent of the unbalanced force at lowest equipment speed.
3. Equipment indicated with external vibration isolation kit as an accessory is not part of this paragraph.

B. Quality Assurance:

1. All vibration isolators shall have calibration markings or some method to determine adjustment, and the actual deflection under the imposed load after installation and adjustment.
2. All isolators shall operate within the linear portion of their load vs. deflection curves. Load vs. deflection curves shall be linear over a deflection range of not less than 50 percent above the design deflection.
3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than 10 percent.

C. Description:

1. All vibration isolation devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance, and deflections of the base manufacturer.
2. Acceptable manufacturers of vibration isolation products shall be: Mason Industries, Amber Booth Company, Peabody Noise Control, Korfund Dynamics Corporation, Vibration Mountings and Equipment, Vibration Eliminator Co., and Thybar Corporation provided they meet the requirements of this specification. Mason Industries model numbers have been used in this specification to establish quality of components, but are in no way to limit competitive bidding by other manufacturers.
3. Refer to Table 15500-1 at the end of this article for application of the various types listed to appropriate equipment and efficiency level.
4. All vibration isolation products shall be factory painted (epoxy).

D. Vibration Isolator Types:

1. Type 1: Elastomer hanger rod isolator.
    a. Molded (minimum 1 3/4-inch thick) neoprene element with projecting bushing lining the rod clearance hole.
    b. Steel retainer box encasing neoprene mounting capable of supporting equipment up to four times the rated capacity of the element.
    c. Minimum 0.35-inch static deflection at rated load.
    d. Mason Industries Type HD, or equal by Isotech or Kinetics Noise Control
2. Type 2: Spring mount isolator
    a. Minimum OD (outside diameter) to OH (compressed height) ratio = 0.80:1.0
    b. Reserve deflection (from loaded to solid height) of 50 percent of rated deflection.
    c. Minimum 1/4-inch thick neoprene acoustical base pad on underside.
    d. Designed and installed so that ends of springs remain parallel.
    e. Non-resonant with equipment forcing frequencies or support structure natural frequency.

f. Hot dipped galvanized holders with cadmium plated hardware. Springs shall be cadmium plated or galvanized.

g. Minimum static deflection at rated load indicated in Table 15500-1 of this paragraph.

h. Mason Industries Type SLF , or equal by Isotech or Kinetics Noise Control

3. Type 3: Combination spring/elastomer hanger rod isolator.

a. Spring and neoprene elements in a steel retainer box with the features as specified for Type 1 and 2 isolators.

b. Minimum static deflection at rated load indicated in Table 15500-1 of this paragraph.

c. Mason Industries Type WHS, or equal by Isotech or Kinetics Noise Control

E. Pipe Flexible Connectors

1. Provide flexible connectors at pumps. All connectors shall be installed on the equipment side of shutoff valves, horizontal and parallel to shafts whenever possible.

2. Manufactured of kevlar or nylon tire cord and EPDM, both molded and cured in hydraulic presses.

3. Straight pattern double sphere connectors, reinforced with a molded-in external ductile iron ring between the spheres, with floating ASA drilling flanges (Class type to match adjacent equipment and piping flanges).

4. Rated at 250 psi/170 degrees F, dropping in a straight line to 170 psi/250 degrees F for sizes 1 1/2 to 12 inches.

5. Connectors shall be pre-extended per manufacturer's recommendation to prevent elongation under pressure.

6. Minimum safety factor of 3.6:1 at a maximum pressure rating shall be certified by test reports.

7. Connectors bolted to gate, butterfly of check valves to have a minimum 5/8-inch flange spacer installed between the connector and the coupling flange.

8. Mason Industries Type SFDEJ, or equal by Isotech or Kinetics Noise Control

F. Execution:

1. General

a. Isolation systems shall be installed in strict accordance with the manufacturer's written instructions. Vibration isolator shall not cause any change of position of equipment resulting in stress on equipment connections.

2. Equipment Installation

a. Equipment shall be isolated as per Table 15500-1 at the end of this article.

b. Additional requirements:

(1) After the entire installation is complete, and under full operational load, the isolators shall be properly adjusted. Verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions.

(2) Install equipment with flexibility in wiring.

**Table 15500-1**

| Equipment | MTNG | ISOL | BASE | DEFL |
|---|---|---|---|---|
| Air Handling Units | Ceiling or wall | Type 3 | -- | 0.75 in. |
| Air Conditioning Units | Ceiling | Type 3 | -- | 0.75 in. |
| Centifugal In-Line Fans | Ceiling | Type 3 | -- | 0.75 in. |

| | | | | |
|---|---|---|---|---|
| Unit Heaters | Ceiling | Type 3 | -- | 0.75 in. |
| Centrifugal In-Line Pumps | Ceiling or Wall | Type 3 | -- | 0.35 in. |
| NOTES:<br>1. "ISOL" and "BASE" column indicates letter type as appears in the specs.<br>2. "MTNG" refers to method of support of equipment from the structure. | | | | |

**2.40 - GLYCOL SOLUTION**

A. Provide hydronic heating piping systems with 40 percent propylene glycol solution.

B. Concentrated propylene glycol shall be 96 percent (maximum) glycol and 4 percent (minimum) corrosion inhibitors. The glycol shall be tested in accordance with ASTM D1384 with less than 0.5 mils penetration per year for all system metals. Manufacturer shall be Dow Chemical, Union Carbide, Equitherm, or equal. Silicate based inhibitors shall not be permitted. Automotive type antifreeze shall not be permitted. The solution shall be compatible with pump seals, boilers, other elements of the system, and all water treatment chemicals used within the system.

C. Glycol shall be added to the system after system has been pressure tested, chemically cleaned, flushed with water and drained.

**2.41 - WATER TREATMENT EQUIPMENT**

A. Provide bypass feeder complete with two (2) system connections, fill port, and drain for each system. Bypass feeder shall be rated for 300 psig at 200 degrees F with steel tank and gasketed cast iron or steel cover. Feeder shall also include valves, funnel, drain, filter and support legs. Tank size shall be as indicated.

**2.42 - WATER TREATMENT**

A. Retain a Water Treatment Firm to provide cleaning, flush out, water chemical treatment and glycol blending in all heating hot water (hydronic) piping systems. Submit certification stating that flushing out, chemical treatment and glycol blending have been completed satisfactorily.

B. Qualifications of the Water Treatment Firm: The Water Treatment Firm shall have a minimum of five years of experience in the water treatment business; have laboratory facilities and staff capable of performing all necessary analyses relating to this job. All treatment programs shall be performed under the direction of a qualified graduate chemist or qualified licensed professional engineer.

C. A service contract agreement satisfactory in form and substance to the Owner shall be executed between the HVAC Subcontractor and the Water Treatment Firm through its authorized agents binding the Water Treatment Firm to provide service for the water treatment systems involved for a period of one year from the date of the initial system start and treatment thereof, as hereinafter described. The service contract agreement shall be assigned to the Owner on the Date of Substantial Completion so that water treatment will continue uninterrupted during the one year life of the service contract.

D. After completing the installation or modification and before initial system start of each system involved, the HVAC Subcontractor shall flush out and refill piping as specified prior to initial startup. The Water Treatment Firm shall supervise the cleaning, flushing out, and refilling of the systems involved. Flush-out chemicals and procedures shall be furnished by the Water Treatment Firm. Systems shall then be refilled as specified and treated chemically in accordance with recommendations of the Water Treatment Firm. Notify the Water Treatment Firm at least 48 hours in advance of initial system fill.

E. The Water Treatment Firm shall perform tests following the flush-out and refilling procedure and a written report submitted to the Engineer and Owner. Residual chemical levels shall be limited as follows unless more stringent levels are required by the manufacturer of the installed boilers:

1. Phosphate: 0 ppm
2. Total hardness: 0 ppm as $CaCO_3$
3. Suspended solids: 300 ppm maximum
4. Oxygen: 0.1 ppm maximum
5. Specific conductivity: 2000 ohm/cm maximum
6. pH: 8.3 to 10.5

F. The Water Treatment Firm shall supervise and instruct the Owner's operating personnel in the following:

1. Initial introduction of water treatment to all systems and the control thereof.
2. Chemical product literature, identification for use and application procedure.
3. Testing procedure and interpretation of test results and proper control limits for each constituent, and
4. Log sheets with instructions in correct entry procedure.

G. Repeat the process for the systems upon completion of each phase.

H. The Water Treatment Firm shall provide service calls at frequency of not less than one call per month during the course of its one year contract. Furnish all required chemicals for proper treatment of the heating hot water systems for the one year period together with the necessary control testing kit or apparatus and reagents for field analysis of the water during the aforementioned one year period.

1. For each service call, provide written reports of water analysis results with recommendations.
2. Provide a quarterly review of conditions to the Owner.

I. Hot Water Piping Treatment Equipment and Chemicals: Each system shall have a bypass feeder as described in the Paragraph entitled “Water Treatment Equipment” of this Section. The bypass feeder shall be piped across the suction and discharge pipes of the system. The hot water piping system shall be thoroughly flushed and cleaned with Dearborn BC 45 Cleaner, Dow, Barclay or equal, and charged with Dearborn B329 Nitrite Corrosion Inhibitor, Dow, Barclay or equal, after cleaning. Limits of 800 to 1000 mg/L shall be maintained. It shall be the responsibility of the HVAC Subcontractor to secure an agreement between the pump manufacturer and the Water Treatment Firm as to the proper level of treatment to be maintained in such systems to avoid damage to pumps and pump seals. A letter stating such understanding shall be submitted to the Engineer before acceptance of the pumps and the water treatment program.

J. Test Kits: All required test kits and reagents for determining the proper water conditions shall be provided.

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable state and local codes, at the HVAC Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - MANUFACTURER'S INSTRUCTIONS AND SERVICES**

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project.

B. Services shall be provided by factory-trained service engineers for the satisfactory completion of installation, start-up, adjusting, testing and training for those equipment and systems described herein below. Factory-trained service engineers shall be specifically trained on the type of equipment specified.

1. Hot water boilers

2. Dehumidifiers

C. Upon completion of all Work, furnish, in duplicate, certificates of inspection from equipment manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating condition.

**3.04 - PIPING INSTALLATION**

A. Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.9. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of piping thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other accepted methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

B. Piping shall not be permitted in electrical rooms and stairwells.

C. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Install piping to permit draining of all sections of each piping system without traps. Piping sections shall mean each section of piping between isolation valves. Pitch piping back to section low points. Provide drain valves at all piping section low points. Provide manual vent valves at all piping section high points.

E. Make provisions for pipe expansion and contraction with suitable anchors, offsets and expansion loops. Install piping accurately aligned to allow freedom of movement in all planes without imposing buckling, swaying, and undue stress on any section of the piping, equipment and structure. Anchors and pipe guides shall be provided where necessary and indicated to localize expansion or prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed using turnbuckles where required. Supports, anchors, or stays shall not be attached in places where construction will be damaged by installation operations or by the weight or expansion of the pipeline.

F. Provisions shall be made for the expansion and contraction of the hot water mains connected to the boiler by providing substantial anchorage at suitable points and by providing swing joints to allow the piping to expand and contract without imposing excessive forces on the boiler.

G. Furnish and install strain-free assembly of pipe and fittings to connect the return to the back section as recommended by the boiler manufacturer. Provide capped tees at all turns in the return piping to the back section of the boiler for cleaning of the return piping at or near the boiler.

H. Unless otherwise specified or shown, connections to equipment shall be made with unions or flanges for pipe 2 inches or less in diameter and with flanges for pipe 2 1/2 inches or more in diameter. Connections between ferrous piping and copper piping shall be electrically isolated from each other with dielectric couplings or other accepted methods.

I. Piping, General: Determine and establish measurements for piping at job site. Cut pipe to actual dimensions and assemble to prevent residual stress. Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted. Within buildings, run piping parallel to structure lines and conceal in finished spaces.

J. Pipe Joints:

1. Threaded Joints

a. Threaded joints shall be made with tapered threads properly cut and shall be made tight with a stiff mixture of graphite and oil, applied to the male threads only, and in no case to the fittings. Weeping of glycol solution at threaded joints shall not be acceptable.

2. Welded Joints

a. Welded joints shall be fusion welded in accordance with ASME B31.1, unless otherwise required. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction shall not be acceptable. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength.

b. All pipe welding shall be oxyacetylene or electric arc. Welding rods suitable for the material to be welded shall be used throughout. All special fittings shall be carefully laid out and joints shall accurately match intersections. Care shall be exercised to prevent the occurrence of protruded weld metal into the pipe. All welds shall be of sound metal free from laps, cold shots, gas pockets, oxide inclusions and similar defects.

c. Beveling: Field and shop bevels shall be in accordance with the recognized standards and shall be done by mechanical means or flame cutting. Where beveling is done by flame cutting, surfaces shall be cleaned of scale and oxidation before welding.

d. Alignment: Before welding, the component parts to be welded shall be aligned so that no strain is placed on the weld when finally positioned. Height shall be so aligned that no part of the pipe wall is offset by more than 20 percent of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operation. If tack welds are used, welds shall be of the same quality and made by the same procedure as the completed weld; otherwise, tack welds shall be removed during the final welding operation.

e. Erection: Where the temperature of the component parts being welded reaches 32 degrees F or lower, the material shall be heated to approximately 100 degrees F for a distance of 3 feet on each side of the weld before welding, and the weld shall be finished before the materials cool to 32 degrees F.

f. Defective Welding: Defective welds shall be removed and replaced. Repairing of defective welds shall be in accordance with ASME B31.1.

g. Electrodes: After filler metal has been removed from its original package it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3. Flanged Joints

   a. Flanges shall be faced true, and made square and tight. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thickness, full-face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service.

4. Soldered Joints:

   a. Soldering shall be performed in accordance with best soldering practice. Before soldering copper tubing joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Provide suitable flux for use with solder. Surplus soldering material shall be removed at all joints. Piping shall be supported prior to soldering and not be sprung or forced.

   b. For solder end valves, remove stems and washers and other items subject to damage by heat during installation. Reassemble valve after soldering is complete. Valves without heat sensitive parts do not require disassembly but shall be fully opened during soldering.

5. Brazed Joints:

   a. Brazing of copper tubing joints shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be continuously purged with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Piping shall be supported prior to brazing and not be sprung or forced.

K. Equipment Connections:

1. The size of the connections to each piece of equipment shall be not smaller than the connections on the equipment. No bushed connections shall be permitted. Change in sizes shall be made with reducers or increasers only.

2. All components shall be installed in accordance with manufacturer's installation instructions.

3. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow.

4. Circulating pump characteristics shall be such that the head of the pump under varying conditions shall not exceed the rated horsepower of the drive motor.

5. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the pumps even though piping adjustments may be required after the pipe is installed.

6. On components that require draining, HVAC Subcontractor shall provide piping to and discharging into appropriate drains.

L. Pipe Hangers and Supports:

1. Selection, application and installation of piping hangers and supports shall conform with MSS SP-58, unless otherwise indicated.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and contraction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers shall be 6 inches clear from other piping, hangers, conduits, lighting fixtures, equipment, ceiling suspension systems, ductwork and other obstructions. Where insulation or other covering is provided, minimum clearance shall take into account such covering.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Rod Sizes, MSS SP-58.

6. Piping to Receive Insulation:

   a. Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under SECTION 15520, HVAC INSULATION.

7. Maximum Spacing Between Supports:

   a. Support piping within one foot on either side of flanged valves, and in-line pumps. Support within 2 feet of wall penetrations.

   b. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support within 2 feet of floor and roof penetrations and within 2 feet of offsets and 90 degree turns.

   c. Horizontal Piping: Locate supports within one foot on either side of each change of direction. Otherwise, support steel piping and copper tubing as follows:

| **Maximum Spacing** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nominal Pipe Size inches** | **≦1** | **1 1/4** | **1 1/2** | **2** | **2 1/2** | **3** | **4** | **5** | **6** |
| Steel Pipe | 7 | 7 | 9 | 10 | 11 | 12 | 14 | 16 | 17 |
| Copper Tube | 5 | 7 | 8 | 8 | - | - | - | - | - |

8. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load.

9. Pipe hangers, inserts and supports shall conform to MSS SP-58, except as specified as follows:

   a. Types 5, 12, and 26 shall not be used.

   b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

   c. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

   d. Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.

   e. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

   f. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

M. Seismic Bracing Requirements:

1. Piping, ductwork and equipment shall be supported and braced to resist seismic loads and the seismic restraints shall be designed in accordance with SMACNA Seismic Restraint Manual.

2. Conform to the seismic design requirements of the specified Building Code. Site seismic criteria can be found on Drawing 00 S-001 of the Drawings.

N. Pipe Through-Penetrations:

1. Provide pipe sleeves where pipe passes through walls, floors, ceiling, roofs, and partitions. In new construction, sleeves will be installed, secured in proper position and location during construction by the trade whose element will be penetrated. Such trades include concrete, masonry, drywall and/or plaster in the case of framed construction. In existing construction, pipe sleeves shall be furnished and installed under this Section. Core drilled holes in masonry and concrete may be provided by this Section in lieu of pipe sleeves, however cored drilled holes in masonry shall have cavities completely grouted smooth under this Section. Furnish sleeves of sufficient length to pass through entire thickness of walls, floors and roofs.

2. Pipe Penetrations through Building Exterior Construction: Provide a mechanically adjustable segmented elastomeric seal, with sleeve sized as recommended by seal manufacturer.

3. Pipe Penetrations through Building Interior Construction: Provide not less than 1 1/2-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with rock wool insulation.

   a. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone.

   b. For fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with UL listed fill, void, or cavity material to maintain fire resistive integrity. Install firestopping assembly in accordance with UL FRD systems, and as recommended by manufacturer. Completely fill voids flush with the surface. Firestopping for filling voids in floors in which smallest dimension of a void is 4 inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed firestoppings shall be replaced with new firestoppings as specified in this Section.

4. Extend sleeves in floor slabs 2 inches above the finished floor. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

5. Seismic-braced pipe

   a. Proper clearances between penetrating piping and any barrier shall be provided. The penetrations holes shall be sized such that the hole diameter is 2 inches larger for pipe diameters 1-inch nominal to 3-inch nominal, and 4 inches larger for 4-inch and larger nominal diameter pipe.

   b. All open space around seismically braced through-penetrations shall be protected by a Listed, flexible through-penetration seal system.

O. Refrigeration Piping and Accessories:

1. Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written acceptance. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made. Pipe shall be purged with nitrogen and capped until refrigerant line is charged.

2. Directional Changes

   a. Changes in direction shall be made with fittings.

3. Functional Requirements:

   a. All piping shall be pitched down 1/2-inch per 10 feet of pipe toward the compressor to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the Drawings.

4. Filter Dryer:

   a. A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. The filter dryer shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. The filter dryer shall be installed such that the filter dryer can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Filter dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

5. Sight Glass:

   a. A moisture indicating sight glass shall be installed in all refrigerant circuits downstream of all filter dryers.

**3.05 - DUCTWORK AND EQUIPMENT INSTALLATION**

A. Installation shall be according to THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS unless otherwise specified. Friction beam clamps indicated in THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS shall not be used. Supports shall be attached only to structural framing members. Supports shall not be anchored to metal decking unless a means is provided and accepted for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

B. Dust Control:

   1. To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The air distribution system shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

C. Ductwork and equipment shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Hangers and Supports:

   1. Furnish and install safe and substantial means of support for all equipment and parts of the ductwork system. Attach all ductwork and equipment securely to the structure.

   2. All ductwork and equipment shall be hung to true alignment, using appropriate hanger arrangements. Hangers and supports shall be located so that ductwork and equipment and associated hangers and supports will be minimum 6 inches clear from other piping, hangers, supports, conduits, lighting fixtures, equipment, ceiling suspension systems, and other obstructions. Where insulation or other covering is provided, minimum clearance shall take into account such covering.

   3. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Engineer, or as otherwise shown on the Drawings. Equipment and ductwork shall not be supported from metal decking.

   4. Rod Sizes, MSS SP-58.

E. Where dissimilar metals occur between ductwork and dampers, ductwork and hangers, or ductwork and any other mating surfaces, provide minimum 1/8-inch thick neoprene pads between the dissimilar metals. Pads shall provide continuous separation between the ductwork and mating materials. Pads shall provide continuous separation between the ductwork and damper frames to form an airtight seal.

**3.06 - BOILER INSTALLATION**

A. Boilers and boiler pumps shall be installed in accordance with manufacturer's recommendations, Contract Drawings and approved submittals. Boiler Manufacturer shall provide the services of a representative to supervise the assembly and installation of the boilers.

B. Boiler pumps shall be installed so as to ensure easy accessibility for service or removal and replacement of all components such as, but not limited to, impellers, motors, drive couplings, bearings, strainers, other pump appurtenances, isolators, and flex connections.

C. Near boiler piping shall include boiler isolation valves, motorized valves where indicated, check valves, strainers, pumps and accessories on each boiler as shown on the Contract Drawings and as specified.

D. The HVAC Subcontractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition.

E. Provide piping connections and accessories as specified and as indicated on the Contract Drawings.

F. Category IV (defined in NFPA 211) boilers require special gas venting. Use only the vent materials and methods specified within the Boiler Manufacturer's Installation and Operation Manual unless otherwise indicated.

G. Connect each Category IV direct-vent appliance's flue outlet with a continuous Boiler Manufacturer's approved vent system to the vent termination outside the building. Where indiacted, the vertical vent shall be routed through a designated chase. All system components shall be listed to UL standard and supplied from the same manufacturer.

H. Pipe the discharge of the safety relief valve to prevent injury in the event of pressure relief. Pipe the discharge to a drain. Provide piping that is the same size as the safety relief valve outlet.

I. Install electrical devices furnished with boiler but not specified to be factory mounted.

J. Pipe condensing boiler condensate connections to condensate acid neutralizing tubes specified in Section 15400. Acid neutralizing tubes shall be piped to the nearest floor drain.

K. After final assembly and connection, the boiler shall be thoroughly cleaned internally following the manner described within the boiler manufacturer’s installation instructions. This cleaning shall include boiler cleanout, flush, blowdown and a wash as directed and detailed in boiler manufacturer instructions. The process of cleaning the boiler(s) and piping system shall be repeated as often as necessary to ensure that all mill scale, core sand, rust, dirt and debris, cutting oils and thread sealers or any other contaminants have sufficiently been eliminated from the boiler(s) and piping system and to produce a condition of the boiler water that is clean and finally considered acceptable to the Engineer.

**3.07 - BOILER START-UP**

A. The HVAC Subcontractor shall supervise all phases of boiler installation, pressure testing, startup, and training of operating personnel. The HVAC Subcontractor shall also provide all installation verification inspections, system functional and safety operational tests, and heating system capacity verification tests. Perform hydrostatic test, repair leaks, and retest until no leaks exist.

B. HVAC Subcontractor shall include, as part of his contract, all charges and costs for boiler testing, start-up, checkout, adjusting, field and State inspections, including service contracts for systems and equipment as here-in-after specified. Provide signed documentation to the Awarding Authority for completion of specified procedures.

C. An authorized representative of the boiler manufacturer shall perform the initial start-up, final adjusting and testing of the burner and controls in the presence of the gas inspector. Boiler Manufacturer's representative shall also provide training on the boilers and controls and in boiler care and maintenance to Owner’s operating personnel.

D. The start-up requirement for this single source responsibility shall not be waived by the HVAC Subcontractor, nor shall the responsibility for the start-up be assumed by any other party unless such a deviation from the specified Contract start-up specifications has received prior written approval from the Awarding Authority through the submittal phase of the project specifically allowing other group(s) to provide the boiler start-up.

E. Initial start-up, testing and adjustment shall comply with all applicable local and state regulations and requirements. Start-up and final adjustment shall be in accordance with the Boiler Manufacturer's start-up instructions. Test and adjust boiler for maximum efficiency. Test and adjust combustion controls, and boiler controls for proper operation and maximum system efficiency. Check and adjust initial operating set points and high and low limit safety set points of fuel supply, water level and water temperature. Set field-adjustable switches and circuit-breaker trip ranges as indicated. Replace damaged or malfunctioning controls and equipment in accordance with the manufacturer's warranty requirements.

F. Purging of the boilers, and all required tests for proper venting.

G. At time and date of original start up, provide instruction to the Owner’s operating personnel in the procedures to resolve a "Lockout" condition. At this time, operating personnel shall also be instructed in the operation and routine management of the burner and safety controls. The Owner shall arrange to have personnel who require training to be present during the original lightoff. In addition, manufacturer's representative shall provide a training session for the Owners operating personnel at a later date prior to Owners Final Acceptance. Coordinate time and date of additional training.

H. Boiler combustion shall be tested and adjusted utilizing electronic combustion instruments to verify that the boiler is operating within acceptable tolerances of the factory fire test report, with a print-out copy submitted to the Engineer. HVAC Subcontractor shall obtain and provide a written report of the start-up, including the factors of the factory fire test, and the factors of the start-up, a copy of which shall also be furnished to the Engineer.

I. Final acceptance of the boiler plant installed within this scope of work shall be contingent on passing a satisfactory system pressure test, mechanical performance test and heating function test to determine that the system will perform according to the contract requirements. The above tests shall be witnessed by the Engineer and the Owner at his option and acceptance will only be granted in writing by the Owner after receipt of certification from the Engineer that the design criteria have been met.

J. Notify the State Boiler Inspector when the installation of the boiler(s), burner(s) and controls is substantially complete. Request an inspection of the boilers to be conducted by the State Boiler Inspector and to have a Certificate of Inspection issued upon satisfactory inspection.

K. After receipt of Certificate of Inspection, furnish a suitable glass front frame in which to place said certificate. Frame, with inspection certificate inserted therein, shall then be placed on or posted in a suitable location within the Boiler Room in which the new boiler has been installed.

L. Maintain all apparatus in satisfactory operating condition. Perform periodic burner tune-up and cleaning of the boiler fireside surfaces when dirty, provide preventative maintenance, perform turndown tests, conduct tests for flame safeguard, combustion efficiency, draft tests, limit control tests and safety valve tests, check the ignition system and adjust, repair or replace any until such time as the Owner accepts the equipment.

M. HVAC Subcontractor shall guarantee the entire installation for a period of one (1) year from the date of Owner Acceptance and beneficial usage by the Owner and Date of Final Payment.

**3.08 - FIELD QUALITY CONTROL**

A. After system installation has been completed and prior to initial operation, inspect piping and ductwork systems for compliance with Drawings, Specifications, and accepted submittals. Ensure that all equipment has been installed, piped and wired correctly with no leaks or other improper operating conditions. Operate all equipment to demonstrate they perform in accordance with the manufacturer’s intent. Perform flushing and tests in compliance with the specified Codes with the additions specified herein. Have piping and ductwork accepted by the Engineer before insulating or otherwise concealing.

B. Test Procedures, Repair of Defects, and Reports

1. Prepare and submit procedures, material and equipment for all specified tests to the Engineer for acceptance prior to the planned tests. Material and equipment used in testing shall be subject to inspection by the Engineer.

2. Provide all material and labor required for testing. Instruments, test equipment, and test personnel required to properly conduct all tests shall be provided. Provide water, fuel, electricity.

3. Repair defects disclosed by tests or, if required by the Engineer, replace defective work with new work without additional cost. If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted at no additional cost.

4. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case. When tests have been completed and corrections made, submit signed and dated test reports.

C. Water Piping Pressure Tests

1. All water piping shall be hydrostatically tested at 150 psig at the highest point. Tests shall be for a four-hour duration, during which time piping shall show no leaks. Any equipment not capable of withstanding test pressures shall be suitably isolated from the test pressure. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking, or remelting and adding more solder or brazing material, shall not be acceptable.

D. Water Piping Flushing

1. Flush all water piping and equipment.

2. Exercise every precaution to avoid introducing foreign matter such as welding beads and slag or dirt into the piping systems. All completed welds shall be hammered to loosen debris. All piping, valves and fittings shall be internally cleaned of oil, grease or dirt, prior to assembly into systems by use of wire brush and swab.

3. Flushing shall be started only after all piping has been hydrostatically tested and all equipment has been completely connected up.

4. Flushing water shall be bypassed around water coils (all types), expansion tanks, heat pumps, heat exchangers and boilers to prevent flushing water from passing through. Flushing of water coils and boilers shall be performed separate from the main flushing procedure. Air shall be removed from all water systems by operating the manual air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be valved-off after the system has been vented.

5. Provide start-up strainer baskets during flushing operations and replace with specified strainer baskets upon completion of all flushing. Used flushing water shall be discharged to the sanitary sewer.

6. The system shall be thoroughly flushed, no less than 15 minutes at no less than three (3) feet per second flow velocity, of all foreign matter until a white linen bag installed in a strainer basket shows no evidence of contamination. The white linen bag shall be in the strainer basket during the entire flushing operation prior to its being presented to the Engineer for acceptance. The Engineer will inspect the linen bag prior to completion of flushing and approve the flushing operation.

E. Refrigeration Systems Tests:

1. Refrigerant Leakage Test: After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a refrigerant leakage test. The refrigerant leakage test shall be done with dry nitrogen before any refrigerant pipe is insulated or covered. High and low side of the refrigerant system shall be tested with the minimum refrigerant leakage test pressure specified in ASHRAE 15, for the refrigerant employed in the system. System shall be proved tight and free of leaks by allowing the refrigerant leakage test pressure to remain on the system for 24 hours with no drop in pressure. The initial test pressure and surrounding air temperature will be recorded. After the 24 hour hold period, the final system pressure and surrounding air temperature will be recorded. A correction of 0.3 psi shall be allowed for each degree F change in the initial and final temperature of the surrounding air, plus for an increase and minus for a decrease. The system shall have passed the refrigerant leakage test if the corrected final system pressure is equal to the initial system test pressure. If the pressures are not equal, the leaks shall be located and repaired.

2. Refrigerant Leaks: To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking, or remelting and adding more brazing material, shall not be acceptable. After leak repairs have been made, the refrigerant leakage test shall be conducted again.

3. System Charging and Startup Test: Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with electronic leak detectors, and bubble leak detection, Big Blu or equal.

4. Evacuation Test: After the foregoing tests have been satisfactorily completed and the pressure relieved, entire system shall be evacuated to an absolute pressure of 300 microns. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. Vacuum line shall be closed, and the system shall stand for 1 hour. After this period, the absolute pressure shall not exceed 500 microns. If the pressure rises over 500 microns, the system shall continue to be evacuated until the system reaches 300 microns and can stand for 1 hour with the vacuum line closed without the absolute pressure rising over 500 microns. During evacuation, pressures shall be recorded by a thermocouple type, electronic type, or a calibrated-micron type gauge.

F. Factory Supervised Equipment Tests:

1. Provide field testing of equipment specifically listed in the paragraph entitled “Manufacturers Instructions and Services” in this Section.

2. Upon completion, and before acceptance of the Work, the listed equipment shall be subjected to such operating tests as may be required to demonstrate satisfactory functional operation. Each operating test shall be conducted at such times as the Owner may direct.

3. Manufacturer's Test Plans: Submit field acceptance test plans for each equipment type to be tested. Field acceptance test plans shall be developed by the equipment manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing contractor, or the equipment sales agency furnishing the equipment, shall not be acceptable. The Engineer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The Engineer will also review and approve the accepted field acceptance tests of the equipment and subsequent test reporting.

4. Testing:

   a. All heating equipment testing shall take place when outdoor air temperature is 30 degrees F or less. Gas inspector and gas company representative shall also be in attendance when applicable.

   b. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the accepted reporting forms. Notify the Engineer in writing at least 15 calendar days prior to the testing. Within 14 calendar days after acceptable completion of testing, submit each test report for review and acceptance.

   c. Operational test: Conduct a continuous 8 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every hour. Use the test report forms for logging the operational variables.

   d. Report forms: Type data entries on test report forms. Completed test report forms for each item of equipment shall be reviewed, accepted, and signed by the HVAC Subcontractor's test director. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

   e. Deficiency resolution: At no additional cost, deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

5. Hot Water Boilers:

   a. Conform to the paragraph entitled “Boiler Startup” in this Section and the requirements herein.

   b. For boilers with inputs greater than 200,000 BTU/hour, obtain from the Boiler Manufacturer a completed (by the boiler manufacturer) Form H-3 Manufacturers Data Report for Watertube Boilers as required by the Provisions of the ASME Code Rules, Section IV and shall transmit to the Owner after boiler installation for record purposes.

   c. Start-up, testing and adjustment shall comply with all applicable local regulations and requirements. Start up and final adjustment shall be in accordance with the boiler manufacturer’s start-up instructions and the indicated control sequences. Test and adjust boiler for maximum efficiency. Test and adjust combustion controls, and boiler controls for proper operation and maximum system efficiency. Perform ignition tests, flame safeguard tests, combustion efficiency tests, draft tests, limit control tests, safety valve tests, boiler capacity turndown tests, and boiler primary pump tests. Perform tests on hot water temperature control. Replace damaged or malfunctioning controls and equipment in accordance with the manufacturer’s warranty requirements.

   d. Boiler shall be started and adjusted utilizing instruments to verify that the boiler is operating within acceptable tolerances of the factory fire test report. Copies of a written report of the start-up, including the factors of the factory fire test and the factors of the start-up, shall be furnished to the Engineer.

G. Coordinated Testing:

1. Prepare test procedures for the simultaneous, integrated testing of HVAC controls provided under SECTION 15900 – HVAC CONTROL SYSTEMS which interlock and interface with factory prewired and external controls for the equipment

2. Prerequisite Testing: Equipment for which operating tests are dependent upon the completion of the work covered by SECTIONS 15900 – HVAC CONTROL SYSTEMS and 15950 – HVAC TESTING, ADJUSTING AND BALANCING shall have that work completed as a prerequisite to testing work under this Section. Indicate in each field acceptance test plan when such prerequisite work is required.

3. Test Procedure: Procedures shall be structured to test the equipment factory prewired controls and external controls through all modes of control to confirm that the controls are performing with the intended sequence of control. Controller shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

4. Performance variables: Equipment manufacturers shall identify the acceptable limits or tolerance within which each tested performance variable shall acceptably operate.

5. Job Specific: Each test plan shall be job specific and shall address the particular conditions which exist in this Project. Generic or general preprinted test procedures shall not be acceptable.

6. Specialized components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

**3.09 - TRAINING**

A. General: Orientate training to the specific equipment and systems being installed under the Contract. Coordinate training times with the Owner. Furnish training materials and supplies. For guidance, assume that the attendees have a high school education and are familiar with HVAC systems.

B. Training Course Documentation: Training shall be based on the accepted Operation and Maintenance Manuals. Deliver manuals for each trainee with one additional set for archiving at the project site. For each daily training session, submit an attendance sheet signed at end of the session by each trainee. The attendance sheet shall include an outline of subject matter covered by the session, the date of the session, and the printed name and signature of the instructor teaching the session. All documents shall contain the name and logo of the company that the instructor represents.

C. Provide training on equipment and/or systems described herein below. Provide the services of manufacturer's representative to instruct Owner's Operating Personnel in the over-all operation of the equipment and control panels. Manufacturer's representative shall also be provided for additional training in equipment care and maintenance. Training shall be for minimum 8 hours continuous.

1. Hot Water Boilers

2. Dehumidifiers

3.

**3.10 - EQUIPMENT ADJUSTING AND CLEANING**

A. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer.

B. V-belts and sheaves shall be tested for proper alignment and tension prior to initial operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, and not bouncing.

C. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

D. Provide all other work required to be performed by the HVAC Subcontractor specified in SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING.

E. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance.

**3.11 - PAINTING**

A. Field painting shall be provided under SECTION 09941, FIELD PAINTING by the Painting Subcontractor. Paint the following:

1. Aboveground uninsulated pipe, fittings and valves.
2. All-service jackets and PVC fitting covers on aboveground insulated piping.
3. Unfinished factory-primed equipment surfaces.

B. Field Painting shall not be applied until after installation and testing is complete.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 15520**

**HVAC INSULATION**

**(Filed Sub-Bib Required)**

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## PART 1 – GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of SECTION 15520, HVAC INSULATION is a part of DIVISION 15, HEATING, VENTILATING AND AIR CONDITIONING which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING.

B. The Work of SECTION 15520, HVAC INSULATION, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. Provide new field-applied insulation for new piping, ductwork and equipment as indicated and in compliance with Contract Documents.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS and as specified herein.

1. Product Data - Annotate descriptive data to show the specific manufacturer, material and specifications, thicknesses, etc. of each item.

a. Piping insulation and jackets

b. Duct insulation and jackets

c. Equipment insulation and boxes

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All material shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and to maintain material warranties.

C. Receiving:

1. All material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

2. Inspect for damage and correctness, and inventory items, upon delivery to site.

3. Store and safeguard material in accordance with manufacturer's recommendations.

4. Store material protected from the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provisions:

1. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, performance, and reliability equal to that specified. Materials shall be the product of a single manufacturer insofar as possible.

C. Workmanship and Design:

1. Install products that comply with state, local and federal codes and regulations.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. ASTM International (ASTM):

1. A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
2. A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications
3. C195: Mineral Fiber Thermal Insulating Cement
4. C553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
5. C591: Unfaced Pre-formed Rigid Cellular Polyisocyanurate Thermal Insulation
6. C612: Mineral Fiber Block and Board Thermal Insulation
7. C916: Adhesives for Duct Thermal Insulation
8. C1136: Flexible, Low Permeance Vapor Retarders for Thermal Insulation
9. D1784: Rigid Poly(VinylChloride) (PVC) Compounds and Chlorinated Poly(VinylChoride) (CPVP) Compounds
10. E 84: Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

1. 255: Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL):

1. 723: Test for Surface Burning Characteristics of Building Materials

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the approval of the Engineer and without extra cost to the Owner r, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If Work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Attend regular coordination and job progress meetings required.

**1.10 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes, including but not limited to, the Massachusetts Building Code.
2. Massachusetts Department of Environmental Protection.
3. Local Fire Department
4. Occupational Safety and Health Administration (OSHA)
5. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Owner, Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and approval, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**PART 2 - PRODUCTS**

**2.01 - GENERAL**

A. Packaging and Labeling:

1. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation materials shall be asbestos-free.

B. Surface Burning Characteristics:

1. Materials shall be plenum-rated having flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

C. Recycled Materials:

1. Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this Section. The minimum recycled material content of the following insulation types are:
    a. Rock Wool - 75 percent slag by weight
    b. Fiberglass - 20 to 25 percent glass cullet by weight
    c. Plastic Rigid Foam - 9 percent recovered material
    d. Rigid Foam - 9 percent recovered material

**2.02 - PIPING INSULATION**

A. Insulation material shall conform to Table 15520-1. Insulation thickness shall be as listed in Table 15520-2. Insulate all piping listed in these tables. Where piping is located in unheated spaces such as attics and crawl spaces, provide insulation thickness 1-inch greater than indicated in Table 15520-2. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

B. Fittings Insulation:

1. Factory premolded insulation inserts for pipe fittings, flanges and valves shaped to fit the specific fitting to be insulated. Inserts shall be of same material as the straight pipe. Inserts shall be of same thickness as the straight pipe insulation.

C. Piping Insulation Jackets:

1. All-Purpose Jacket: Insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2. PVC Jackets: ASTM D1784 polyvinyl chloride (PVC) jackets, minimum 20 mil thick, factory premolded PVC fitting covers, UV-resistant, gloss white finish.

3. Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage (0.010 inch), and factory pre-molded fitting covers, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface.

**2.03 - DUCT INSULATION**

A. Provide factory-applied insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier jacket.

B. Rigid Insulation: Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 3 pound per cubic foot (pcf), 1-inch thick.

C. Blanket Insulation: Blanket flexible mineral fiber insulation conforming to ASTM C553, Type 1, Class B-3, 3/4 pound per cubic foot (pcf) nominal, 1 1/2-inch thick.

D. Weatherproof Duct Insulation:

1. Provide ASTM C591 Type I, polyurethane or polyisocyanate board insulation, minimum density of 1.7 pcf, 2-inch thick, and weatherproofing as specified in manufacturer's instructions.

E. Duct Insulation Jackets:

1. All-Purpose Jacket: Insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2. Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide insulation bands.

**2.04 - EQUIPMENT INSULATION**

A. Insulate equipment and accessories as specified in Table 15520-3 and Table 15520-4. In outside locations, provide insulation 1-inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.

**2.05 - ADHESIVES, SEALANTS, AND COATING COMPOUNDS**

A. Lagging Adhesive: Fire resistant, for pipe and duct insulation.

1. Provide appropriate class recommended by insulation manufacturer for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation.

2. Provide appropriate class for attaching fibrous glass insulation to metal surfaces.

B. Insulation and Vapor Barrier Adhesive: ASTM C916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

C. Mineral Fiber Insulation Cement: ASTM C195.

D. Vapor Barrier Coating: Provide in accordance with insulation manufacturers' recommendations.

E. Weatherproof Coating: For outside applications, provide in accordance with insulation and jacket manufacturer's recommendations.

F. Flexible Cellular Insulation Adhesive: Air-drying contact adhesive for joining insulation longitudinal seams and butt joints.

G. Flexible Cellular Insulation Coating: Water-based latex enamel for protective finish. Do not use vinyl lacquer finish or equivalent.

**2.06 - ACCESSORY MATERIALS**

A. Staples: ASTM A167, Type 304 or 316 stainless steel outside-clinch type.

B. Insulation Bands: 1/2-inch wide; 26 gage Type 304 or 316 stainless steel.

C. Anchor Pins and Speed Washers: Provide in accordance with insulation manufacturer’s recommendations.

D. Vapor Barrier Materials: ASTM C1136. Resistant to flame, moisture penetration, and mold growth, color white.

E. Fibrous Glass Cloth and Tape: 20 by 20 maximum size mesh. Tape shall be 4-inch wide rolls. Tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable State and local codes, at the Plumbing Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

D. Do not insulate the following:

1. Unions
2. ASME stamps
3. Access plates of fan housings
4. Cleanouts or handholes
5. Components within factory preinsulated HVAC equipment
6. Factory preinsulated flexible ductwork
7. Factory preinsulated HVAC equipment
8. Manufacturer’s nameplates
9. Chrome plated pipes
10. Flexible connectors (pipe and/or duct)

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - PIPING INSULATION**

A. Insulation (Except Flexible Cellular, Cellular Glass and Calcium Silicate Insulation):

1. Place sections of insulation around pipe and joints tightly butted into place.

2. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 15520-1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating, or manufacturer's weatherproof coating for outside service, unless pipe insulation is supplied with factory-applied self-seal lap. Apply coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages, thermometers, etc. fill voids with coating. Seal with a brush coat of the same coating.

3. Roof: Where pipe penetrates the roof, insulate piping to a point flush with top of flashing and seal with vapor barrier coating. Butt top of flashing and interior insulation tightly to exterior insulation. Extend exterior metal jacket 2 inches down over end of interior insulation. Seal flashing and counterflashing underneath with vapor barrier coating.

B. Flexible Cellular Insulation:

1. Do not use flexible cellular insulation for pipes in fire rated chases and inside fire walls.

2. Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide calcium silicate or cellular glass insulation inserts and metal jackets. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of finish as recommended by insulation manufacturer to flexible unicellular insulation in outside locations. Do not use vinyl lacquer finish or equivalent. Provide flexible cellular insulation for outdoor use with UV-resistant coating.

C. Cellular Glass and Calcium Silicate Insulation:

1. Provide in accordance with manufacturer's printed instructions.

D. Piping Insulation Jackets:

1. All Purpose Jackets

a. Provide all-purpose jackets to cover straight pipe runs. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center and ½ inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inch wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inch. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

2. Polyvinyl Chloride (PVC) Jackets:

a. Provide PVC jacketing system to cover all pipe fittings, flanges and valves of services to be insulated except as noted herein. Do not provide PVC jacketing where exposed to weather. Provide PVC jacketing only in ambient temperatures below 150 degrees F. Do not provide PVC jacketing at insulated pipe through-penetrations.

b. Secure jacketing with jacket manufacturer's solvent welding adhesive to seal all lap joints in the system. For services where vapor barrier is required, provide vapor retarder mastic compatible with PVC as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer

3. Stainless Steel Jackets:

   a. Provide stainless steel jacketing system to cover all straight runs, pipe fittings, flanges and valves of services to be insulated where exposed to weather or exposed to ambient temperatures 150 degrees F and above. Provide metal jacketing at insulated pipe through-penetrations.

   b. Provide insulation bands to secure jackets to insulation. Provide factory prefabricated metal covers for insulation on fittings, valves, and flanges. For services where vapor barrier is required, provide vapor retarder mastic as recommended by the jacket manufacturer applied over all lap joints in the jacketing system.

   c. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with insulation bands at not more than 9-inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Seal ends of all insulated piping with vapor retarder mastic as recommended by the jacket manufacturer.

E. Hangers and Anchors:

1. Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide insulation protection shields.

2. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, or other acceptable material, all minimum 15 psi compressive strength, of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable.

3. Where anchors are secured to piping carrying medium less than 60 degrees F that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

F. Through-Penetrations:

1. Where interior wall is penetrated, extend a metal jacket 2 inches out on either side of wall and secure on each end with an insulation band. Where floor is penetrated, extend a metal jacket from a point below the floor slab to a point 10 inches above floor with one insulation band at the floor and one not more than one inch from end of metal jacket. Where exterior wall is penetrated, extend metal jacket through sleeve to a point 2 inches beyond interior surface of wall and secure on each end with an insulation band.

2. Provide insulation inserts beneath the metal jacket. Insulation inserts shall be of calcium silicate or cellular glass of the same thickness as adjacent insulation. Insulation inserts shall cover full pipe circumference and be not less in length than the metal jacket. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating.

G. Flanges, Unions, Valves and Fittings for Piping:

1. Factory fabricated removable and reusable insulation inserts shall be used. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2 1/2 inches, elbows insulated using insulation segments shall not have less than three segments per elbow. Place and join segments with manufacturer's recommended water-vapor resistant, fire retardant adhesive appropriate for the temperature limit of the service. Overlap tape seams one inch. Total dry film thickness shall be not less than 1/16-inch. Unions are not to be insulated; taper insulation to union at a 45 degree angle.

2. PVC Fitting Covers: Install factory premolded one-piece PVC fitting covers over insulation.

3. Stainless Steel Fitting Covers: Install factory-fabricated one-piece fitting covers over insulation. Secure covers with no less than 3 insulation bands per cover.

H. Piping Exposed to Weather:

1. Stainless Steel Jackets: Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with stainless steel bands at not more than 9-inch centers with no less than 3 bands per jacket section. Overlap longitudinal joints of horizontal piping down to shed water. On vertical piping, the circumferential seams of the jacket shall overlap the upper edge of the jacket below. Cover circumferential strips with butt joints, not less than 4 inches wide, of material identical to the jacket material. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

2. Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches.

**3.04 - DUCTWORK AND ACCESSORIES INSULATION**

A. Provide rigid type duct insulation in all exposed locations; provide blanket type insulation in all concealed locations. Provide field-applied insulation to exterior of supply air ductwork except where located inside conditioned spaces served, outside air intake ductwork, exhaust air ductwork between the outdoor discharge and the control damper or backdraft damper and plenums, and ductwork located outdoors. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with damper handles, and other such items. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit.

B. Rigid Insulation:

1. Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on center and secure with washers and clips. Spot weld anchor pins or attach with waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for indoor work or manufacturer's recommended weatherproof coating for outdoor work. Coatings shall be reinforced with open weave glass membrane.

C. Flexible Blanket Insulation:

1. Apply insulation with joints tightly butted. Secure insulation to ductwork with adhesive in 6-inch wide strips on 12-inch centers. Staple laps of jacket with outward clinching staples on 4-inch centers. Sealing shall be in accordance with paragraph entitled "Insulation Finishes and Joint Sealing." Provide pins, washers and clips at 18 inches on center and not more than 4 inches from duct edge for duct surfaces greater than 24 inches across except for top surfaces of horizontal ducts. For vertical ducts with surfaces less than 24 inches across, provide pins no more than 4 inches from duct edge at 18 inches on center. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation shall not be permitted. Cut off protruding ends of pins after securing and sealing clips with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure laps with outward clinch staples on 4-inch centers. In cold air ducts, including outside air intake ducts and plenums, vapor seal joints and staple as specified.

D. Stainless Steel Jackets for Ductwork Outside Building:

1. Ensure longitudinal and circumferential joints overlap at least 2 inches wide, with field-cut edge of circumferential joint turned under one inch to provide smooth edge. Place longitudinal joints to shed water. Seal joints with insulation manufacturer's recommended weatherproof coating. Secure jackets in place with insulation bands on 9-inch centers. Do not use dissimilar metals for direct duct connections. Where ducts penetrate exterior walls, continue increased thickness required for ductwork exposed to weather and metal jackets through sleeve to a point 2 inches beyond interior wall surface. Where metal jacket abuts an uninsulated surface, seal joints with a weatherproof mastic recommended by insulation manufacturer. For rectangular ducts, provide corner angles to exposed corners of insulation. Apply two coats of weatherproof coating recommended by insulation manufacturer to entire surface with a layer of glass cloth embedded between coats. Ensure glass cloth overlaps not less than 2 inches at joints and adjoining surface. Each coat of weatherproof coating shall be 1/16-inch minimum thickness.

E. Through-Penetrations:

1. Insulation shall be continuous through sleeves, wall and floor openings, except at fire dampers in duct systems. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at manufacturer's recommended coverage per gallon.

F. Access Doors:

1. On externally insulated ducts, plenums, and casings, bevel insulation around access doors.

G. Insulation Finishes and Joint Sealing:

1. Fill breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturer's recommended weatherproof coating for outside work. Vapor seal joints by embedding a single layer of 3-inch wide open weave glass membrane, maximum 20 by 20 mesh per linear inch between two 1/16-inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1 1/2-inch overlap. At jacket penetrations such as hangers, instrumentation, control devices, and damper operating rods, fill voids in insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on ducts. Provide vapor barrier jacket continuous across seams, reinforcements, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over projection. For joints for heating only systems, provide insulation with two coats of fire resistant adhesive with glass fabric mesh embedded between coats.

H. Moisture Seal:

1. Provide a vapor (moisture) seal where insulation terminates against metal hangers, anchors and other projections through insulation on surfaces for which a vapor seal is specified. Keep insulation dry during application of finish. Bevel and seal edges of exposed insulation.

**3.05 - EQUIPMENT INSULATION**

A. Apply equipment insulation suitable for temperature and service in rigid block or semi-rigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit contours of equipment. Stagger end joints where possible. Bevel edges of insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After cellular glass insulation is in place on areas to be insulated, except where metal-encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Fill mineral fiber joints with insulating cement. Bevel insulation around name plates, ASME and access plates. For insulation on equipment that is opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.

B. Insulation shall be removable at access locations on equipment. Fabricate a male-female shiplap type joint for removable sections.

C. Heating Equipment (Except Pumps):

1. On equipment with ribs, apply insulation over 6-inch by 6-inch by 12-gauge welded wire fabric spot welded to equipment over ribs. Secure insulation to the fabric with J hooks and 2 by 2-inch washers or wire loop insulation to the fabric.

2. Secure insulation with 16-gauge stainless steel or copper wire or 3/4-inch wide 20-gauge stainless steel bands spaced on 12-inch centers. Seal joints with bedding compound for cellular glass or for mineral fiber with insulating cement and cover insulation with a smooth coat of insulating cement. Cover non-removable irregular surfaces such as corner angles with a smoothing coat of insulating cement. Apply two coat of lagging adhesive with a layer of glass cloth embedded between coats. Dry film thickness of finish shall be 1/32-inch minimum.

D. Cold Equipment (Except Pumps):

1. Secure insulation with 16 gage, galvanized steel or copper clad wire or with 3/4-inch wide 20 gage stainless steel bands spaced on 12-inch centers. Seal joints with joint sealer. Cover non-removable irregular surfaces such as corner angles with a smoothing coat of insulating cement. Apply two coats of vapor barrier coating with a layer of glass cloth embedded between coats. Dry film thickness of finish shall be 1/32-inch minimum.

**3.06 - FIELD QUALITY CONTROL**

A. Except as otherwise permitted herein, Mechanical systems shall be cleaned and tested prior to application of insulation. Obtain Engineer's approval of systems before applying field insulation. Visually inspect to ensure that insulation materials provided conform to Specifications. Inspect installation of insulation for compliance with requirements.

1. With Engineer's acceptance, HVAC piping systems may be insulated before systems are tested, adjusted, and balanced but not before pressure testing and related inspections. Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. Seal exposed ends of pipe insulation with waterproof vapor barrier material. After systems are tested, adjusted, and balanced, insulate control valves and devices.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF TEXT**

**See Attached Tables**

**TABLE 15520-1**

**INSULATION MATERIAL FOR PIPING**

| Service | Material | Spec | Type | Class | Vapor Barrier Required |
|---|---|---|---|---|---|
| Heating Hot Water Supply & Return Piping (Maximum 225°F) | Mineral Fiber | ASTM C 547 | | 1 | No |
| Refrigerant Suction Piping (35°F nominal) | Flexible Cellular | ASTM C 534 | I | | No |
| Metallic A/C Condensate Drain Located Inside Building | Flexible Cellular | ASTM C 534 | I | | No |

**TABLE 15520-2**

**PIPING INSULATION THICKNESS (INCH)**

| | | Tube and Pipe Size DN (MM) | | | | |
|---|---|---|---|---|---|---|
| **Service** | **Material** | **1/4 - 1 ¼** | **1 1/2-3** | **3 1/2-5** | **6-10** | **11-36** |
| Heating Hot Water Supply & Return (Maximum 225°F) | Mineral Fiber | 1.5 | 2 | 2 | 2 | 2 |
| Refrigerant Suction Piping (35°F nominal) | Flexible Cellular | 1 | 1 | - | - | - |
| Metallic A/C Condensate Drain Located Inside Bldg. | Flexible Cellular | 0.5 | 0.5 | - | - | - |

**TABLE 15520-3**

**INSULATION MATERIALS FOR EQUIPMENT**

| Equipment | Spec | Type | Class | Vapor Barrier Required |
|---|---|---|---|---|
| Flexible Mineral Fiber<br>Surface Temperatures up to 400°F | ASTM C 553 | I | B-3 | No |
| Rigid Mineral Fiber | ASTM C 612 | | | No |
| Surface Temperatures up to 400°F | | | 1 or 2 | |
| Surface Temperatures up to 850°F | | | 3 | |

**TABLE 15520-4**

**INSULATION THICKNESS FOR EQUIPMENT**

| Equipment | Recommended Thickness |
|---|---|
| Air Separators | 2" |
| Duct-Mounted Coils | 2" |

**SECTION 15855**

**FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Fiberglass Reinforced Plastic Duct Dampers and Appurtenances as specified and/or as shown on drawings.

B. Provide duct and dampers for odor abatement systems with all appurtenances to make it operable, as indicated and in compliance with Contract Documents.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accoirdance with the provisions of the DOCUMENT 00700, GENEREAL CONDITIONS, and SECTION 01300, SUBMITTALS.

1. Submittals required under this section include, but are not limited to the following.

a. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

b. Certified shop and working drawings. Drawings for the duct and dampers shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

c. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

d. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

e. Files shall be drawn to scale.

f. Drawings shall be in conformance with all other requirements as specified in this specification.

2. A letter from the resin supplier stating that the material used for this project will comply with the specification and meet all corrosion requirements.

3. Design calculations performed by the manufacturer and stamped by a Professional Engineer for record purposes.

4. Samples, representative of the ductwork, construction method and material used to be supplied on this project.

5. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

6. Manufacturer's literature and specifications. Show catalog dates.

7. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

10. Four copies of manufacturer's recommended regeneration instructions, procedures and safety precautions. Provide detailed instructions for particular system as required.

11. List of 5 operating installations to demonstrate compliance with the requirements of Paragraph 1.07.H.

    a. Provide current (verified) contact information for each installation.

12. Paint manufacturer's product data and specifications indicated conformance to shop painting requirements specified including statement of compliance for compatibility.

13. Manufacturer's literature as needed to supplement certified data.

14. Two (2) sample cutouts demonstrating 100 mils ( liner, and filament wound structural laminate. Samples to be a minimum of 8-inch diameter cut out, and a 12-inch diameter piece of duct at least 12 inches (300 mm) long complying with RTP-1 visual level I.

15. Copies of burial calculations for at least 3 sizes of duct between 12-inch and 48-inch .

16. Submit details of:

    a. Resin Type

    b. Types and amounts of filler

    c. Corrosion liner description

    d. Reinforcement types for hand lay-up or chopped laminates

e. For filament-wound laminates:

(1) Helix angle

(2) Glass content range

(3) Strand yield

(4) Strand by inch in the winding band

(5) Ply thickness

(6) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.

f. For all Fabricated parts:

(1) Construction type

(2) Laminate thickness

(3) Ply sequences

(4) Glass content range

g. For all secondary overlays (both interior and exterior):

(1) Laminate thickness

(2) Ply sequences and widths

(3) Construction details for all other special configurations and fabricated parts.

17. Shop test results.
18. Motor shop test results.
19. Qualifications of field service technician.
20. Schematic control and power wiring diagrams.
21. Shop and Field inspections reports.
22. List of recommended spare parts other than those specified.
23. Recommendations for short and long term storage.
24. Special tools.
25. Shop and field testing procedures and equipment to be used.
26. Number of service technician days provided and per diem field service rate.
27. Manufacturer’s product data, specifications, and color charts for shop painting.
28. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
29. The most recent ISO 9001 series certification.
30. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

31. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

    a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

32. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

B. Provide components to manufacturer's standard for service intended unless otherwise required.

C. Provide components and accessories of manufacturers' latest and proven design.

D. The drawings and specifications direct attention to certain required features of the tanks, but do not purport to cover details entering into its design, construction and installation; nevertheless, provide tanks so that systems will be complete and ready for operation.

E. Provide field services as required for installation, with factory-trained technician to assist in determining location.

F. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

G. Upon completion of the installation, provide services of above serviceman for field testing.

H. Turn on no form of energy to any part of system prior to receipt by Engineer of certified statement of approval of installation from Contractor containing his supplier's authorization to energize system unless done by the supplier's servicemen may do so for purposes of checkout.

**1.08 - REFERENCES**

A. Air Movement and Control Association (AMCA):

1. 500D: Laboratory Methods of Testing Dampers for Rating.

B. American Society of Mechanical Engineers (ASME):

1. B-16.5: Pipe Flanges and Flanged Fillings NPS 1/2 Through NPS 24 Metric/Inch Standard.
2. RTP-1: Reinforced Thermoset Plastic Corrosion Resistant Equipment.

C. American Society for Testing and Materials (ASTM):

1. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
2. D2310: Standard Classification for machine-Made “Fiberglass” Pipe.
3. D2412: Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. D2996: Standard Specification for Filament Wound “Fiberglass” (Glass Reinforced Thermosetting-Resin) Pipe.
5. D3567: Practice for Determining Dimensions of Fiberglass (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.
6. D3982: Standard Specification for Contact Molded Fiberglass Duct and Hoods.
7. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Bureau of Standards (NBS):

1. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

E. NSF International (NSF):

1. 61: Drinking Water System Components - Health Effects

F. Occupational Safety and Health Association (OSHA):

1. 29 CFR Part 1910.27: Fixed Ladder
2. 29 CFR Part 1926.104: Safety Belts, Life Lines and Lanyards
3. 29 CFR Part 1926.500: Fall Protection
4. 29 CFR Part 1926.501: Fall Protection
5. 29 CFR Part 1926.502: Fall Protection

G. Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):

1. 1884: Fiberous Glass Duct Construction Standards.

## PART 2 - PRODUCTS

### 2.01 - FRP DUCT

A. Materials and Fabrication:

1. Type: Filament wound rated at design pressures as specified and indicated.
2. Minimum wall thickness, in accordance with SMACNA Table 5-7 and as specified:
    a. 2-inch through 14-inch: 0.145-inch.
    b. 16-inch through 22-inch: 0.180-inch.
    c. 24-inch through 30-inch: 0.220-inch.
    d. Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.
    e. Rectangular ductwork thickness: As specified in SMACNA and as specified and indicated. In no case shall the rectangular duct thickness be less than substituting the long side of the rectangular duct for the round equivalent thickness.
3. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.
4. Provide all ducts designed for not less than 20 inches water column pressure, and 15 inches water column vacuum.
5. The design, applicable construction, and inspections shall be in accordance with SMACNA, and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.
6. Provide a minimum structural safety factor of 4 in the design of all ducting.
7. Maximum deflection of rectangular ducts under deadload and operating conditions: Not to exceed 1 percent of the width of the longest side.
8. Resin: Hetron FR992, Derakane (Ashland Inc.) 510 or equal, selected to meet the exposures and temperatures of the air to be exhausted.
9. Minimum barcol hardness: 36.
10. Fillers other than antimony trioxide added for flame retardancy are not acceptable and should not exceed 5 percent by weight.
11. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment.
12. Flame spread rating: 25 or less per ASTM E84.
13. Catalyst: DHD9 or Hi-Point 90 per resin manufacturer.
14. Corrosion liner:
    a. Inner surface: One ply of 10 mils thick minimum C-glass surfacing veil saturated with vinylester resin.
    b. Provide the surface veil overlapped a minimum of 1 inch with two (2) layers of 1-1/2 oz./sq. ft. chopped strand mat following the surface veil layers.
    c. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours.
    d. Total liner thickness: 100 mils minimum.
    e. No thixotropic agent or fire retardant additive is to be used in the liner resin.

f. Corrosion liner: Not less than 20 percent or more than 30 percent glass by weight.

g. Provide liner passing ASME RTP-1 Table 6, level II visual inspection. Total glass content 25 percent to 30 percent.

15. Structural layer: Filament wound of Hetron FR992, or Derakane 510 premium grade, vinylester resin and Type E 250 strand yield continuous glass roving.

a. Band width: 2.25 inches using (7) strands per inch.

b. Filament winding cycle thickness: 0.06 inches maximum.

c. Glass content 55 percent to 65 percent.

d. Winding angle: 65 degrees ± 2 degrees for increased vacuum service.

16. Provide the exterior of all laminates containing sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections.

17. Provide an ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements.

18. Provide ductwork located outdoors with an exterior colored surface coat.

a. Color: White or as selected by Owner.

19. Provide ductwork located indoors with two (2) coats of PPG Speedhide 42-7 Intumescent paint to provide a class 1 flame and smoke rating.

20. ASTM E84 Steiner Tunnel test results shall be attached as part of the submittal packet.

21. Standard lengths: Provide in accordance with the manufacturers published product data sheets and accepted shop drawings.

22. Duct stiffness: Minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions.

23. Markings on duct and spool pieces shall be in accordance with shop drawings.

**2.02 - FITTINGS AND JOINTS**

A. Fittings:

1. Hand-layup construction fabricated from the same resin and have the same strength as the FRP ductwork.

2. Internal diameter of all fittings: Equal to the adjacent duct.

3. Tolerance on angles of all fittings: +/- 1 degree for 24 inch diameter and smaller and +/- 1/2 degree for 30 inch diameter and larger.

B. Elbows:

1. Radius: 1.5 times the diameter.

2. 24-inch and smaller: Smooth radius.

3. 30-inch and larger: Mitered.

4. Bends 30 degrees and less: 1 miter, 2 piece

5. Bends 31 degrees to 60 degrees: 2 miter, 3 piece

6. Bends 61 degrees to 90 degrees: 4 miter, 5 piece

C. Turning Vanes:

1. Provide turning vanes and splitters at all single mitered bends 46 degrees and greater and similar fittings that are not one-piece smooth radius fittings per SMACNA standards.

2. Turning Vanes: Filament wound and reinforced with unidirectional glass, metallic vanes are not acceptable.

D. Flange Joints:

1. Provide flanged connections at flexible connectors, expansion joints, vessels, grease filters, fans, and other locations as indicated.

2. Flanges:

a. Hand lay-up construction with dimensions in accordance with NBS PS 15-69 and the Duct Dimension Schedule.

b. Flanges 24-inch and smaller: One piece integral, SMACNA Thermoset Duct construction manual and supplied undrilled for field drilling and alignment.

3. Flanges shall be drilled in accordance with NBS PS 15-69 -Table 2. acks of flange face shall be flat so that washer seats fully on bolt face and flange backing.

4. Flange Faces: Perpendicular to the axis of the duct within 1/2 degree.

5. Flange Faces: Flat to within +/- 1/32 inch for sizes 18-inch and smaller and flat within +/- 1/16 inch for sizes 20-inch and larger.

6. Gaskets: EPDM, full face, minimum 1/8-inch thick.

7. Hardware: Type 316 stainless steel.

E. Duct Joints:

1. Butt and wrap joint type connections.

2. Fittings: Butt and wrap joint type connections.

3. Apply adhesive material for field joining in rolls and resin containers no larger than five gallons.

4. Provide all joints per SMACNA standard, and per manufacturer’s laminate schedule and procedures.

**2.03 - EXPANSION JOINTS**

A. Expansion Joints:

1. Provide expansion joints where indicated and where required for flexibility and to accommodate the duct support system.

2. Provide flanged joints where connecting ductwork to vessels, grease filters, fans, equipment and other locations as indicated.

3. Provide slip-type joints where flanges joints are not specified or indicated.

4. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified and indicated.

5. Material: EPDM

6. Backing Rings: 3/8-inch thick, 2 inches wide, Type 316 stainless steel.

7. Extension: 3 inches .

8. Compression: 2.5 inches .

9. Lateral Offset: 2.5 inches .

10. Thickness: 1/4-inch minimum.

11. Bolts, Nuts and Washers: Type 316 stainless steel.

B. Manufacturers:

1. RM-Holz (Holz Rubber Company, Inc.)
2. Metraflex, Inc.
3. Garlock (EnPro Industries)
4. Mercer Rubber Company

**2.04 - DUCT DRAINS**

A. Provide 1 inch minimum CPVC pipe and CPVC ball valve trapped duct drains on all low points in all main, branch and riser ducts to allow removal of condensate.

1. Provide piping in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and valves in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

B. For ducts located outdoors insulate the drains, trap and piping with 1-inch (25 mm) of insulation in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

**2.05 - DAMPERS**

A. Provide factory fabricated dampers conforming to AMCA 500D requirements and as specified.

B. Provide FRP dampers manufactured from the same materials and resin as specified for duct.

C. Materials and Construction:

1. Blades: Two (2) piece, molded including blade stiffeners. Provide damper blade offset 5 degrees in the closed position to form a normal stop.
2. Axle: Pultruded FRP made of the same resin as specified for the duct and continuous strand roving.
3. Control Shaft: Provide axle extending 6 inches (150 mm) beyond frame, full length vinylester with Type 316 stainless steel pins embedded transverse of axle.
4. Bearings: Molded PTFE with 10 percent carbon and graphite fill.
5. O-Rings: Viton.
6. Metallic parts in contact with the air stream are not acceptable.

D. Provide the following type of dampers for the service specified:

1. Balancing:
   a. Opposed multi-blade type.
2. Isolation:
   a. Butterfly type constructed of one gauge heavier than respective duct.
   b. Provide dampers equipped with full circumference extruded double tadpole blade seals.
   c. Butterfly damper leakage: Not to exceed 2.9 cfm/sq. ft. against 26 inches W.C.
3. Volume damper:
   a. Butterfly type, locking quadrant of same material as duct.

E. Provide manual dampers with lever type, locking quadrant operator Identified with OPEN and CLOSE positions.

F. Where indicated, provide electric motor operators as specified herein.

G. Dampers shall be of self-supporting construction and shall not deflect or deform while free standing.

H. Dampers shall have flanged ends for connection to ductwork and equipment.

I. Manual Operators:

1. Dampers 16-inch and larger: Provided gear operators with an epoxy coating.

2. Dampers 14-inch and smaller: Provide hand quadrant actuators fabricated of Type 316 stainless steel with a 5-stage locking quadrant indicator.

J. Balancing Dampers:

1. Manual: Provide a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill and pin-in place" once system is balanced so handle cannot vibrate loose.

2. Electric: Provide as specified.

K. Chain wheel operators: Provide galvanized steel chainwheels with galvanized steel chain and chain guides for all dampers with operator or gear operators higher than 6.5 feet above operating floor level.

1. Provide chain that reaches to within 3 feet of the operating floor level.

2. For dampers with gear operator mount with chainwheel in the vertical position.

3. Provide in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

L. Electric Motor Actuators:

1. Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

2. For fan inlet service provide modulating actuators.

**2.06 - AIR INLETS**

A. Material compatible with ductwork system specified.

B. Provide Type 316L stainless steel wire mesh bird screen for all fresh air intakes.

C. Each air exhaust from each of the tanks shall have a volume damper as indicated and specified.

**2.07 - DUCT SYSTEM SUPPORTS**

A. Duct Support:

1. Provide supports for all ducts designed and furnished by the duct system supplier in accordance with SECTION 15056, PIPE SUPPORTS and as specified herein.

2. Provide hanger spacing as indicated in ASTM D3982.

3. Provide ductwork supported from structure by straps or rods. Provide Type 316L stainless steel angle iron brackets to support ducts where structure is not available.

4. For exterior duct, design and provide free standing duct supports to meet specified duct spacing requirements and specified loads.

5. Provide anchors, inserts or clamps to secure hangers to structures. Provide Type 316 stainless steel anchors, screws and bolts. Provide in accordance with manufacturers recommendations and Factory Mutual limitations and restrictions.

B. Provide all duct supports shall be designed to withstand seismic loads as indicated and specified.

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS – Not Used**

**3.02 - INSTALLATION**

A. General:

1. Install ducts, dampers and appurtenances in accordance with manufacturer's recommendations.

2. Prior to installation, inspect each duct length and all fittings, flush clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

3. Provide all materials and equipment required.

**3.03 - PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

D. After installation and accepted testing by the Engineer Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleand from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING – Not Used**

**3.07 - LUBRICATIONS REQUIREMENTS- Not Used**

**3.08 - SPARE PARTS**

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

C. Provide the following spare parts, all identical and interchangeable with similar parts installed in Work:

1. Two spare gaskets of all types, materials and sizes.

2. One (1) set of all special tools.

**3.09 - DUCTWORK**

A. Assemble per SMACNA, Standards as specified hereinbefore.

B. Do not exceed 6-feet spacing of hangers on horizontal ducts; 4-feet on vertical ducts.

C. Support ductwork from structure by 16-gauge straps. Use hanger material compatible with ducts; use angle brackets to support vertical ducts.

D. Use anchors, inserts or clamps to secure hangers to structures; use stainless steel anchors if drilled-in type are installed.

E. Install duct connections to masonry openings airtight. Pack the space between the sleeve and framed prepared opening and the duct and the duct insulation with mineral wool or other FM approved fire resistant material.

F. Flanged connections to equipment, 3-inch minimum length.

G. FRP ductwork:

1. Joints, finished joints in accordance with NBS PS 15-69 Standards.

**3.10 - SYSTEM TESTING**

A. Test at 1.5 times the system design pressure specified and indicated.

B. Determine leakage by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

**3.11 - SYSTEM BALANCING**

A. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

B. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

C. Submit report to the Owner outlining balancing procedures used; report to include:

1. Type of measuring devices used.

2. Air quantities at each outlet, damper and fan.

3. Fan speeds.

4. Fan suction and discharge pressures.

5. Air quantities through fan, by test and by summation of air quantities at outlets.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15857**

**ODOR CONTROL SYSTEMS – CARBON**

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## PART 1 – GENERAL

### 1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide carbon odor control systems as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Scope includes:

1. Furnish, install and test an odor abatement system cable of handling and removing 99 percent of 10 PPM hydrogen sulfide and sewage vapors, complete, with all appurtenances to make it operable, as indicated and as specified.

2. Not used

3. All FRP ductwork, mating components, gaskets and all associated hardware between the Odor Control Fan and Mist/Grease Filter.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

2. Certified shop and working drawings. Drawings for the vessels and fans shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

   a. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

   b. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

   c. Files shall be drawn to scale.

   d. Drawings shall be in conformance with all other requirements as specified in this specification.

3. The Contractor shall submit Certificates of Analysis from the activated carbon supplier indicating the proposed carbon meets the specifications. Test Reports on the representative samples of GAC shall contain the following information.

   a. Hydrogen sulfide ($H_2S$) capacity, (g/mL)

   b. Mesh size confirmation

   c. Moisture, (percent as packed)

4. Provide a written statement certifying that the sample of the carbon material is representative of the carbon media that will be shipped and installed under this contract.

5. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

6. Manufacturer’s literature and specifications. Show catalog dates.

7. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.
9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.
10. Four copies of manufacturer's recommended regeneration instructions, procedures and safety precautions. Provide detailed instructions for particular system as required.
11. List of 5 operating installations of similar units.
    a. Provide current (verified) contact information for each installation.
12. Submit details of:
    a. Resin Type
    b. Types and amounts of filler
    c. Corrosion liner description
    d. Reinforcement types for hand lay-up or chopped laminates
13. Control Panel:
    a. Bill of materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, location of control panel internal and external mounted components. Provide panel elevation drawings with and without doors.
    d. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, instrumentation and electrical drawings.
14. Shop test results.
15. Motor shop test results.
16. Qualifications of field service technician.
17. Schematic control and power wiring diagrams.
18. Shop and Field inspections reports.
19. List of recommended spare parts other than those specified.
20. Recommendations for short and long term storage.
21. Special tools.
22. Shop and field testing procedures and equipment to be used.
23. Number of service technician days provided and per diem field service rate.
24. Manufacturer's product data, specifications, and color charts for shop painting.
25. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
26. The most recent ISO 9000 series certification.
27. Material Certification:
    a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations

in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

28. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

29. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

**1.05 - PRODUCT HANDLING**

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**1.07 - QUALITY ASSURANCE**

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Systems shall be the product of one manufacturer.

C. Systems shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

E. Provide components to manufacturer's standard for service specified and indicated unless otherwise required.

F. Provide components and accessories of manufacturers' latest and proven design.

G. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

H. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

I. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 1 person-days.

3. Functional Completion Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1/2 person-days.

4. Field Performance Testing: Field performance test equipment specified.

a. 1/2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

J. Manufacturer of systems shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

K. If equipment proposed is heavier, larger, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

**1.08 - WARRANTY – NOT USED**

**1.09 - REFERENCES**

A. Air Movement and Control Association (AMCA):

1. 210 Test Code

2. 300 Test Code

3. 500D: Laboratory method for Testing Dampers for Rating.

B. American Society for Testing and Materials International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel.

2. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment

3. D2867: Standard Test Method for Moisture in Activated Carbon.

4. D3299: Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
5. D4097: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
6. D4167: Standard Specification for Fiber-Reinforced Plastic Fans and Blowers
7. D5158: Standard Method for Determination of Particle Size of Powered Activated Carbon by Air Jet Sieving
8. D6646: Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon
9. E84: Standard Test method for Surface Burning Characteristics of Building Materials.

C. Fiberglass Reinforced Plastics Institute, Inc. (FRPI):

1. Laminate Certification Manual.

D. National Bureau of Standards (NBS):

1. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.
2. National Electrical Manufacturers Association (NEMA):
3. MG1: Motor and Generators
4. ICS1: Industrial Control and Systems

E. Underwriters Laboratory (UL):

1. UL 508A – Standard for Industrial Control Equipment

**1.10 - SPECIAL TOOLS**

A. Provide one 40-inch (1 meter) long grain sampler for obtaining carbon samples from adsorber vessel. Sampler to consist of two polished brass telescoping slotted tubes.

**PART 2 - PRODUCTS**

**2.01 - ACTIVATED CARBON**

A. Provide activated carbon to fill each reactor vessel.

B. The activated carbon shall be virgin, un-impregnated granular activated carbon, derived from bituminous, sub-bituminous or lignite coal.

C. The activated carbon shall be suitable for vapor phase adsorption of Hydrogen Sulfide and other odor causing compounds such as mercaptans typically found in vapors emitted by the wastewater treatment process.

D. Activated carbon shall conform to the following minimum requirements:

| | | |
|---|---|---|
| $H_2S$ breakthrough capacity (Per ASTM D6646) | g $H_2S$ removed/cc | 0.2 minimum |
| Moisture (per ASTM D2867) | wt. percent | 8 maximum |
| Mesh size (per ASTM D5158) | | |
| Greater than 4 Mesh (4.75 mm) | percent | 10 maximum |
| Less than 8 Mesh (2.36 mm) | percent | 5 maximum |

E. Submit a certificate certifying that the carbon meets the specified requirements.

**2.02 - SEISMIC DESGIN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage and supports designed in accordance with the seismic requirements indicated and specified. The Engineer is responsible for the design of the concrete foundation/equipment pads.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all compounds have been sized for the seismic forces specified and indicated.

**2.03 - ADSORBER VESSEL**

A. Provide carbon bed adsorber of filament-wound fiber glass conforming to ASTM D3299 or contact-molded fiberglass conforming to ASTM D4097. Fabricated in conformance to NBS PS-15-69 Standard.

B. Provide equipment suitable for continuous exposure to saturated hydrogen sulfide gas. Provide a certification from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin supplied with the submittal data.

C. Wall Laminate:

1. Inner corrosion barrier, resin rich barrier of 10-15 mils minimum not to exceed 20 percent +/- 5 percent glass by weight. Glass shall be of non-continuous fiber.

2. Provide the inner corrosion barrier followed by not less than two layers of chopped-strand mat or two passes of chopped roving to a total of 3 ounces/square foot. Should the chopped roving technique be employed, the chopped fibers shall be 1/2-inch length.

3. The inner corrosion barrier plus the two mat layers shall total 100 mils, minimum and be 27 percent plus or minus 5 percent glass by weight.

4. In addition to the above requirements provide vessel with average glass content by weight of 55 percent, plus or minus 5 percent.

5. Minimum adsorber vessel wall thickness: 1/4-inch.

6. The manufacturer will submit certified test results on physical properties of laminate with submittal data. Vessels not to be painted, but have clear ultraviolet adsorbers in the final resin coat.

D. All nozzle fittings: Flanged, one-piece, contact-molded construction, except pressure taps threaded replaceable Type IV Grade 1 CPVC bulkhead fittings with gaskets. Face and drill flanges to 125-pound ANSI Standard, pressure rated for 25 psig. Project flanges 4-inch from vessel surface and reinforce with four well-bonded gusset plates which extend to outside edge of flange. Do not use laminated or encapsulated bolts and fasteners, but make them replaceable.

E. All cut-walls shall be reinforced as required.

F. The adsorber vessel, if necessary, constructed in sections of appropriate height with flanged or other acceptable joints to allow the equipment to be placed in the building. Furnish suitable gasket for flanged joint.

G. Locate all fittings as indicated and specified. Provide adsorber with inspection-access hatch, drain nozzles, chemical feed nozzles, pressure gage taps, air inlet and outlet connections.

H. Design adsorber vessel to withstand full range of pressure conditions to which it may be subjected, including flooded tank due to the operation of the fire suppression sprinkler system.

I. Equip adsorber with anchor pads, bolts, washers, and lifting lugs necessary for field erection. Anchor bolts and washers 316 stainless steel, 1/2-inch minimum bolt.

J. Provide three samples probes at 9-inch intervals below the top of each carbon, extending into the carbon bed 1 foot minimum. Probe sized for adequate extraction of air samples from the carbon bed and be nonblinding. Extend probes outside the vessels wall and blocked off with a ball valve and cap.

K. Carbon bed support system as recommended by the manufacturer.

**2.04 - STATIC GROUNDING OF CARBON BED**

A. Include provisions to adequately ground the carbon bed. Details should be submitted to demonstrate that the carbon bed will be adequately grounded. Provide stainless steel 2-hole ground pads at each vessel and associated grounding materials and hardware for connection to the system grounding grid.

**2.05 - FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK**

A. Provide in accordance with SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

**2.06 - DAMPERS**

A. Provide in accordance with Section 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

**2.07 - MOTORS**

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of fans under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and speed: As indicated in the Fan Schedule.

D. Provide flex-coupled motors with base supports.

E. In addition to the requirements for bearings specified in SECTION 01171, ELECTRIC MOTORS provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet 0.9 motors from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Service Factor: 1.15.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

L. Site Altitude: 3,300 feet (1000 m) above sea level.

**2.08 - GASKETING AND SEALING**

A. Flanged nozzles: Viton or hypalon full face gaskets of 50 to 60 Shore “A” Durometer hardness.

B. Fabricated gaskets: Machine-made or die-stamped with inside and outside edges parallel or concentric, as applicable. Make bolt holes oversized to prevent crimping of gasket when installed.

**2.09 - CARBON ADSORBER ACCESSORIES**

A. Overflow, and drain connections furnished with Schedule 80 CPVC pipe, fittings and ball valves. Provide clear PVC pipe for overflow.

B. Piping: Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

C. Valves: Provide in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

D. Provide a Magnehelic differential pressure gauge installed on the housing to indicate differential pressure across each carbon bed. Tank mount with enclosure, calibrated in inches of water and column.

E. Blank flanges, material same as vessel, with bolts for air inlet connection.

F. Lifting and hold down lugs.

**2.10 - FANS**

A. Manufacturers:

1. Hartzell
2. New York Blower
3. Verantis

B. General:

1. AMCA rated and constructed.
2. Impeller wheels statically and dynamically balanced within vibration and noise limits.
3. Provide electric motor, drive equipment, belt guard, vibration isolators, supports and appurtenances.
4. Design fan with non-overloading characteristics for the horsepower indicated.
5. V-belt drive rated 50 percent greater than motor horsepower with adjustable sheaves to provide fan speeds 10 percent above or below rating point.
6. Provide electric motors mounted on adjustable ASTM A36 steel plate.
7. Provide fans with backward-inclined blades designed to operate within motor nameplate rating at all speeds provided by adjustable-pitch sheaves.
8. Provide integral or supplementary vibration or sound-adsorbing fan mountings.

C. Centrifugal Fan:

1. Single-width, single-inlet, multiblade design, backward-inclined blades. Drive motor, fan and casing mounted on common rail or support base with vibration isolators.
2. Construct fan of fiber glass reinforced polyester. Encase Type 316 stainless steel shaft in an FRP sleeve.
3. Flanged inlet and outlet connections.
4. Provide a casing drain with ball valve and cap.
5. Shaft Seal: Viton
6. Fan shaft shall be ground and polished Type 316 stainless steel. Bearings shall be located in an enclosed drive compartment and shall be heavy-duty, self aligning, with extended lube tubes for continuous service, with a minimum of 50,000 hrs. L10 life. A neoprene shaft seal shall be located where the shaft enters the inner bearing housing with a neoprene shaft slinger between the seal and wheel.
7. Fan assembly:
    a. Dynamically balanced and completely assembled at the factory prior to shipping. All fans shall meet balance requirements of the Acoustical Society of American Standards. Fan construction shall conform to ASTM Standard D4167 for fiber reinforced plastic fans and blowers. Fan performance shall be tested in an AMCA Registered Test Laboratory in accordance with AMCA 210 Test Code for air performance and AMCA 300 Test Code for sound. Fans shall be licensed to bear the AMCA Certified Air Performance Rating Seal.

8. Accessories:
    a. Provide motor cover and belt guard of epoxy coated steel.
    b. Provide a belt guard of epoxy coated steel for covering belts and motor sheave.
    c. Provide electrical grounding of fan housing to motor frame.
    d. Provide Type 316 stainless steel hardware.
9. Provide motors in conformance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

**2.11 - ACOUSTICAL ENCLOSURE**

A. Provide the sound enclosure of materials compatible with the environment in which it is operating and enclosing the entire fan assembly.

B. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

C. Fabricate the exterior of the enclosure of fiberglass or Type 316 stainless steel.

D. Provide an enclosure of unitized welded, bolted or screwed panel construction.

E. Access Covers:
    1. Provide hinged access covers on all sides and top of the enclosure with lockable latches, locks and keys, 2 sets.
    2. Checking, changing and adding lubricant to be capable of being performed without unmounting or removing enclosure and without the use of tools to open the enclosure.

F. Cooling and Insulation:
    1. Fabricate the enclosure to that the air is controlled and directed over the motor. Provide sound attenuation for cooling air outlet.
    2. Interior surface of the enclosure: 2-inch urethane foam with a protective film that is washable and free of perforations and/or materials that would accumulate oil and dust.
    3. Provide air circulation fan and thermostat.

G. Provide the enclosure as an integral part of the blower assembly and if size permits ship the blower assembly with the enclosure mounted so that factory quality, as tested, shall be consistent with all units.

H. Maximum noise level at 3 feet (0.9 meter) from enclosure: 80 dB(A).

I. Provide a wall mounted exhaust fan on one side of the enclosure and a non-ferrous acoustical louver on the opposite side.
    1. Manufacturers:
        a. Greenheck
        b. Loren Cook
    2. Bear the AMCA Certified Ratings Seals for Sound and Air Performance.
    3. Spark resistant aluminum blades and hub.
    4. Frame: Bolted structural steel channels and motor plate coated with a phenolic epoxy.

5. Direct drive.

   a. Swept propeller blades with a steep pitch for low sound, dynamically balanced to AMCA 204-05. Provide galvanized steel OSHA guard and 45 degree weather hood.

   b. Motor: Class I Div 1 explosion proof, NEMA premium efficient, ball bearings.

   c. Mount the motor starter in the Control Panel specified herein.

   d. Mount a Class I Div 1 thermostat inside the enclosure to control the exhaust fan. Range 50 to 90 deg F.

J. Provide enclosure with factory pre-wired internal LED lighting and light switch. Lighting to be fed from separate 120VAC power source outside the specified control panel.

**2.12 – PRE-FILTER (GREASE/MIST ELIMNATOR)**

A. A pre-filter shall be provided to remove moisture / particulate prior to the fan.

B. Housing: Housing shall be manufactured using fiberglass reinforced plastic. Stainless or alternate plastic materials are not acceptable. Manufacture shall have a minimum of 10 year' experience in the design and supply of similar equipment. Manufacturer shall retain the services of an independent inspector who is responsible to confirm the prefilter has been manufactured in accordance with this specification and all FRP work meets or exceeds ASME RTP-1 level 2 visual inspection criteria

1. Resin system shall be a corrosion resistant vinyl ester with a class 1 flame spread rating. Acceptable products are AOC K022-AC or Dow Derakane 510-B series. Resin system shall not require any additives such as nyacol or antimony to achieve the class 1 flame spread rating. Finished laminate including liner and structure shall be translucent

2. All internal surfaces shall have a 100-mil corrosion liner made up of a single nexus veil followed by two layers of 1.5 oz chopped strand matt.

3. All exterior surfaces shall have gelcoat applied. This coating shall contain UV inhibitors, color to be selected by the owner.

4. Housing shall have machined UMHW guides to prevent stainless frame on filter pad from scratching or damaging the corrosion liner.

5. Filter housing shall be designed for 12" positive and negative pressure with a maximum of 1/8" deflection.

6. Housing shall have an access door for pad removal complete with EPDM gasket and 316 Stainless hinges / quick latches. For filter housings larger than 3' across, two access doors shall be provided. Access doors shall have stainless toggle clamps for easy pad access. Bolt-on access doors are not acceptable.

7. Housing shall be provided with a 2" wide, 2" deep sump running the width of the housing to facilitate drainage from the pad edges. Sump shall have a 2" drain connection at the base, and come from the manufacturer complete with external water trap.

8. For installation, housing shall have (2) 8" diameter FRP legs. Length of legs shall be coordinated with the contractor. Housing shall be supported by these legs independent of connecting ductwork, anchored with stainless steel HILTI bolts.

9. Housing shall have a differential gauge bracket and be supplied with a Dwyer Magnehelic pressure gauge and connections for gauge on either side of filter pad. Unit shall come complete from the factory with all DP equipment pre-assembled and installed.

10. Pad shall have 2" of stainless mesh followed by 4" of poly mesh. Mesh shall be held together by a stainless steel frame. Total pad width including pads and frame shall be 8".

11. Maximum pad segment width of pads is 24". Pads larger than 24" wide must be segmented to allow easy removal by the owner. Segment width should not exceed 24".

C. DIMENSIONS / DESIGN:

1. End connections shall be sized for a maximum air velocity of 2500 f/m. Flange dimensions shall match the connecting ductwork. Flange thickness shall not be less than that listed in ASTM 3982.

2. Inlet cone shall be designed so that the airstream can spread evenly over the pad surface. Cone angle shall be no less than 60 deg.

3. Housing shall be sized so that air velocity through the filter pad is 400 f/m.

4. Particle removal efficiency shall be 99% of particles 10 microns or larger.

**2.13 - SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

**2.14 - INTERCONNECTING DUCTWORK**

A. Provide the ductwork between the reactor vessel and the odor control fan by odor control manufacturer.

B. Provide the ductwork assembly and design compatible with the fan and vessel.

C. Material: Provide in accordance with SECTION 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

D. Provide an expansion joint in the ductwork and installed at the outlet of the exhaust fan. The expansion joint shall dampen axial, lateral, and vibrational duct movement. The expansion joint shall be resistant to ultraviolet degradation and to the corrosive gases being processed.

1. Provide expansion joints in accordance with Section 15855, FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES.

**2.15 - FLOW CONTROL DAMPER (BALANCING) - NOT USED**

**2.16 - CONTROL PANEL**

A. Provide a pre-wired factory-tested UL 508A listed control panel. Mount the panels at eye level where indicated. Use 316 stainless steel strut and fasteners. The short circuit rating of the control panel and all of the components shall be UL listed and labeled for 65 KAIC amperes at 480 volt.

1. Panels to be at least 3-ft away from odor control vessels, fan enclosure, or duct.

2. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

B. Enclosure: NEMA 4X, Type 316 stainless steel, hinged with quarter turn handle(s).

C. Provide a single 480 VAC / 3-phase / 60 Hz power connection with step-down transformers as required for the odor control system.

D. Provide a main power disconnecting circuit breaker on the panel face. Provide circuit breaker rated at 65k (minimum).

E. Provide dedicated circuit breakers for each additional motor circuit.

F. Instruments and ancillary devices supplied with the Odor Control system shall obtain device power from the OC control panel. However, the enclosure lighting circuit shall not be powered from the OC control panel and shall be provided with a separate dedicated feed rated at 120VAC, single phase, 20 Amps.

G. Provide a surge protector with a minimum rating of 120 kA per phase, 60 kA per mode at 480 volt.

H. Provide and mount odor control fan (OC.F-1) and odor control enclosure exhaust fan (OC.EF-1) inside control panel.

I. Motor heaters for OC.F-1 and OC.EF-1 shall be powered from the control panel.

J. Bring all electrical devices to terminal blocks in the panel sized for 12 gauge wire. All controls wires to be 14 gauge copper. Tag each end of the wire with shrink tube type labels. All tags to match the shop drawing wiring diagrams. Run all wires neatly through race-ways.

K. Provide 30-mm pushbuttons, switches, and push-to-test LEDs.

L. Provide the following items on the panel door, each with flexible engraving stock nameplates with black letters on a white background, fastened with 3M VHB tape:

1. Nameplate with manufacturer's contact information, model number, serial number, and manufacture date.
2. Through-the-door main circuit breaker, minimum 65 kA rating.
3. Electrical warning labels.
4. Unit tag number in accordance with Contract drawings.
5. "HAND/OFF/AUTO" – switch
    a. HAND – odor control fan starts
    b. OFF – odor control fan stops and cannot start remotely
    c. AUTO – odor control fan starts and stop with remote signals from plant control system.
6. "EMERGENCY STOP" red mushroom head
    a. Stops all fans regardless of H/O/A switch setting.
7. "POWER ON" – white LED
8. "OC FAN RUNNING" – green LED
9. "OC FAN FAULT" – amber LED
10. "EXHAUST FAN RUNNING" – green LED
11. "EXHAUST FAN FAULT" – amber LED
12. "PRE-FILTER HIGH DP" – amber LED

M. Provide dry contacts for the following remote signals:

1. Run command (Input)
2. Run status (Output)
3. Not in remote status (Output)
4. Pre-filter high differential pressure (Output)
5. Common fault (either OC FAN or EXHAUST FAN) (Output)
6. E-STOP active (Output)

**2.17 - EQUIPMENT SCHEDULE**

A. Manufacturers:

1. ECS
2. PureAir
3. Daniel Co.

B. Carbon Adsorber:

1. System Air Flow Capacity: 15,000 cfm
2. Carbon Volume: 876 pounds /vessel
3. Number of Vessels: 1
4. Number of Beds/Vessel: 2
5. Vessel Diameter: 128 inches
6. Vessel Overall Height: 192 inches
7. Vessel Pressure Drop at Design Flow Rate: 6 inches WC

C. Fans:

1. Quantity: 1
2. Fan Rating: 15,000 cfm at 10 inches WC
3. Motor HP: 30
4. Motor Enclosure: TEFC
5. Motor Speed: 1,800 rpm,
6. Drive Type: V-belt

**PART 3 - EXECUTION**

**3.01 - VERIFICATION OF CONDITIONS**

**3.02 - INSTALLATION**

A. General:

1. Install equipment and appurtenances in accordance with manufacturer's recommendations.
2. Provide all materials and equipment required.

**3.03 - PAINTING**

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

**3.04 - CLEAN UP**

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

**3.05 - MANUFACTURER'S FIELD SERVICES**

A. Manufacturer's Field Services shall be provided as specified herein.

**3.06 - MANUFACTURER'S TRAINING**

A. Manufacturer's training shall be provided as specified herein.

**3.07 - LUBRICATION REQUIREMENTS**

A. All lubricating oils required for the first year of operation shall be provided.

**3.08 - SPARE PARTS**

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Furnish and deliver to Owner at site of Work the following spare parts, all identical and interchangeable with similar parts installed in Work:

1. One of each type pressure gauge, with diaphragm seals or plain, as necessary.

2. Two spare gaskets of all types, materials and sizes.

3. Complete set of replacement belts.

**3.09 - ADSORBER**

A. Install adsorber and all components in accordance with manufacturer's recommendations.

B. Install adsorber on a concrete pad as indicated on the drawings.

**3.10 - FIELD AND FUNCTIONAL TESTING**

A. After installation, perform all of the following full operational tests in presence of the Owner. Furnish all labor, materials and equipment required for such tests.

1. Adsorber Vessel:

a. Factory test with water to the height of the overflow or the straight side height of the vessel, greater amount. Submit test data.

b. The water level must be unchanged after 24 hours with no visible signs of leakage or wall deflection exceeding 1/4 percent of span.

c. Hydrostatic test shall be witnessed by the Engineer.

2. Start-up:

a. Provide the services of a factory-trained service technician, certified by the manufacturer to service the type of equipment herein specified, to assist in start-up operation.

b. Tests to be performed consist of start-up and operation of entire system at design capacity, and verification of operation of drives and other components, without, overheating, leakage, cracking of parts, structural damage, jamming, binding, or other defects.

c. During tests, make observations of fan head, capacity, and motor input. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests at no additional cost to the Owner.

3. In case of failure to demonstrate ability to function as indicated and specified, modify, rebuild or replace equipment or parts thereof at no additional cost to Owner, until equipment is in accordance with specifications. After three (3) unsuccessful test attempts, replace non-conforming equipment at no additional cost to the Owner. Repeat tests until specified requirements have been met, at no additional cost to the Owner.

**3.11 - SYSTEM TESTING**

A. Following the Owner approval of start-up results, provide services of an independent State qualified air testing laboratory to measure and report on efficiency and performance of the odor control system. Submit testing procedures of testing laboratory to the Owner at least 15 days prior to tests. Have manufacturer's service technician present during system testing.

**3.12 - SYSTEM BALANCING**

A. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

B. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

C. Submit report to the Owner outlining balancing procedures used; report to include:

1. Type of measuring devices used.
2. Air quantities at each outlet, damper and fan.
3. Fan speeds.
4. Fan suction and discharge pressures.
5. Air quantities through fan, by test and by summation of air quantities at outlets.

**3.13 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15900**

**HVAC CONTROL SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 15900, HVAC CONTROL SYSTEMS is a part of DIVISION 15, HEATING, VENTILATING AND AIR CONDITIONING which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING.

B. The Work of SECTION 15900, HVAC CONTROL SYSTEMS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. Design and provide new control systems for Heating, Ventilating and Air Conditioning (HVAC) complete and ready for operation as indicated and in compliance with the Contract Documents.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section of the Specifications, the Drawings, and the codes and standards listed herein.

C. Provide direct digital control (DDC) Building Automation System (BAS), and electric/electronic control systems, for the various HVAC sub-systems as indicated. Pneumatic control systems shall not be permitted. Furnish and install all components to perform all interlock, control, monitoring and alarm, and sequencing functions as indicated, specified and/or required.

1. Electric/electronic control systems shall be standalone, employing programmable or non-programmable devices for the control of equipment as indicated.

2. Building Automation System (BAS) shall be web-based networked electric-actuated DDC system complete with Subcontractor-written software. The system shall provide control, monitoring and alarm functions. The system shall not be interfaced with Supervisory Control and Data Acquisition (SCADA) systems except as indicated. The BAS and all networked devices shall be accessible through any personal computer with the necessary hardware and software and communicate using open protocol. Gateways at equipment with on-board microprocessor controls shall support the selected open protocol, including all object properties and read-write services. Manufacturer's products, including design, materials, fabrication, assembly, inspection, and testing shall be in accordance with ASHRAE 135 and NFPA 70, except where indicated otherwise. Provide software, software licenses, software configurations, database entries, and interfaces. The DDC system shall incorporate, at minimum, the following integrated features, functions and services:

   a. Operator information, alarm management and scheduling functions.

   b. Information management including trending.

   c. Diagnostic monitoring and reporting of DDC functions.

   d. All other features indicated.

D. Control systems shall be furnished, installed, tested, calibrated, and started up by, or under the supervision of trained technicians certified by the HVAC controls manufacturer as qualified and regularly employed in such work.

E. Control system equipment (meters, valves, dampers, panels, etc.) shall bear the manufacturer's nameplate.

F. In process areas, mechanical rooms, electrical rooms, and similar industrial spaces, sensors and thermostats shall be industrial grade having metal enclosures. In laboratories, toilet facilities, control rooms, and similar finished spaces, sensors and thermostats may have plastic enclosures. NEMA enclosures types for each type of space shall be as indicated.

G. Controls systems manufacturer:

1. All HVAC control system equipment, devices, hardware and software shall be manufactured by either Alerton Controls, Allen-Bradley, Johnson Controls, Inc. Siemens, or Schneider Electric. Unless otherwise indicated, HVAC control system products shall be by only one of these manufacturers and there shall be no mixing of products by different manufacturers, except as permitted by the selected manufacturer amongst the three named hereinabove

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. ARCNET: ANSI/ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it is possible to determine the maximum delay before a device is able to transmit a message.

B. BACnet: Building Automation and Control Network; the common name for the communication standard ASHRAE 135. The standard defines methods and protocol for cooperating building automation devices to communicate over a variety of LAN technologies.

C. BACnet Internetwork: Two or more BACnet networks, possibly using different LAN technologies, connected with routers. In a BACnet internetwork, there exists only one message path between devices.

D. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers

E. BBMD: BACnet Broadcast Management Device (BBMD). A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Every IP subnetwork that is part of a BACnet/IP network must have only one BBMD. See also "BACnet/IP"

F. BAS: Building Automation Systems, including DDC (Direct Digital Controls) used for facility automation and energy management.

G. Bridge: Network hardware that connects two or more network (or BACnet internetwork) segments at the physical and data link layers. A bridge may also filter messages.

H. Broadcast: A message sent to all devices on a network segment.

I. Device: Any control system component, usually a digital controller, that contains a BACnet Device Object and uses BACnet to communicate with other devices. See also "Digital Controller".

J. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

K. Digital Controller: An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions. In most cases, synonymous with a BACnet device described in this specification. See also "Device".

L. Direct Digital Control (DDC): Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

M. DDC System: A network of digital controllers, communication architecture, and user interfaces. A DDC system may include programming, sensors, actuators, switches, relays, factory controls, operator workstations, and various other devices, components, and attributes.

N. Ethernet: A family of local-area-network technologies providing high-speed networking features over various media.

O. Firmware: Software programmed into read only memory (ROM), flash memory, electrically erasable programmable read only memory (EEPROM), or erasable programmable read only memory (EPROM) chips.

P. Gateway: Communication hardware connecting two or more different protocols, similar to human language translators. The Gateway translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

Q. Hub: A common connection point for devices on a network.

R. Internet Protocol (IP, TCP/IP, UDP/IP): A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

S. Input/Output (I/O): Physical inputs and outputs to and from a device, although the term sometimes describes software, or "virtual" I/O. See also "Points".

T. I/O Expansion Unit: An I/O expansion unit provides additional point capacity to a digital controller.

U. Local-Area Network (LAN): A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

V. LonTalk: ANSI/EIA 709. A communication protocol developed by Echelon Corp. LonTalk is an optional physical and data link layer for BACnet.

W. MAC Address: Media Access Control address. The physical node address that identifies a device on a Local Area Network.

X. Master-Slave/Token-Passing (MS/TP): ISO/IEC 8802 (Part 3). One of the LAN options for BACnet. MS/TP uses twisted-pair wiring for relatively low speed and low cost communication (up to 4,000 ft at 76.8K bps).

Y. Native BACnet Device: A device that uses BACnet as its primary, if not only, method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

Z. Network: Communication technology for data communications. BACnet approved network types are BACnet over Internet Protocol (IP), Point to Point (PTP) Ethernet, ARCNET, MS/TP, and LonTalk®.

AA. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

BB. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

CC. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

DD. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

EE. Peer-to-Peer: Refers to devices where any device can initiate and respond to communication with other devices.

FF. PID: Proportional, integral, and derivative control; three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

GG. PICS: Protocol Implementation Conformance Statement (PICS), describing the BACnet capabilities of a device. See BACnet, Annex A for the standard format and content of a PICS statement.

HH. Points: Physical and virtual inputs and outputs. See also "Input/Output".

II. PTP: Point-to-Point protocol connects individual BACnet devices or networks using serial connections like modem-to-modem links.

JJ. Router: A BACnet router is a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

KK. Stand-Alone Control: Refers to devices performing equipment-specific and small system control without communication to other devices or computers for physical I/O, excluding outside air and other common shared conditions. Devices are located near controlled equipment, with physical input and output points limited to 64 or less per device, except for complex individual equipment or systems. Failure of any single device will not cause other network devices to fail. BACnet "Smart" actuators (B-SA profile) and sensors (B-SS profile) communicating on a network with a parent device are exempt from stand-alone requirements.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTAL PROCEDURES and as specified herein.

1. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item.

a. Actuators

b. Control valves

c. Control dampers

d. Transmitters

e. Sensors

f. Thermowells

g. Sunshields

h. Thermostats

i. Flow switches

j. Pressure switches

k. DDC system

l. Miscellaneous control devices

m. Control panels

2. Shop Drawings:

a. Control System Diagrams: For each system, indicate HVAC process flow diagrams and location of devices, control panels, the connections of control devices in control loops, references of control device contacts and device operating coils to line numbers of a ladder diagram and sequencing diagrams showing the operation of valves, dampers, and contacts relative to controller output, and HVAC process variables.

b. Ladder Diagram: Indicate connections and interlocks to control system devices and other devices such as starters, drives, control panels, and HVAC equipment panels. Diagram shall be coordinated by line number and device number with each control system diagram.

c. Operating Parameters: Indicate operating parameters for devices shown on the control system diagram such as setpoints, ranges, limits, differentials, outside air temperature schedules, contact operating points, and HVAC equipment operating time schedules.

d. Control Valve Schedules: Indicate valve size, valve coefficient (Cv), flow rate, pressure drop, top size, quantities and sizes of actuators, spring range, positioner range, operating signal characteristics, and power source.

e. Control Damper Schedules: Indicate damper size, quantities and sizes of actuators, spring range, positioner range, operating signal characteristics, and power source.

f. Wiring Diagram: Indicate terminal blocks, wire marker identification, connections to control system devices, external and internal power sources, and connections to external devices, starters, drives, control panels, jumpers, and ground connections.

g. Sequences of Operation: Sequence of operation for each HVAC control system coordinated with device identifiers on control system diagram and ladder diagram.

h. Arrangement Drawing: Arrangement diagram of each control panel coordinated with device identifiers on the control system diagram and the ladder diagram.

i. List of I/O Points: Also known as a Point Schedule, provide for each input and output point physically connected to a direct digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Digital Output (DO), Digital Input (DI)), point sensor range, point actuator range, point address, BACnet object, associated BIBBS (where applicable), and point connection terminal number. Typical schedules for multiple identical equipment are allowed unless otherwise requested in design or contract criteria.

j. BACnet Communication Architecture Schematic: Provide a schematic showing the project's entire BACnet communication network, including addressing used for LANs, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

k. Control System Drawings Title Sheet: Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the HVAC Controls Sub-subcontractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

3. Reports – Prepare as specified in Paragraph 3.7 (Field Quality Control) of this Section:
   a. Procedures
   b. Field tests
   c. Performance verification tests
   d. Calibration adjustment and commissioning
4. Manufacturer's Instructions:
   a. Training course documentation
5. Operation and Maintenance Manuals – Prepare manuals in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA and Paragraph 1.6 of this Section.
6. Certification – Submit documentation certifying completion of the following items in compliance with this Section.
   a. Manufacturers Services
   b. Tests
   c. Training
   d. Commissioning
7. Closeout Submittals:
   a. Record Drawings – Prepare and maintain record drawings as specified under this Section.
   b. Qualified service organization list.

**1.05 - PRODUCT HANDLING**

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Shipping:

1. All equipment and material shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance and to maintain equipment and material warranties.

C. Receiving:

1. All equipment and material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.
2. Inspect for damage and correctness, and inventory items, upon delivery to site.
3. Store and safeguard equipment and material in accordance with manufacturer's recommendations.
4. Store equipment and material protected for the weather, humidity and temperature variations, dirt and dust or other contaminants.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. General Provisions:

1. Drawings and specification direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment, controls, or appurtenances.

2. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished shall fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.

2. Install equipment that complies with state, local and federal codes and regulations.

D. Signs and Tags:

1. A tag shall be mechanically attached directly to each field-mounted device or attached by a metal chain or wire. Signs shall be mechanically attached to control panel doors.

E. Verification of Dimensions:

1. The HVAC Subcontractor and the HVAC Controls Sub-subcontractor shall become familiar with details of work, shall verify dimensions in the field, and shall advise the Engineer of any discrepancy before performing work.

F. Design/Construction Standards:

1. Accomplish work in accordance with NFPA 70 and NFPA 90A, except as indicated otherwise for equipment, materials, installation, examination, inspection, and testing.

G. Operation and Maintenance Manuals:

1. In addition to the requirements specified in the Submittals paragraph of this Section, meet the following requirements. Submit Operation and Maintenance Manuals for items of equipment listed under paragraph entitled "Product Data." Manual shall contain full hardware support documentation, which shall include but not be limited to the following:

a. General description and specifications

b. Installation and initial checkout procedures

c. Detailed electrical and logical description

d. Troubleshooting procedures, diagrams, and guidelines

e. Alignment and calibration procedures for components

f. Preventive maintenance requirements and a maintenance checklist

g. Detailed schematics and assembly drawings

h. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement

i. Signal identification and timing diagrams

j. Complete record control drawings, schedules, and sequence of operation

k. Controller configuration and parameter setting procedures

l. Step-by-step procedures required for each HVAC control systems startup, operation, shutdown, recovery, and fault diagnosis

m. Calibrations and settings adjustments and results of calibration checks specific to each HVAC control system

n. Manufacturer supplied operator manuals for equipment

o. Qualified service organization list

H. HVAC Controls Sub-subcontractor's Qualifications:

1. Submit documentation certifying the HVAC Controls Sub-subcontractor performing the work has completed at least three control system installations of a similar design to this project, and programmed similar sequences of operation for at least five years.

I. Project Sequence:

1. The control system work for this project shall proceed in the following order:

a. Submit and receive acceptance on the Shop Drawings, Product Data, and Certificates specified under the paragraph entitled "SUBMITTALS."

b. Perform the control system installation work, including all field check-outs and tuning.

c. Provide support to TAB personnel as specified under the paragraph "TEST, ADJUST AND BALANCE SUPPORT."

d. Submit and receive acceptance of the Controls System Operators Manual specified under the paragraph "HVAC CONTROL SYSTEMS OPERATORS MANUALS."

e. Submit and receive acceptance of the Performance Verification Testing Plan and the Pre-PVT Checklist specified under the paragraph "PERFORMANCE VERIFICATION TESTING."

f. Perform the Performance Verification Testing.

g. Submit and receive acceptance on the PVT Report.

h. Submit and receive acceptance on the Training Documentation specified under the paragraph "TRAINING". Submit at least 30 days before training.

i. Deliver the final Control Systems Operators Manuals.

j. Conduct the Training in the order specified.

k. Submit and receive acceptance of Closeout Submittals.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. Air Movement and Control Association International (AMCA):

1. AMCA 500-D Laboratory Methods of Testing Dampers for Rating

D. American National Standards Institute (ANSI):

1. ANSI/ATA 878.1 ARCNET - Local Area Network: Token Ring
2. ANSI C12.1: Electric Meters
3. ANSI C12.16: Electricity Metering Solid-State Electricity Meters

E. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE 111: Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems
2. ASHRAE 135: BACnet-A Data Communication Protocol for Building Automation and Control Networks

F. American Society of Testing Materials (ASTM):

1. A36: Carbon Structural Steel
2. A126: Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
4. C665: Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
5. E84: Surface Burning Characteristics of Building Materials

G. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
3. C62.45: Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits

H. International Organization for Standardization (ISO):

1. ISO/IEC 8802: Telecommunications and Information Exchange Between Systems

I. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
2. ST 1: Specialty Transformers (Except General Purpose Type)

J. National Fire Protection Association (NFPA):

1. 70: National Electrical Code
2. 90A: Installation of Air Conditioning and Ventilating Systems

K. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1. HVAC Duct Const Stds: HVAC Duct Construction Standards Metal and Flexible
2. HVACTAB: HVAC Systems - Testing, Adjusting and Balancing

L. Underwriters Laboratories, Inc. (UL):

1. 508: Industrial Control Equipment
2. 508A: Standard for Industrial Controls Panels
3. 1449: Surge Protective Devices

M. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - COOPERATION AND COORDINATION WITH OTHER TRADES**

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed promptly.

B. Furnish to all other trades advance information on location and size of all frames and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of the Engineer and without extra cost to the Owner, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If Work is installed before coordinating with other trades so as to cause interference with the Work of such trades, make all necessary changes in Work under this Section.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Engineer before proceeding.

H. Attend regular coordination and job progress meetings required.

I. Supervise the following related work done under other Sections of these Specifications.

1. Provision of auxiliary contacts with buttons, switches and indicator lights in required configurations, on motor starters.
2. Installation of control dampers, control valves, and thermowells in piping for sensor insertion.
3. Assembly of multiple section dampers with required inter-connecting linkages and shafts through duct for external mounting of damper actuators.
4. Provision of baffles to eliminate stratification and provide specified air volumes, affixed permanently after stratification is eliminated.
5. Provision of duct access doors for service to control equipment.

J. See SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING FOR ADDITIONAL REQUIREMENTS.

**1.10 - PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

A. Access panels shall be furnished under this Section and installed by the trade responsible for the appropriate Section of the Specifications for the surface upon which the panels are mounted. Prepare a schedule showing location, size and function of all required access panels and deliver schedule to representatives of all installing trades.

B. Access doors in ductwork shall be furnished and installed under SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING. Prepare a schedule showing location, size and function of all required access doors and deliver schedule to representatives of the installing trade.

C. Anchoring inserts shall be furnished under this Section and installed under SECTION 03300, CAST-IN-PLACE CONCRETE. Prepare a schedule showing location, size and function of all required anchoring inserts and deliver schedule to representative of the installing trade.

D. For new construction, pipe sleeves shall be furnished under this Section and installed by the trade whose finished interior surfaces will be penetrated. Prepare a schedule showing location, size and function of all required pipe sleeves and deliver schedule to representatives of all installing trades. For existing construction, pipe sleeves shall be furnished and installed under this Section.

E. Control valves, control dampers, and thermowells for immersion temperature sensors shall be furnished under this Section and installed under SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING. Prepare a schedule showing location, size and function of all required control valves, control dampers, and thermowells and deliver schedule to representatives of the installing trades.

**1.11 - PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION**

A. Duct smoke detectors will be furnished and wired to the fire alarm control panel under Division 16. Duct smoke detectors shall be wired to associated air handling units under this Section. Duct smoke detectors will be mounted under SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING.

**1.12 - ELECTRICAL WORK**

A. The Electrical Subcontractor shall furnish and install the following under Division 16:

1. All power including wiring, conduit and connections to HVAC control panels, controllers, workstations, HVAC equipment and motors (except valve and damper actuators).
2. Motor control center (MCC) located motor starters for 3-phase HVAC equipment.
3. Local motor starters for 120 VAC HVAC equipment, except for motor starters that are factory-furnished and wired as an integral part of packaged mechanical equipment where indicated or specified.
4. Safety disconnect switches at HVAC equipment.
5. Standalone Hand-Off-Auto (H-O-A) switches and manual on/off switches
6. All wiring, conduit and connections for the fire alarm system.

B. This Section shall furnish and install the following:

1. All control wiring, conduit and connections, and all devices required for control of the HVAC system.
2. All wiring, conduit and connections to HVAC control valve and control damper actuators.
3. All control connections to the "Auto" contacts of H-O-A switches
4. All control connections to auxiliary contacts at motor starters.
5. Auxiliary contacts for MCC located motor starters and local motor starters that are not factory furnished by the motor starter manufacturer but required to accomplish the specified control sequences.

C. Control wiring shall be 120 VAC or less. Provide control wiring in conduit as specified in Division 16.

D. Boilers:

1. Comply with applicable regulations of the Massachusetts Boiler Rules. Control system wiring shall comply with ASME CSD-1 requirements.
2. All boiler room wiring from the main disconnect switch panel to the boiler controls, boiler primary pump(s), limit circuit, operating controls, gas valves and actuators, switches and additional control devices shall be furnished and installed under this Section in accordance with the requirements of Division 16.

3. Boiler control circuit shall be taken from a two-wire branch circuit, one side grounded, not exceeding 120 volt, line to line. All safety control switching shall be accomplished in the hot ungrounded conductor and through the 24 volt low voltage wiring provided by the boiler manufacturer and in accordance with the manufacturer's instructions and recommendations.

4. All wiring for boilers and burners shall be rated for the maximum operating temperature to which it may be exposed. All wiring between components shall have copper conductors not thinner than 18 AWG and constructed in accordance with the Electrical Code specified herein. All field installed wiring, conduit, junction boxes and the like shall be installed so as not to interfere with the boiler manufacturer's recommended cleaning and maintenance procedures.

5. Division 16 shall provide fuse protection for the control circuit. Division 16 shall provide a manually operated emergency switch just outside the boiler room door and marked for easy identification to shutdown all boilers in the room. If there is more than one (1) boiler room door, provide a switch located at each door. For any boiler not equipped with a factory wired shut-off switch, provide an electrical junction box at the boiler equipped with a SPST switch to be wired into the limit circuit so as to function as a service switch. Service switch box shall be mounted on the boiler jacket panel without obstructing cleanout panel accessibility or preventative maintenance routines. Shutdown switches shall be wired to disconnect all power to the boiler controls. All switches shall be marked "ON/OFF". All switches at doors shall have a plate marked "Gas Burner".

**1.13 - CODES, PERMITS AND FEES**

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform to the governing edition of the following regulations and agency requirements.

1. State and Local Building Codes including, but not limited to, the Massachusetts Building Code, the Massachusetts Fire Code, and the Massachusetts Electrical Code.

2. Local Fire Department

3. Occupational Safety and Health Administration (OSHA)

4. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No Work shall be covered before examination and approval by Authorities having jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the, Owner, Engineer and Authorities Having Jurisdiction without extra cost to the Owner. If Work is covered before inspection and approval, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

**1.14 - RECORD DRAWINGS**

A. Prepare and maintain record drawings in accordance with SECTION 01346, AS-BUILT DRAWINGS and as specified herein.

B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of the accepted HVAC Control Systems Shop Drawings at the job site at all times. On a daily basis, record work completed and all changes from accepted HVAC Control Systems Shop Drawings clearly and accurately, including work installed as a modification or addition to the accepted controls system design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.

C. Record Drawings shall show as-built condition of diagrams, schematics, control sequences, and corrections to equipment schedules. Schedules shall show actual manufacturer and make and model numbers of installed equipment. Remove all superseded data to show the completed work.

D. The Record Drawings will be used as a guide for determining the progress of the Work installed. They shall be reviewed on a regular basis and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be accepted until the Record Drawings are accurate and up-to-date.

E. At completion of Work prepare a complete set of Record Drawings showing all systems as actually installed. Provide all drawings necessary to show the required record information. Indicate all changes made to the accepted HVAC Control Systems Shop Drawings. Submit cad-drafted prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer. Submit final accepted Record Drawing electronic files in PDF format.

F. Certify the accuracy of the Record Drawings. Record Drawings shall become the property of the Owner.

G. When required by jurisdiction, submit Record Drawings for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

**1.15 - AMERICAN IRON AND STEEL ACT**

A. This Contract is subject to PL-113-76 the Consolidated Appropriations Act, 2014, Section 436 (American Iron and Steel Act), which requires the use of iron and steel products that are wholly manufactured in the United States for inclusion in the Work. It is understood that any iron and steel used on this project are to be produced in the United States, and produced in a manner which complies with the American Iron and Steel Requirement. Any melting, bending, coating, galvanizing, cutting, etc. process for manufacturing or fabrication will be in full compliance with the American Iron and Steel as mandated in the Environmental Protection Agency's State Revolving Fund Programs.

**PART 2 - PRODUCTS**

**2.01 - COMPONENTS**

A. Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or equipment other than the latest generation shall not be acceptable. Electric and electronic devices not located within control panels shall have a NEMA/EEMAC Type 1 enclosure unless otherwise indicated or specified. Provide NEMA/EEMAC Type 4 enclosures for outdoor installations. Actuators and transmitters shall operate within temperature limit ratings of plus 35 to 150 degrees F. Panel mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus (-) 35 to 150 degrees F.

B. All components shall be mercury-free, and shall not contain other hazardous materials as defined by federal regulations.

C. Stainless steel shall conform to ASTM A167.

**2.02 - ACTUATORS**

A. Provide 24 VAC electric or electronic actuators for control valves and control dampers.

B. Modulating actuators shall be proportional control type. Floating point control type shall not be permitted. Thermal type actuators shall not be permitted.

C. Provide direct-drive actuators except where indicated otherwise. Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Provide modulating actuators capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between. Unless indicated otherwise, provide spring return actuators on all control dampers and all control valves.

D. Actuators shall function as specified within 85 to 110 percent of their power supply rating. Damper actuators shall have spring return. Valve actuators shall have spring return or non-spring return. Actuators shall fail to their spring return positions on signal or power failure unless indicated or specified as non-spring return actuators. Actuators shall have visible position indicators. Where actuators do not have positive spring returns for fail-safe operation, provide relays or reserve power as applicable for electric and electronic actuators to achieve proper timed positioning for up to 4 minutes after primary power failure. Non-spring return actuators shall have a switch for changing the fail position. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change.

E. Damper Actuators: Damper actuators shall be rated for at least 150 percent of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

F. Valve Actuators: Valve actuators shall be rated for at least 150 percent of the motive power necessary to operate the valves over their full range of operation against the total and differential pressures.

**2.03 - CONTROL VALVES**

A. Valve Assembly:

1. Valves shall have stainless steel stems and stuffing boxes with extended necks to clear piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Minimum rated bubble tight close off pressure of the valve shall exceed the rated deadhead pressure of the pump that supplies it, but not less than 150 psi. Valve leakage rating shall be 0.01 percent of rated Cv for soft-seated valves and 0.05 percent for metal-to-metal seated valves. Class 125 copper alloy valves and Class 150 steel or stainless steel valves shall conform to ASME B16.5 as a minimum. Class 125 cast iron valves shall conform to ASTM A126 Class B or C as a minimum.

2. Two-way valves 10-inch and smaller shall be ball valve type or globe valve type except two-position valves shall be ball valve type. Two-way valves 12-inch and larger shall be butterfly valve type. Three-way valves 6-inch and smaller shall be ball valve type or globe valve type except two-position valves shall be ball valve type. Three-way valves 8-inch and larger shall be butterfly valve type.

B. Butterfly Valve Assembly:

1. Butterfly valves shall be threaded lug type suitable for dead-end service, and for modulation to the fully closed position, with Class 150 carbon steel bodies or Class 125 cast iron bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from -20 degrees to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator. Provide external linkage for three-way butterfly valves.

C. Two-Way Valves:

1. Two-position valves shall be line size. Modulating valve sizes shall be no smaller than two (2) pipe sizes smaller than line size. Two-way modulating valves shall have equal percentage characteristics. For modulating valve, select valve flow coefficient (Cv) for a pressure drop at design flow conditions equal to 75% to 125% of the approved coil's actual pressure drop at design flow conditions.

D. Three-Way Valves:

1. Two-position valves shall be line size. Modulating valve sizes shall be no smaller than two (2) pipe sizes smaller than line size. Three-way valves shall provide constant total flow throughout full travel. For modulating valves, select valve flow coefficient (Cv) for a pressure drop through the valve's coil port at design flow conditions equal to 75% to 125% of the approved coil's actual pressure drop at design flow conditions.

E. Valves for Hot Water and Glycol Service:

1. Valves for hot water service below 250 degrees F shall conform to ASME B16.1. Bodies for valves 2-inch and smaller shall be brass or bronze unless otherwise specified herein and have threaded-end or union-end connections. Bodies for valves 2 1/2-inch and larger shall be cast iron unless otherwise specified herein and have flanged-end connections. Internal trim, including seats, seat rings, modulating plugs, and springs, of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass, bronze or stainless steel except that valve stems shall be Type 316 stainless steel. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

2. Provide stainless steel valves in chemical storage rooms, truck bay, headworks and disc filter room.

**2.04 - CONTROL DAMPERS**

A. Provide control dampers where indicated as specified herein, except where motor-operated (control) dampers are indicated in HVAC equipment schedules to be supplied as an equipment accessory.

B. Control dampers shall be thermally isolated, low leakage dampers. Damper blades shall have high density foam insulation encased between metal blade skins. Damper blades shall have thermal break isolating inside and outside blade skins from each other. Dampers shall have galvanized steel or aluminum frames and blades to match the ductwork material in which installed. For stainless steel ductwork, provide aluminum dampers with minimum 1/8-inch thick neoprene pads between the dissimilar metals. Pads shall provide continuous separation between the ductwork and the damper to form an airtight seal.

C. Damper Assembly:

1. Damper shall conform to SMACNA HVAC Duct Const Stds. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger damper sizes shall consist of a combination of sections.

2. Flat blades shall be made rigid by folding the edges. Provide blades with compressible seals at points of contact. Provide channel frames of dampers with jamb seals to minimize air leakage. Dampers shall not leak more than 10 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to 200 degrees F. Dampers shall be rated at not less than 2,000 fpm air velocity. Moving parts of the operating linkage in contact with each other shall consist of dissimilar materials. Damper axles shall be 1/2-inch minimum plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by non-ferrous dissimilar thrust bearings. Pressure drop through dampers shall not exceed 0.08-inch water gage at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches wide. Dampers shall be tested in accordance with AMCA 500-D.

D. Operating Links:

1. Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Mating parts shall consist of dissimilar materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

**2.05 - TRANSMITTERS**

A. Transmitters shall produce a linear 4 to 20 mA dc output corresponding to the required velocity pressure measurement. Each transmitter shall have a low-range differential pressure sensing element and a square root extractor. The transmitter shall be a two-wire, loop powered device. Sensing element accuracy shall be plus or minus 1 percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement. Each transmitter shall have offset and span adjustments.

**2.06 - SENSORS**

A. Where feasible, provide the same sensor type throughout the project. Sensors shall be compatible with the controller to which they are connected. Avoid using transmitters unless absolutely necessary to provide a standardized 4-20 mA output signal. Precision thermistors or resistance temperature detectors (RTDs) may be used in applications below 200 degrees F except thermistors shall not be used in chemical areas, areas with open water tanks, the Dewatering Building, and other moist areas. Provide RTDs for all other applications. Thermocouples shall not be permitted.

B. Sensors for boiler operation shall be in accordance with the boiler manufacturer’s recommendations.

C. Spans and Ranges:

1. Transmitters for temperature sensors shall be calibrated to provide a signal of 4 to 20 mA dc output over the span or range specified herein.

   a. Conditioned space temperature, from 50 to 100 degrees F.

   b. Duct temperature, from 40 to 140 degrees F.

   c. Outside air temperature, from minus 30 to 130 degrees F.

   d. Heating hot water temperature, from 70 to 250 degrees F.

   e. Chilled water temperature, from 30 to 80 degrees F.

   f. Condenser water temperature, from 30 to 130 degrees F.

   g. Relative humidity, from 0 to 100 percent for high/low limit applications; from 20 to 80 percent for space applications.

   h. Differential pressure, from 0 to 2.0 inches W.C. (gauge).

D. Temperature Sensors:

1. Theremistors: Sensor accuracy over the application range shall be 0.36 degrees F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F.

2. Resistance temperature detectors: RTD shall be platinum with a tolerance of plus or minus 0.25 percent at 32 degrees F, and shall be encapsulated in epoxy, Series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F. RTD transmitter shall be integrally-mounted unless otherwise indicated.

   a. Space (Room) Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor. Provide factory painted metallic covers in industrial spaces and workshops. Where indicated, provide space temperature sensors with timed override button, setpoint adjustment lever, and digital temperature display. Provide a communication port or wireless support for a portable operator interface.

   b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.

   c. Duct Averaging Type: Continuous averaging sensors shall be 1-foot in length for each square foot of duct cross-sectional area, and a minimum length of 6 feet, such that the resistance represents an average over the cross section in which it is installed. Sensing element shall have a bendable copper sheath.

   d. Pipe Immersion Type: Provide minimum 3-inch immersion. Provide each sensor with a corresponding pipe-mounted thermowell. Provide the thermowell with a heat-sensitive transfer agent between the sensor and the well interior.

   e. Outside Air Type: Provide the sensing element on the building's north side with a protective sunshield that positions the sensor approximately 3 inches off the wall surface, and does not inhibit free air flow across the sensing element.

3. Electronic Temperature Transmitter: Transmitter shall be selected to match the resistance range of the Transmitter. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA DC output corresponding to required temperature measurement. Output error shall not exceed 0.1 percent of the calibrated measurement. Transmitter shall include offset and span adjustments.

E. Relative Humidity Sensors:

1. Sensor: Nonsaturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. Sensing elements shall be bulk polymer or thin film polymer. Sensing elements shall have an accuracy of plus or minus 2 percent of full scale within the range of 20 to 80 percent relative humidity.

2. Transmitter: Provide a two-wire, loop-powered transmitter located at the sensing elements to convert the sensing elements output to a linear 4 to 20 mA dc output corresponding to required humidity measurement. Output error shall not exceed 0.1 percent of calibrated measurement. Transmitter shall include offset and span adjustments. Transmitter shall have ability to be calibrated electronically by using a one-point, in-situ method which allows for error correction with a single potentiometer.

F. Dew Point Sensors:

1. Sensor: Analog salt-phase transition or dual chilled, mirror type sensor. Sensor shall have an allowable deviation of plus or minus 1 degrees F dew point over the range of 10 to 80 degrees F dew point.

G. Occupancy Sensors:

1. UL Listed, wall- or ceiling-mounted passive infrared sensing (PIR) type designed to detect large body motions over 40 feet away, and smaller motions such as hand movements up to 25 feet away. Sensor shall be false trip resistant; intelligent, continually adapting type; provided with non-volatile memory such that settings saved in protected memory are not lost during power outages; designed for 1,600 square feet of coverage when used where the ceiling height is between 8 to 12 feet.

2. Sensor shall have 4 to 30 minute adjustable timer, minimum 35 to 100 degrees F (1.6 to 38 degrees C) operating environment rating, 24 VAC power and short circuit protection.

H. Pressure Sensors:

1. Pressure sensors shall be a pressure transmitter with an integral sensing element.

2. Sensor: Sensor over pressure rating shall be 25 psig above its normal operating range. Sensing element accuracy shall be plus or minus one percent of full scale.

3. Transmitter: Transmitter accuracy shall be plus or minus 0.1 percent of the calibrated measurement. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required pressure measurement. Transmitter shall have offset and span adjustments.

**2.07 - THERMOWELLS**

A. For immersion temperature sensors in piping, provide thermowells with threaded brass plug and chain, 2-inch lagging neck and extension type well, and inside diameter and insertion length as required for the application. Thermowells shall be stainless steel when used in steel piping, and brass when used in copper tubing. Provide thermowells with conducting material inside the well.

**2.08 - SUNSHIELDS**

A. Provide sunshields for outside air temperature sensing elements to prevent the sun from directly striking temperature sensing elements, and protects the sensors from snow, ice, and rain. Provide sunshields with adequate ventilation so that the sensing element responds to the ambient temperature of surroundings. The top of each sunshield shall have galvanized metal or aluminum rainshield projecting over the face of the sunshield. Sunshields shall be painted white or shall be unpainted aluminum.

**2.09 - THERMOSTATS**

A. Ranges:

1. Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint indicated.

B. Electric Room Thermostats:

1. General: Thermostats shall be 120 VAC or 24 VAC nonmodulating electric type. Contacts shall be 2-position single-pole double-throw (SPDT) or single-pole single-throw (SPST), hermetically sealed, and wired to identified terminals. Maximum differential shall be 3.5 degrees F. Thermostats shall have manual adjustment dials or levers. Direct acting (heating) thermostats shall have a minimum range of 40 to 75 degrees F. Reverse acting (heat removal ventilating) thermostats shall have a minimum range of 60 to 90 degrees F. Provide factory painted metal enclosures in unfinished industrial spaces and workshops. Provide plastic or factory painted metal enclosures in finished spaces.

C. Electronic Room Thermostats:

1. Microprocessor-based, standalone room thermostats with modulating and/or discrete signals as applicable, programmable or non-programmable as indicated. Signal type shall be compatible with connected controlled devices. Heating/cooling thermostats shall have automatic changeover function. Thermostats shall have continuous display of temperature setpoint, 40 to 90 degrees F range minimum, with display of room temperature on demand; thermistor sensing element; +/- 1 degrees F accuracy or better; 32 to 120 degrees F minimum ambient temperature range; and 5 to 90 percent minimum ambient relative humidity range. Provide factory painted metal enclosures in unfinished industrial spaces and workshops. Provide plastic or factory painted metal enclosures in finished spaces.

D. Microprocessor-Based Programmable Room Thermostats:

1. Microprocessor-based room thermostats shall have built-in keypads for scheduling of day and night temperature settings. When out of the scheduling mode, thermostats shall have continuous 12-hour time display, with AM and PM indication, continuous display of day of the week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, use the display for setting and interrogating time program ON-OFF setpoints for each day of the week. The time program shall allow two separate temperature setback intervals per day. Thermostats shall have a means for temporary and manual override of program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain timing and to maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 2 degrees F. Where used for heat pump applications, thermostat shall have an emergency heat switch.

E. Nonmodulating Capillary Thermostats and Aquastats:

1. Thermostats shall have a capillary length of at least 5 feet, adjustable direct reading scales for both setpoint and differential, and a differential adjustable from 6 to 16 degrees F.

2. Aquastats shall be strap-on or immersion type, with 10 degrees F fixed differential.

F. Modulating Capillary Thermostats:

1. Thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

G. Low-Temperature Protection Thermostats (Freezestats):

1. Provide thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 20 square feet. Provide longer elements for larger coils at 1-foot for every square foot of coil face area, or provide additional thermostats wired in series. Capillary shall be mounted within 18 inches downstream of the heating coil served. Freezestats shall have DPDT contacts with one set of contacts wired directly to auxiliary contacts in the motor starter of the air handling unit served, and another set of contacts for the switch status condition. Provide normally closed switch contacts rated for the respective motor starter's control circuit voltage. A freezing condition at any 18-inch maximum increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with an auto reset feature so that following a tripped event, the thermostat will automatically reset and the air handling unit can restart.

**2.10 - FLOW SWITCHES**

A. Thermal mass flow principle insertion type flow switch for air and water applications, sensing element encapsulated in Series 300 stainless steel sheath with minimum 3-inch insertion length, repeatability of +/- 2 percent of setpoint or better, maximum 5 second response time, minimum 5 to 130 degrees F operating temperature for sensing element and control circuit, Fluid Components International (FCI) Model FS2000 or acceptable equivalent product.

1. SPDT relay alarm circuit; 120 VAC, maximum 10 watts rated input; 24 VAC output.
2. Mounting kit.

**2.11 - PRESSURE SWITCHES**

A. Pressure Switches:

1. Switches shall have an adjustable setpoint with visible setpoint scale. Range shall be as required. Differential adjustment shall span 20 to 40 percent of the range of the device.

B. Differential Pressure Switches:

1. Air flow type switches shall be an adjustable diaphragm-operated device with DPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. Switches shall be rated for minimum 230 VAC without time delay. Fittings shall be angled-tip type with tips pointing into the airstream. Range shall be 1 to 30 inches W.C. (gauge) differential with maximum 4-inch water gage dead W.C. (gauge) - band. Switches shall be rated for minimum 0 to 150 degrees F media temperature.
2. Water flow type switches shall be an adjustable diaphragm-operate device with DPDT contacts, with taps for sensing lines to be connected to pipe pressure fittings designed to sense water pressure. Switches shall be designed to detect flow and be rated for minimum 230 VAC without time delay. Pressure element material shall be stainless steel and/or copper alloy. Switches shall have adjustable range setpoint spring with calibrated scale and shall switch at the selected setpoint. The bellows shall be rated for minimum 250 psig with the minimum allowable differential pressure of 200 psig between the bellows. Range and switching differential shall be suited to the system it serves. Switches shall be rated for minimum 40 to 240 degrees F media temperature.

**2.12 - DDC SYSTEM**

A. Provide DDC-based BAS complete with software, software licenses, software configurations, database entries, and interfaces. Include all programming, objects, and services required to meet the sequences of control. All components shall be UL listed. The BAS shall consist of the following:

1. Network Automation Engine(s)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Network processing, data storage and communications equipment
6. Other components required for a complete and working BAS

B. DDC Architecture:

1. Automation Network:

a. The BAS shall network application-specific controllers. Provide application and data server(s) as required for systems operation.

b. Network Automation Engines (NAE) shall reside on the automation network.

2. Control Network:

   a. Network Automation Engines (NAE) shall provide supervisory control over the control network.

   b. Field Equipment Controllers (FEC) shall reside on the control network.

   c. Control network communication protocol shall be BACnet MS/TP Bus Protocol with Ethernet TCP/IP.

C. Provide a DDC system in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the control sequences. Provide open protocol communications between the DDC system and native devices furnished with direct digital controllers, input devices and output devices.

D. Provide complete software capable of programming, configuring, and monitoring the digital controllers. Software shall include graphic interface, scheduling, alarming, and trending.

E. All digital controllers shall have internal clock, and the system shall automatically synchronize clocks daily and adjust for daylight savings time.

F. Each digital controller shall have sufficient memory to support the required control, communication, trends, alarms, and messages. Protect programs residing in memory with EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply). The backup power source shall have capacity to maintain the memory during a minimum 72-hour continuous power outage. Rechargeable power sources shall be constantly charged while the controller is operating under normal line power. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long.

G. Digital controllers shall have integral keypad and display located in panel face to adjust and monitor setpoints, controlled device positions, input sensor values, and other control system parameters. Controllers shall have a 120 VAC power supply.

H. Network Automation Engines (NAE):

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

2. Automation network: The NAE shall reside on the automation network and shall support a subnet of system controllers.

3. User Interface: Each NAE shall have the ability to deliver a web-based User Interface (UI). All computers connected physically or virtually to the automation network shall have access to the web-based UI.

   a. The web-based UI software shall be embedded in the NAE.

   b. The web-based UI shall support functions using a standard version of Microsoft Internet Explorer.

   c. Processor: The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

   d. Diagnostics: The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

e. Power Failure: In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

(1) During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into flash memory.

(2) Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

I. Field Equipment Controllers (FEC):

1. The FEC shall be a fully user-programmable

2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences.

3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately.

4. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

5. The FEC shall support a Local Controller Display either as an integral part of the FEC or as a remote device communicating over the SA Bus.

a. The display protocol shall match existing Pump & Power Building DDC System.

b. The Display shall allow the user to view monitored points without logging into the system.

c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.

d. The Display shall provide password protection with user adjustable password timeout.

e. The Display shall be menu driven with separate paths for:

(1) Input/Output

(2) Parameter/Setpoint

(3) Overrides

(4) The Display shall use easy-to-read English text messages.

(5) The Display shall allow the user to select the points to be shown and in what order.

(6) The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightness and automatic backlight brightening during user interaction.

J. Graphics Software: Provide web-based system graphics viewable on browsers compatible with MS Internet Explorer 11.X or greater using an industry-standard file format such as HTML, BMP, JPEG, or GIF. Graphic displays shall have full-screen resolution when viewed on the workstation computers. The graphics shall show the present value and object name for each of the project's I/O points on at least one graphic page. Arrange point values and names on the graphic displays in their appropriate physical locations with respect to the floor plan or equipment graphic displayed. Graphics shall allow the operator to monitor current status, view zone and equipment summaries, use point-and-click navigation between graphic pages, and edit setpoints and parameters directly from the screens. Items in alarm shall be displayed using a different color or other obvious visual indicator. Provide graphics with the following:

1. Graphic Types: Provide at least one graphic display for each piece of HVAC equipment, building floor, and controlled zone. Indicate dynamic point values, operating statuses, alarm conditions, and control setpoints on each display. Provide summary pages where appropriate.

2. HVAC Equipment: Provide a graphic display for each piece of HVAC equipment. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, provide one graphic to depict the entire plant. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, control dampers, and control valves. Show the direction of air and water flow

   a. Graphic Title: Provide a prominent, descriptive title on each graphic page.

   b. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.

**2.13 - MISCELLANEOUS CONTROL DEVICES**

A. Function Modules: Function modules shall accept mA dc analog input signals to produce analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs.

   1. Minimum Position Switches and Temperature Setpoint Devices: Minimum position switches and temperature setpoint devices shall accept manual input and shall produce steady analog output. Switches and devices shall be suitable for recessed wall mounting or panel mounting and shall have a graduated dial.

   2. Signal Inverter Modules: Signal inverter modules shall accept analog input signal and produce analog output signal that linearly reverses the direction of signal change of input versus output.

   3. High-Low Signal Selector Modules: High-low signal selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal.

   4. Sequencer Modules: Sequencer modules shall provide fixed time delayed sequencing of one or more contact transfers from an analog input signal. Sequencers shall return contacts to their zero input signal condition when power is interrupted.

B. Relays: Relays shall be minimum double-pole, double-throw (DPDT) with a 10-ampere resistive rating at 120 or 24 VAC as required, and shall have an enclosed coil. Provide with a light indicator which is lit when the coil is energized and is not lit when the coil is not energized.

C. Time-Delay Relays: Time-delay relays shall be DPDT with octal connectors and dust covers. The adjustable timing range shall be 0 to 3 minutes minimum.

D. Regulated Power Supplies: Power supplies shall provide a 24-VDC linear supply at not less than 2 amperes, with regulation to 0.05 percent of output voltage. Power supplies shall have a fused input, and shall be protected from voltage surges and power-line transients. Power supply output shall be protected against overvoltage and short circuits. Power supply loading shall not be greater than 1.2 amperes.

E. Transformers: UL 508 and NEMA ST 1 as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for available voltage and secondaries wound for correct control circuit voltage. Transformers shall be sized so that connected loads equal 80 percent of rated capacity. Transformers shall be enclosed in rustproof, galvanized steel cabinets with conduit connections. Disconnect switch shall be provided on the primary side, and for other than terminal level equipment provide a fuse or circuit breaker cutout on the secondary side.

F. Pilot Lights and Manual Switches: Device illumination shall be by light-emitting diode (LED) or neon lamp. Switches shall have operating levers and index plates showing switch positions and names of apparatus controlled or other appropriate designations.

G. Damper End Switches: SPDT mercury switch rated for 1 amp at 120 VAC complete with 3 foot leads. Switch to be designed for mounting on motor crank arm. Damper actuators with integral auxiliary switches are acceptable in lieu of separate damper end switches.

H. Buzzers: Piezo type, continuous tone, 95 dB at 2 feet, 2,900 +/- 250 Hertz frequency, panel-mounting, 24 or 120 Vac.

**2.14 - HVAC CONTROL PANELS**

A. Panel Assembly: Panel shall be fabricated for bottom entry connection for control system electric power, control system wiring, interconnection of control systems, interconnection of starters, and external shutdown devices. Panels shall house controllers, display modules and I/O devices such as relays, transducers, etc. that are not required to be located external to the control panel due to function. Panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

B. Panel Electrical Requirements: Control panel shall be powered by nominal 120 VAC terminating at panel on terminal blocks. Instrument cases shall be grounded. Interior and exterior panel enclosures shall be grounded.

C. Enclosures: Enclosures for each panel shall be a single door, wall-mounted box conforming to NEMA 250 Type 1 unless otherwise indicated, with a continuous hinged and gasketed exterior door with a print pocket, key lock, and interior offset removable metal back panel. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock.

D. Main Power Switch and Receptacle:

1. Provide each control panel with a main external power on/off switch and transformer located inside the cabinet. Also provide each panel with a separate 120 VAC duplex receptacle.

E. Mounting and Labeling: Provide pilot lights, switches, panel-mounted control devices, and pressure gages shall be mounted on the door. Power conditioners, fuses, and duplex outlets shall be mounted on the interior of the cabinet. Other components housed in the panel shall be mounted on the interior back panel surface of the enclosure.

F. Wiring:

1. Electric and electronic device signals entering and leaving the panel shall be wired to identified terminal blocks.

2. Wiring shall be installed in wiring ducts so that devices can be added or replaced without disturbing existing wiring that is not affected by the change. Wiring to single-loop controllers shall have a 4-inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. Interconnections required for power or signals shall be made on device terminals, if available, or panel terminal blocks, with not more than two wires connected to each terminal.

3. Instrument signal grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Wiring shield grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Grounding terminal blocks shall be identified by reference level.

4. Wiring connected to controllers shall be identified by function and polarity, e.g., process variable input and remote setpoint input and output.

G. Quality Assurance: The Control Cabinet shall be manufactured and labeled in accordance with UL508A. Simply supplying UL recognized individual components shall not be sufficient. The assembled control cabinet, as a whole, shall be inspected for proper wiring methods, fusing, etc., and shall be labeled as conforming to UL508A. Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The system shall be manufactured by a nationally recognized Trade Union (I.B.E.W. or similar trade union). Lack of an NRTL certified UL508A wiring methods inspection and label or lack of a Trade Union label shall be grounds for rejection.

**2.15 - NAMEPLATES**

A. Provide plastic or metal nameplates where indicated which are mechanically attached to the control panels and walls. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64-inch, and shall have contrasting color, produced by filling with enamel or lacquer or by use of laminated materials. Painting of lettering directly on the surfaces of the control panel and walls is not permitted.

B. Panel-mounted nameplates shall have lettering minimum 1/4-inch tall. Wall-mounted nameplates shall have lettering minimum 1/2-inch tall.

**2.16 - CONTROL WIRING**

A. Wiring:

1. Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanisms. Terminal blocks shall be rail mounted, and shall have end plates, partition plates or enclosed sides for separation.

2. Control wiring for 24-V circuits shall be 18 AWG minimum and shall be rated for 300-V service.

3. Control wiring for 120-V circuits shall be 14 AWG minimum and shall be rated for 600-V service.

4. Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-V service.

5. Instrumentation cable and field-installed analog signal wiring shall be 18 AWG, stranded copper, single or multiple twisted, minimum 2-inch lay of twist, 100 percent shielded pairs, and shall have 300-V insulation. Each pair shall have a 20-AWG tinned copper drain wire, individual pair, and overall insulation. Cables shall have an overall aluminum polyester or tinned overall copper cable shield tape, 20-AWG tinned-copper cable drain wire, and overall cable insulation.

6. Nonconducting wiring ducts in control panels shall have slotted side snap-on covers, fittings for connecting ducts, mounting clips for securing ducts, and wire retaining clips.

7. Conform to the requirements specified under Paragraph “Electrical Work” of this Section.

8. Provide tray rated (TC) cable when cable is run in cable tray system.

B. Surge and Transient Protection:

1. Provide each controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

a. Power Line Surge Protection: Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:

(1) The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.

(2) The device shall react within 5 nanoseconds and automatically reset.

(3) The voltage protection threshold, line to neutral, shall be no more than 211 volts.

(4) The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.

(5) The primary suppression system components shall be pure silicon avalanche diodes.

(6) The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.

(7) The device shall have an indication light to indicate the protection components are functioning.

(8) All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.

(9) The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

(10) The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.

(11) The device shall be capable of operating between -20 degrees F and + 122 degrees F.

b. Telephone and Communication Line Surge Protection: Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines in accordance with the following:

(1) The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges.

(2) The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology.

(3) The device shall be installed at the distance recommended by its manufacturer.

C. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Plenum-rated cable may be used for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, and in attics.

**2.17 - HANGERS AND SUPPORTS**

A. Securely attach hangers and supports to building structural elements. All material shall be steel. Hangers, supports, rods and fasteners shall be hot-dipped galvanized, except shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

B. Where support points are required to avoid other work, provide a system of channels and angles between support points. Provide all necessary supports and cross framing. No part of piping, conduit, equipment, and the building shall be stressed beyond its normal allowable working strength.

**2.18 - SUPPLEMENTARY STEEL AND CHANNELS**

A. Provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment and systems provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. Unless otherwise specified herein, all supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes, and shall be hot dipped galvanized after fabrication. Unless otherwise specified herein, all channels shall be hot dipped galvanized. Supplementary steel and channels shall be series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

**2.19 - PIPE SLEEVES**

A. Sleeves in Masonry and Concrete Walls, Floors, and Flat Roofs: Service weight cast iron or standard class ductile iron pipe, except shall be schedule 40 series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room. Where sleeves are cast into new concrete, sleeves shall be ASTM A 53, Schedule 40 or Standard Weight steel pipe, have 2-inch high annular ring water stop continuously welded all around the pipe sleeve, and be hot-dipped galvanized after fabrication, except shall be all series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

B. Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs: Hot-dip galvanized steel sheet, minimum 26 gage thickness, except shall be Series 300 stainless steel in outdoor locations, chemical storage rooms, truck bay, headworks, and disc filter room.

C. Mechanically Adjustable Segmented Elastomeric Seals: Seals shall have EPDM seal elements and Series 300 stainless steel hardware.

**2.20 - ACCESS PANELS**

A. Access panels shall give access to each control device in concealed spaces above non removable (hard) suspended ceilings, and to all other concealed parts of the system. Access panels shall be located where indicated on the Drawings, or where otherwise require accessibility for the proper inspection, operation and maintenance of the system.

B. Access panels shall be Milcor Type M, 16-inch by 16-inch minimum, as manufactured by Inryco, Inc., or equal. Door shall be constructed of 18 gage galvanized steel with frame constructed of 16 gage galvanized steel. Casing bead shall be galvanized steel. Hinge shall be continuous steel with stainless steel pin. Locks shall be flush, screwdriver operated, with metal cam. Galvanized steel sleeve shall be welded to panel for access to cam lock control. Prime coat shall be factory applied rust-inhibitive light gray paint.

**2.21 - CONTROL SEQUENCES**

A. Control sequences of operation shall be as indicated on the Drawings.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Arrange for permits, inspections, and tests, in accordance with applicable state and local codes, at the HVAC Subcontractor's expense. Verify all measurements at job site.

C. Avoid interferences with other trades.

**3.02 - VERIFICATION OF CONDITIONS**

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

**3.03 - MANUFACTURERS INSTRUCTIONS AND SERVICES**

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment and control devices that are to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project.

B. Provide manufacturer’s service in accordance with SECTION 01730, OPERATION AND MAINTENANCE DATA. Services shall be provided for the satisfactory completion of installation, start-up, testing and training for those equipment and systems described herein below.

1. HVAC Control System

C. Upon completion of all Work, furnish, in duplicate, certificates of inspection from equipment manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating condition.

**3.04 - INSTALLATION**

A. Perform installation under the supervision of competent technicians regularly employed in the installation of control systems. Provide components for a complete and operational control system. Provide control system complete and ready for operation, as specified and indicated. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be watertight. Control system installation shall provide adequate clearance for control system maintenance, and as required to calibrate, remove, repair, or replace control system devices. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance. Install devices mounted in or on piping or ductwork, on building surfaces, in mechanical and electrical spaces, or in occupied areas ceiling spaces in accordance with manufacturer's recommendations unless otherwise indicated. Provide control devices to be installed in piping and ductwork with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration.

B. Sensors:

1. General: Provide sensors in locations to sense the appropriate condition. Install sensor and transmitter where easily accessible and serviceable without special tools. Installation in dead spaces are not acceptable. Sensors shall be calibrated according to manufacturer instructions to the accuracy specified in the contract, and operate correctly when installed. Do not install sensors designed for one application in the place of another application (e.g., replacing a duct sensor with a room sensor).

2. Room Sensors: Provide on interior walls to sense average room conditions. Avoid locations which may be covered by office furniture or near heat sources such as copy machines or locations by supply air outlet drafts. Do not mount room sensors on exterior walls if other locations are available. Do not mount room sensors where direct sunlight may occur.

3. Duct Temperature Sensors: Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Locate sensor connection boxes in position not obstructed by ducts or equipment. Install gaskets between sensor housing and duct wall. Seal duct and insulation penetrations. Install duct averaging sensors between two rigid non-metal supports in serpentine pattern to sense average conditions; averaging sensors shall have a total minimum length of one linear foot for every square foot of duct area. Sensors shall be mounted a minimum of 3 inches from outside wall surfaces. Thermally isolate temperature sensing elements from supports. Provide duct access doors to sensors.

4. Immersion Temperature Sensors: Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Provide minimum 3-inch immersion. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of the well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Temperature sensors shall be installed in thermowells with thermal transmission material to speed the response of temperature measurement. Provide thermowells with sealing nuts to contain thermal transmission material.

5. Strap-on Temperature Sensors: Strap-on temperature sensors, using helical screw stainless steel clamps, shall be permitted only where indicated. Clean the pipe to bright metal. Insulate strap-on bulb and pipe after installation. Provide other liquid temperature sensors with thermowells.

6. Outside Air Temperature Sensors: Provide outside air temperature sensors on north side of building, away from exhaust air outlets, fresh air intakes, and other areas which may affect temperature readings. Install sunshields to protect outside air temperature sensors from direct sunlight.

C. Thermostats:

1. Room Thermostats: Provide on interior walls to sense average room conditions. Avoid locations which may be covered by office furniture or near heat sources such as copy machines or locations by supply air outlet drafts. Do not mount room thermostats on exterior walls if other locations are available. Do not mount room thermostats where direct sunlight may occur.

2. Low-Temperature Protection Thermostats (Freezestats): Locate thermostat housing in position not obstructed by ducts or equipment. Install gasket between thermostat and coil casing or duct wall. Seal penetrations. Install between two rigid non-metal supports in serpentine pattern; sensors shall have total minimum length of one linear foot for every square foot of coil face area. Capillary shall be mounted a minimum of 3 inches from outside wall surfaces and within 18 inches downstream of heating coil served. Thermally isolate capillary from supports.

D. Thermometers:

1. Provide thermometers which are installed in liquid systems in thermowells with thermal transmitting materials within the well to speed the response of temperature measurement. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Provide minimum 3-inch immersion. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of the well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Mount thermometers to allow reading while standing on the floor.

E. Control Valves:

1. Provide valve with stems upright where possible but with stems not lower than horizontal.

F. Damper Actuators:

1. Provide damper actuators so that the damper sealing action is smooth and sufficient to maintain leakage at or below specified leakage rate. Multiple actuators operating a common damper shall be connected to a common drive shaft.

G. Wiring:

1. Provide wiring external to control panels, including low-voltage wiring, in electrical metallic tubing raceways. Install wiring without splices between sensors, transmitters, actuators, control devices, and HVAC control panels. Install instrumentation grounding to prevent ground loops, noise, and surges adversely affecting operation of the system. Tag cables, conductors, and wires at both ends, with identifiers indicated on shop drawings.

2. Other electrical work shall be as specified in Division 16. Provide step-down transformers where control equipment operates at lower than line circuit voltages. Control system components serving individual HVAC sub-systems shall be fed from one of the sub-system motor starters, or fed from the nearest distribution panelboard or motor control center, using circuits provided for that purpose. Control system components serving individual heating, ventilating, and air-conditioning units shall be fed from fan motor leads, or fed from the nearest distribution panelboard or motor control center, using circuits provided for that purpose.

3. Ground controllers and cabinets as specified in Division 16. All grounding shall have a direct path to the building earth ground. Conduit grounding and/or grounding of the green ac ground wire at the breaker panel alone is not adequate. Install ground wire from each control panel to adequate building ground. Ground sensor drain wire shields at the controller end.

4. Run circuits operating at more than 100 volts in rigid or flexible conduit, electrical metallic tubing, covered metal raceways, or armored cable.

5. Do not run binary control circuit wiring in the same conduit as power wiring over 100 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 100 volts.

6. Provide circuit and wiring protection required by NFPA 70.

7. Run all wiring in conduit.

8. Provide wiring in concrete in rigid metal conduit. Do not bury aluminum-sheathed cable or aluminum conduit in concrete.

9. Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Number each wire and cable every six feet. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring methods shall be in accordance with UL 508A.

10. For controller power, Division 16 shall provide new 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable. Coordinate same with Division 16.

11. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.

12. The HVAC Controls Sub-subcontractor shall be responsible for correcting all associated ground loop problems.

13. Run wiring in panel enclosures in covered wire track.

H. BACnet Naming Naming and Addressing:

1. Coordinate and provide unique naming and addressing for BACnet networks and devices.

2. MAC Address:

   a. Every BACnet device shall have an assigned and documented MAC Address unique to its network. For Ethernet networks, document the MAC Address assigned at its creation. For ARCNET or MS/TP, assign from 00 to 64.

3. Network Numbering:

   a. Assign unique numbers to each new network installed on the BACnet internetwork. Provide ability for changing the network number; either by device switches, network computer, or field operator interface. The BACnet internetwork (all possible connected networks) can contain up to 65,534 possible unique networks.

4. Device Object Identifier Property Number:

   a. Assign unique Device "Object-Identifier" property numbers or device instances for each device on the BACnet internetwork. Provide for future modification of the device instance number; either by device switches, network computer, or field interface.

5. Device Object Name Property Text:

   a. The Device Object Name property field shall support 32 minimum printable characters. Assign unique Device "Object-Name" property names with plain-English descriptive names for each device. For example, the Device Object Name for the device controlling the hot water heating plant at the McLoughlin Point Facility would be:

      Device Object Name = MP HW HTG System

      A Device Object Name for a fan coil unit controller might be:

      Device Object Name = MP FCU-2

6. Object Name Property Text (Other than Device Objects):

   a. The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include "AHU-1 Space Temperature" and "Fan Start/Stop".

7. Object Identifier Property Number (Other than Device Objects):

    a. Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Subcontractor's discretion but must be approved by the Design Builder. In this case they must be documented and unique for like object types within the device.

I. Minimum BACnet Object Requirements:

1. Use of Standard BACnet Objects:

    a. For the following points and parameters, use standard BACnet objects, where all relevant object properties can be read using BACnet's Read Property Service, and all relevant object properties can be modified using BACnet's Write Property Service: All device physical inputs and outputs, all set points, all PID tuning parameters, all calculated pressures, flow rates, and consumption values, all alarms, all trends, all schedules, and all equipment and lighting circuit operating status.

2. BACnet Object Description Property:

    a. The Object Description property shall support 32 minimum printable characters. For each object, complete the description property field using a brief, narrative, plain English description specific to the object and project application. For example: "HW Pump 1a Proof." Document compliance, length restrictions, and whether the description is writeable in the device PICS.

3. Analog Input, Output, and Value Objects:

    a. Support and provide Description and/or Device-Type text strings matching signal type and engineering units shown on the points list.

4. Binary Input, Output, and Value Objects:

    a. Support and provide Inactive-Text and Active-Text property descriptions matching conditions shown on the points list.

5. Calendar Object:

    a. For devices with scheduling capability, provide at least one Calendar Object with ten-entry capacity. All operators may view Calendar Objects; authorized operators may make modifications from a workstation. Enable the writeable Date List property and support all calendar entry data types.

6. Schedule Object:

    a. Use Schedule Objects for all building system scheduling. All operators may view schedule entries; authorized operators may modify schedules from a workstation.

7. Loop Object or Equal:

    a. Use Loop Objects or equivalent BACnet objects in each applicable field device for PID control. Regardless of program method or object used, allow authorized operators to adjust the Update Interval, Setpoint, Proportional Constant, Integral Constant, and Derivative Constant using BACnet read/write services.

J. Minimum BACnet Service Requirements:

1. Command Priorities:

    a. Use commandable BACnet objects to control machinery and systems, providing the priority levels listed below. If the control sequence of operation requires a different priority, obtain acceptance from the Design Builder.

b. Priority Level Application:

(1) Manual-Life Safety.

(2) Automatic-Life Safety.

(3) Critical Equipment Control.

(4) Minimum On/Off.

(5) Manual Operator.

(6) Load Shedding.

c. Alarming:

(1) Alarm Priorities - Coordinate alarm and event notification with the Design Builder.

(2) Notification Class - Enable writeable Priority, Ack Required, and Recipient List properties of Notification Class objects.

(3) Event Notification Message Texts - Use condition specific narrative text and numerical references for alarm and event notification.

d. Updating Displayed Property Values:

(1) Allow workstations to display property values at discrete polled intervals, or based on receipt of confirmed and unconfirmed Change of Value (COV) notifications. The COV increment shall be adjustable by an operator using BACnet services, and polled intervals shall be adjustable at the operator workstation.

K. BACnet Routers, Bridges, and Switches:

1. Provide the quantity of BACnet routers, bridges, and switches necessary for communications shown on the BACnet Communication Architecture schematic if provided. Provide BACnet routers with BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network. Configure each BACnet device and bridge, router, or switch to communicate on its network segment.

L. Accessibility:

1. Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install digital controllers, data ports, and concealed actuators, valves, dampers, and like equipment in locations freely accessible through access doors.

M. Control Panels:

1. Locate control panels at the locations shown on the drawings. If not shown on the drawings, install in the most accessible space, close to the controlled equipment.

N. Hand-Off-Auto Switches:

1. Wire safety controls such as duct smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

O. Component Identification Labeling:

1. Using an electronic hand-held label maker with white tape and bold black block lettering, provide an identification label on the exterior of each new control panel, control device, actuator, and sensor. Also provide labels on the exterior of each new control actuator indicating the (full) open and (full) closed positions. For labels located outdoors, use exterior grade label tape, and provide labels on both the inside and outside of the panel door or device cover. Acceptable alternatives are white plastic labels with engraved bold black block lettering permanently attached to the control panel, control device, actuator, and sensor.

P. Control Shop Drawings:

Q. Post laminated copies of record as-built control system shop drawings in each mechanical room.

**3.05 - ADJUSTMENTS**

A. Calibrate instrumentation and controls, and verify specified accuracy using test equipment traceable to National Institute for Science and Technology (NIST) standards. Adjust controls and equipment to maintain conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

**3.06 - TEST, ADJUST AND BALANCE SUPPORT**

A. The HVAC Controls Sub-subcontractor shall coordinate with and provide on-site support to the Test, Adjust and Balance (TAB) personnel specified under SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING. This support shall include:

1. On-site operation and manipulation of control systems during the TAB work.
2. Control setpoint adjustments for balancing all relevant mechanical systems.
3. Tuning control loops with setpoints and adjustments determined by TAB personnel. Tune the control system after air and water distribution systems have been balanced, minimum damper positions have been set, and a TAB report has been approved.

**3.07 - HVAC CONTROL SYSTEMS OPERATORS MANUALS**

A. Provide electronic and printed copies of a Control Systems Operators Manual for archiving at the project site. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system. Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Engineer, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders. Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the HVAC Controls Sub-subcontractor’s name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:

1. A copy of the record control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.
2. A copy of the project's mechanical design drawings, including any official modifications and revisions.
3. A copy of the project's accepted Product Data, Shop Drawings, Reports, and Operation and Maintenance Manual submittals provided under the paragraph "Submittals."
4. A copy of the project's accepted final TAB Report.
5. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.
6. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.
7. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.
8. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.

9. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.

10. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.

11. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

B. Storage Cabinets:

1. In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. Provide a copy of the Controls Systems Operators Manual in each of these mechanical room storage cabinets. Provide cabinets large enough to hold the Controls Systems Operators Manual, and the HVAC operation and maintenance manuals provided under Division 15. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site accepted in advance by the Engineer. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."

**3.08 - FIELD QUALITY CONTROL**

A. General:

1. Demonstrate compliance of HVAC control systems. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Calibrate test equipment in accordance with NIST standards. Ensure that tests are performed or supervised by competent employees of the control system installer or the control system manufacturer regularly employed in testing and calibration of control systems. Coordinate with the HVAC system testing, adjusting and balancing requirements of SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING.

2. Testing shall include field tests. Field tests shall demonstrate proper calibration of instrumentation, input and output devices, and operation of specific equipment. After completion of field tests, identify, determine causes, replace, repair, or calibrate equipment which fails to meet the specifications.

3. The plan for each phase of field acceptance testing shall achieve no exceptions noted status in writing before beginning that phase of testing. Furnish written notification of planned testing to the Engineer at least 21 days prior to testing. Include proposed test procedures with notification. The HVAC Controls Sub-subcontractor shall not be allowed to start testing without Engineer’s written acceptance of test procedures. Test procedures shall consist of detailed instructions for complete testing to prove the performance of HVAC control system. Include the following Field Tests and Performance Verification Test in test procedures.

4. Submit original copies of data produced, including results of each test procedure, to the Engineer at the conclusion of each phase of testing. Tests are subject to supervision and acceptance by the Engineer. Do not perform testing during scheduled seasonal off-periods of heating and cooling systems.

B. Field Tests: Calibrate field equipment and verify equipment and system operation before system is placed on-line. Report all findings in the Field Test Report. Indicate test equipment to be used including manufacturers' names and model numbers, date of last calibration, and accuracy of calibration. Include the following tests in field testing.

1. Wiring Integrity Tests: Test wiring for continuity, ground faults, and open and short circuits.

2. System Inspection: Observe HVAC control system in shutdown condition. Check control dampers and control valves for proper normal positions. Document positions for the performance verification test report.

3. Calibration Accuracy and Operation of Input Test: Verify correct calibration and operation of input instrument. For each sensor and transmitter, including for temperature, pressure, relative humidity, and dew point inputs, record the reading at the sensor or transmitter location using calibrated test equipment. Record the output reading provided by that sensor or transmitter. Document each of these location and output readings for the performance verification test report. The test equipment shall have been calibrated within one year of the date of use in the field. Test equipment calibration shall be traceable to the measurement standard of the National Institute of Standards and Technology (NIST).

4. Operation of Output Test: Check the operation of output to verify correct operation. Operate analog device to minimum range (e.g., 4 mA) and maximum range (e.g., 20 mA), and measure and record actual output values.

5. Actuator Range Adjustment: With the controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position through to the full range of stroke position. Record actual spring ranges and normal positions for modulating control valves and dampers.

6. Performance Verification Testing (PVT): Conduct the performance verification tests to demonstrate that the control system maintains setpoints and that the control loops are tuned for the correct sequence of operation. Specifically, the performance verification test shall demonstrate that the HVAC system operates properly through the complete sequence of operation (e.g., seasonal, occupied and unoccupied, warm up, etc.), for specified control sequences. Demonstrate proper control system response for abnormal conditions for which there is a specified system or controls response by simulating these conditions. Demonstrate that hardware interlocks and safety devices work as designed. Demonstrate that the control system performs the correct sequence of control. Repeat the performance verification test during an opposite season to the first performance verification test.

**3.09 - TRAINING**

A. General: Provide a qualified instructor with two years minimum field experience with the installation and programming of similar control systems to conduct training courses for designated personnel in maintenance and operation of HVAC and control systems. Orientate training to the specific system being installed under the contract. Coordinate training times with the Engineer. Furnish training materials and supplies. A training day is defined as 8 hours of classroom, lab, or field instruction, including two 15-minute breaks and excluding one hour lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, assume that the attendees have a high school education and are familiar with HVAC systems.

B. Training Course Documentation: Except for Phase I Training, training shall be based on the accepted HVAC Control Systems Operators Manual. Deliver manuals for each trainee with one additional set for archiving at the project site. Ensure the manuals are submitted, accepted, and available to hand out to the trainees before the start of training. Prepare planned training schedule, agenda, defined objectives, and a detailed description of subject matter for each lesson, and the instructor's background and qualifications to the Engineer at least 30 days prior to first training date. For each daily training session, submit an attendance sheet signed at end of the session by each trainee. The attendance sheet shall include an outline of subject matter covered by the session, the date of the session, and the printed name and signature of the instructor teaching the session. All submitted documents shall contain the name and logo of the company that the instructor represents.

C. Training Modules:

1. Phase I Training - Fundamentals: The first class shall be taught for a period of 5 consecutive training days at least one month prior to the scheduled performance verification test. The training session shall be taught in an Owner-provided facility. Training shall be classroom instruction, but have hands-on operation of similar digital controllers and control systems. Maximum of 8 students shall attend the course. Utilize audio-visual aids as necessary and provide each trainee a printed 8 1/2 by 11-inch hard-copy of all visual aids presented. Upon completion of course, each student, using appropriate documentation, shall be able to perform elementary operations, with guidance, and describe general hardware and functionality of the system. Course shall include, but not be limited to, description of hardware and operation of the system. The training session shall include, but not be limited to, the following:

   a. Objects, services, addressing and how/where they are used on this project.

   b. List of control system components.

   c. List of points and objects.

   d. Device and network communication architecture.

   e. Sequences of control

   f. Alarm capabilities

   g. Trending capabilities

   h. Troubleshooting communication errors

   i. Troubleshooting hardware errors

2. Phase II Training - Operation: The course shall be taught in the field, using the operating equipment at the project site for two consecutive training days no later than one month after acceptance of the HVAC Control Systems Operators Manual. Maximum of 8 students shall attend the course. Training shall be conducted at the BAS operator workstation, and at various controllers in the field covering all type controllers installed, and at other system locations. Include hands-on training under constant monitoring of instructor. Course content shall duplicate the Phase I Training session as applied to the installed system. Instructor shall determine the level of the password to be issued to each student before each session. Upon completion of the course, students shall understand the project's DDC system and be proficient in system operation. The training session shall include, but not be limited to, the following:

   a. A walk-through tour of the HVAC system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)

   b. A discussion of the components and functions at each HVAC control panel.

   c. Logging-in and navigating at each operator interface type.

   d. Using each operator interface to find, read, and write to specific controllers and objects.

   e. Modifying and downloading control program changes.

   f. Modifying setpoints.

   g. Creating, editing, and viewing trends.

   h. Creating, editing, and viewing alarms.

   i. Creating, editing, and viewing operating schedules and schedule objects.

   j. Backing-up and restoring programming and data bases.

   k. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics.

l. Creating new graphics and adding new dynamic data displays and links.

m. Alarm and event management.

n. Adding and removing network devices.

**3.10 - QUALIFIED SERVICE ORGANIZATION LIST**

A. The qualified service organization list shall include names and telephone numbers of organizations qualified to service HVAC control systems.

**3.11 - PROGRAMMED MAINTENANCE**

A. Upon project acceptance, HVAC Controls Sub-subcontractor shall submit to Owner an agreement to provide necessary programmed maintenance and to keep various control systems in proper working condition.

B. Programmed maintenance agreement shall fully describe maintenance work to be performed and shall advise cost of work for subsequent years after warranty period. This programmed maintenance agreement shall be provided free of charge during HVAC Subcontractor's one year warranty period.

**3.12 - FIELD TOUCH UP PAINTING**

A. Provide additional shop paint coating materials to the site, for touch-up of coating per SECTION 09941, FIELD PAINTING, to be applied by the Painting Subcontractor.

B. Field painting and touch-up shall not be applied until after installation and testing is completed and system accepted.

**3.13 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 15950**

**HVAC TESTING, ADJUSTING AND BALANCING**

**(Filed Sub-Bib Required)**

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## PART 1 – GENERAL

### 1.00 - SUB-BID REQUIREMENTS

A. The Work of SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING is a part of DIVISION 15, HEATING, VENTILATING AND AIR CONDITIONING which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 15500, HEATING, VENTILATING AND AIR CONDITIONING.

B. The Work of SECTION 15950, HVAC TESTING, ADJUSTING AND BALANCING, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The HVAC Subcontractor shall subcontract the services of a Testing, Adjusting and Balancing (TAB) Agency which complies with the requirements of paragraph entitled "Independent TAB Agency and Personnel Qualifications" of this Section. Provide test, adjust, and balance (TAB) of the heating, ventilating, and air conditioning (HVAC) air and water distribution systems including equipment, ducts, and piping.

B. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary in accordance with this Section of these Specifications, the Drawings, and the standards listed herein. The Work of this Section shall be the shared responsibility of the TAB Agency, which is a subcontractor to the HVAC Subcontractor, and the HVAC Subcontractor.

C. Items of Work shall consist of the following:

1. Air Distribution Systems:

a. Testing, adjusting and balancing of HVAC air distribution systems. Obtain Engineer's approval before insulation is applied to exterior of air distribution systems.

2. Water Distribution Systems:

a. Testing, adjusting and balancing of HVAC water distribution systems. Obtain Engineer’s approval before insulation is applied to water distribution systems. With Engineer’s approval, the piping systems may be insulated before systems are tested, adjusted, and balanced. Piping insulation shall terminate immediately adjacent to each balancing valve, control valve, or control device. The ends of pipe insulation and the space between ends of pipe insulation and piping shall be sealed with waterproof vapor barrier coating. After completion of Work under this Section, the balancing valves and control devices shall be insulated.

3. Phasing of Work:

a. This Section is structured as though the HVAC construction, and thereby the TAB Work, is going to be completed in a single phase in spite of the fact that there will be two seasons. All elements of the TAB Work are addressed on this premise.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this Section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

C. TAB: HVAC Testing/Adjusting/Balancing procedures performed.

D. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains below 5.1 degrees F dry bulb temperature throughout the period of data recording for TAB Work.

E. Season of maximum cooling load: Time of year when outdoor ambient temperature at equipment installation site remains above 90.6 degrees F dry bulb temperature throughout the period of data recording for TAB Work.

**1.04 - SUBMITTALS**

A. Submit the following in accordance with SECTION 01300, SUBMITTALS and as specified herein.

B. Submittals required under this Section include, but are not limited to, the following:

1. Certificates:

a. Independent TAB Sub-subcontractor and personnel qualifications

2. Preliminary Reports – Preliminary reports shall be submitted and approved prior to commencement of TAB field work.

a. Pre-field TAB engineering report

3. Test Reports:

a. Certified TAB Report

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

**1.07 - QUALITY ASSURANCE**

A. All work shall conform to AABC MN-1 and AABC MN-4, or NEBB TABES, except as supplemented and modified by this Section.

B. Independent TAB Agency and Personnel Qualifications:

1. Submit the following to the Engineer for approval:

a. TAB Agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification.

b. TAB Team Supervisor: Name of the TAB team engineer and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification.

c. TAB Team Field Leader: Name and documented evidence that the team field leader shall have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this Contract's start date.

d. TAB team field technicians: Names and documented evidence that each field technician shall have satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this Contract's start date.

e. Current certificates: Registrations and certifications shall be current, and valid for the duration of this Contract. Certifications which expire prior to completion of the TAB work, shall be renewed in a timely manner so that there is no lapse in registration or certification. TAB Agency or TAB team personnel without a current registration or current certification shall not perform TAB work on this Contract.

2. TAB Team Members: TAB team approved to accomplish work on this Contract shall be full-time employees of the TAB Agency. No other personnel shall do TAB work on this Contract.

3. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Engineer.

C. Responsibilities: The following delineation of work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations.

1. HVAC Subcontractor:

a. HVAC documentation: Furnish one complete set of the following documentation to the TAB Agency:

(1) Drawings and Specifications

(2) Approved submittal data for all equipment directly and indirectly related to the TAB Work.

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

b. Coordination of supporting personnel: Not withstanding the requirements of the prerequisite work check out list, perform the following.

(1) Provide the technical personnel, such as factory representatives and control systems installers required by the TAB field team to support the TAB field measurement work.

(2) Remove and provide replacement pulleys, adjustable sheaves and belts on all belt-driven fans where such is required to achieve the proper fan speeds. The fan speeds shall be determined by the TAB Agency to achieve the fan air flow rates indicated.

(3) Provide clean air filters and water strainers at the start of TAB procedures. Remove start-up screens in water strainers after piping system flushing procedures and provide standard screens specified.

(4) Have pump impellers trimmed by the pump manufacturer to achieve the indicated flow rates (GPM) based on actual system head losses.

(5) Check for correct rotation of all fan and pump motors, and adjust as required.

(6) Provide equipment mechanics to operate equipment and ductwork mechanics to provide the field designated test ports to enable the TAB field team to accomplish the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the TAB field work.

(7) Conversely, ensure that the control systems installers have required support from the TAB team field leader to complete the controls check out.

(8) Ensure that all balancing dampers and balancing valves are installed.

c. Prerequisite Work Check Out List: Complete and document check out and debugging of equipment, piping, ducts, and controls prior to the commencement of TAB field work. Debugging includes searching for and eliminating malfunctioning elements in the systems installations, and verifying all adjustable devices are functioning as designed.

d. Prior to the commencement of TAB field work, ensure completion of applicable inspections and work items listed in the TAB Agency's Pre-Field TAB Engineering Report. Do not allow the TAB Agency to commence TAB field work until all of the following are completed.

(1) Systems installations.

(2) Prerequisite Work Check out Lists specified in the paragraph "Pre-Field TAB Engineering Report" have been completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved Prerequisite Work Checkout Lists.

(3) HVAC system air filters and strainer screens are clean.

e. Insulation work: Ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

f. Deficiencies: Ensure that the TAB Agency submits all design and/or construction deficiency notifications directly to the Engineer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

2. TAB Agency:

a. The Work to be performed by the TAB Agency shall be limited to testing, adjusting, and balancing of air and water distribution systems to satisfy the requirements of this Section.

3. TAB Team Supervisor:

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical TAB procedures and TAB team field work.

b. Support required: Specify the technical support personnel required from the subcontractors other than the TAB Agency; such as factory representatives for control systems or for complex equipment. Inform the subcontractors in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the Pre-Field TAB Engineering Report, or during the TAB field work.

c. Pre-Field TAB Engineering Report: Utilizing all documentation including Drawings and Specifications, approved submittal data for equipment, and up-to-date revisions and change orders; prepare this report. Ensure the HVAC Subcontractor gets a copy of the Prerequisite Work Check Out List at the same time as the Pre-Field TAB Engineering Report is submitted.

d. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

e. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the Pre-Field TAB Engineering Report and verify adherence to the procedures specified in this Section.

f. Test ports required for testing by the TAB field team shall be located in the field by the TAB Team Supervisor during TAB field work.

4. TAB Team Field Leader:

   a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

   b. Full time: Be present at the contract site when TAB field work is being performed by the TAB team. Ensure day-to-day TAB team work accomplishments are in compliance with this Section.

   c. Prerequisite Work: Do not bring the TAB team to the contract site until a copy of the Prerequisite Work Check Out List, with all work items certified by the HVAC Subcontractor to be working as designed, reaches the office of the TAB Agency.

**1.08 - REFERENCES**

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. Air Movement and Control Association International (AMCA):

   1. 203: Field Performance Measurements of Fan Systems

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

   1. HVAC Applications Handbook

E. Associated Air Balance Council (AABC)

   1. MN-1: National Standards for Total System Balance

   2. MN-4: Test and Balance Procedures

F. National Environmental Balancing Bureau (NEBB):

   1. TABES: Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - PRELIMINARY REPORTS**

A. Pre-Field TAB Engineering Report:

   1. Submit report containing the following information:

      a. Pre-field data: AABC or NEBB data report forms with the following pre-field information filled in:

         (1) Design data obtained from Drawings and Specifications, except as superceded by approved submittals.

         (2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

         (3) Designate the actual data to be measured in the TAB field work.

         (4) List of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work.

      b. Prerequisite Work Check Out List: List of inspections and work items which are to be completed by the Installer of each system and subsystem. This list shall be acted upon and completed by the Installer of each system and subsystem.

**1.10 - TEST REPORTS**

A. Certified TAB Reports:

1. Submit Certified TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the Pre-Field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB Team Supervisor. Bind the report with a front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

b. Pressures: Report pressure for the following at final adjusted flow:

(1) Supply fan (SF), exhaust fan (EF), roof exhaust fan (REF), fan coil unit (FCU), air handling unit (AHU) supply fan, and rooftop air conditioning unit (AC) supply fan inlet and discharge static pressures.

(2) Hot water pump (P) inlet and discharge total pressures.

c. Duct Traverses: Report duct traverses for main and branch supply, return, exhaust, relief and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Sub-subcontractor shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

d. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration data, and calibration expiration date. Instruments shall have been calibrated within 12 months of their use. Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with the AABC or NEBB standards specified.

e. Certification: Include the typed name of the Tab Team Supervisor and the dated signature of the TAB Team Supervisor. Include the Supervisor’s AABC or NEBB certification seal and number.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Control systems shall be completely installed before TAB field work is started. The control systems shall be calibrated simultaneously with the TAB field work.

B. Check that clean air filters and water strainer standard (not start-up) screens are in place at start of TAB field work.

C. Prior to the start of TAB field work check for correct rotation of all fans and pumps.

D. Supply list of motors with nameplate amperes and readings taken.

E. Air Distribution Systems:

1. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.

2. Check to verify that all dampers are free to open and close and that all fire dampers are open and equipped with fusible links.

3. Test ports shall be neat round holes with no sharp edges. Provide plastic plugs designed specifically for HVAC balancing test ports.

4. Make any necessary changes in fan speeds to obtain the air flow rates indicated on the Drawings. Use tong ammeter when adjusting fan speeds to avoid overloading motors. Change the size of pulleys, adjustable sheaves and belts as required to obtain proper air delivery.

5. The fixed speed of the fans with variable frequency drives shall be adjusted so that the air flow when the VFD is at full speed is that required by the equipment schedule and, where applicable, the static pressure is the minimum required to satisfy the most critical terminal unit. The fan performance at that point shall not overload the motor. Fan speed adjustment shall be made by means of sheave and drive change for minimum fan RPM required at design air flow with minimum adjustment of balancing dampers.

6. Make final adjustment of air flows as directed to obtain comfortable conditions in all spaces after approved air quantities are obtained. Adjust deflection of all adjustable deflection grilles and registers as directed to minimize drafts.

F. Water Distribution Systems:

1. After air balance is completed, balance the water flow in the water distribution systems. Adjust water flow rates through all elements of the systems by means of balancing valve pressure drop.

2. Check that all valves are free to open and close. Ensure that all shutoff valves are fully open unless indicated to be normally closed.

3. Make any necessary changes to pump impeller diameters to obtain the water flow rates indicated. Use tong ammeter to avoid overloading pump motors.

**3.02 - TAB PROCEDURES**

A. TAB Field Work:

1. Test, adjust, and balance the air distribution systems and water distribution systems listed herein to the state of operation indicated and specified. Conduct TAB work, including maintenance and calibration of instruments, and measurements accuracy in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES, except as supplemented and modified by this Section. Provide instruments and consumables required to accomplish the TAB work.

2. Air distribution systems and water distribution systems shall be proportionately balanced and reported in the certified TAB report.

3. Use the approved Pre-field TAB Engineering Report as instructions and procedures for accomplishing TAB field work.

B. Air Distribution Systems:

1. Adjust fans and volume dampers to achieve indicated flow rates within the accuracy specified in the paragraph entitled “Acceptable Range” of this Section. Perform work under the conditions indicated.

C. Water Distribution Systems:

1. Change or trim pump impellers and adjust all system balancing valves to achieve indicated flow rates within the accuracy specified in the paragraph entitled “Acceptable Range” of this Section. Perform work under the conditions indicated.

D. Acceptable Range:

1. Conduct TAB work on specified systems until measured parameters are within the following permissible tolerances of the design values, that is, the values indicated.

| | |
|---|---|
| Supply Fans* | -10% to +10% |
| Exhaust Fans* | -10% to +10% |
| Supply Diffusers and Registers | -10% to +10% |
| Return and Exhaust Grilles | -10% to +10% |
| Heating GPM | 0% to +10% |
| * For interlocked supply and exhaust air systems, total exhaust fan flow rate and associated total supply fan flow rate shall be within +/- 5% of the difference in their indicated design flow rates, to ensure the required positive or negative pressurization. | |

2. Deficiencies:

a. Strive to meet the intent of this Section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Acceptable Range," provide written notice as soon as possible to the HVAC Subcontractor and the Engineer describing the deficiency and recommended correction.

3. Responsibility for correction of installation deficiencies is with the HVAC Subcontractor. If a deficiency is in equipment design, call the TAB Team Supervisor for technical assistance. Responsibility for reporting design deficiencies to HVAC Subcontractor is with the TAB Team Supervisor.

E. Data from TAB Field Work:

1. After completion of the TAB work, prepare a pre-final TAB Report using the reporting forms approved in the Pre-field TAB Engineering Report. Data required by those approved data report forms shall be furnished by the TAB Agency. Except as approved otherwise by the Engineer, the TAB work and the Tab Report shall be considered incomplete until the Tab work is accomplished to within the accuracy range specified in the paragraph entitled "Acceptable Range" of this Section.

2. Prepare the report neatly and legibly. The pre-final TAB Report shall be the final TAB Report minus the TAB Team Supervisor's review and certification. Obtain, at the contract site, the TAB Team Supervisor's review and certification of the TAB Report.

**3.03 - MARKING OF SETTINGS**

A. Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices, eg. balancing valves and volume dampers so that adjustment can be restored if disturbed at any time. The permanent marking shall indicate the settings on the adjustment devices which result in the data reported on the submitted Certified TAB Report.

**3.04 - MARKING OF TEST PORTS**

A. The TAB team shall permanently and legibly mark and identify the locations of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior of the duct insulation. The location of test ports shall be shown on the as-built HVAC drawings with dimensions given where the test port is covered by exterior insulation.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16050**

**ELECTRICAL WORK – GENERAL**

**(Filed Sub-Bid Required)**

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# PART 1 - GENERAL

**1.00 - SUBBID REQUIREMENTS**

A. The Work of this Section requires a single filed subbid in accordance with MGL c.149, s.44A through 44H, inclusive, as amended.

B. A sub-bid submitted for the Work of DIVISION 16, ELECTRICAL shall include the complete Work specified in all of the following Sections:

1. SECTION 16050, ELECTRICAL WORK – GENERAL
2. SECTION 16110, ELECTRICAL RACEWAY SYSTEMS
3. SECTION 16120, ELECTRIC WIRES AND CABLES
4. SECTION 16160, PANELBOARDS
5. SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT
6. SECTION 16320, GENERAL PURPOSE DRY-TYPE TRANSFORMERS
7. SECTION 16359, ELECTRICAL SYSTEM STUDIES
8. SECTION 16366, LOW VOLTAGE SWITCHBOARD
9. SECTION 16400, SURGE PROTECTION DEVICES
10. SECTION 16402, UNDERGROUND DISTRIBUTION SYSTEM
11. SECTION 16450, GROUNDING
12. SECTION 16481, ELECTRIC HEAT TRACING
13. SECTION 16601, LIGHTNING PROTECTION
14. SECTION 16721, FIRE ALARM SYSTEM
15. SECTION 16724, SECURITY SYSTEM
16. SECTION 16761. VIDEO SURVEILLANCE SYSTEM
17. SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT
18. SECTION 16920, 600-VOLT MOTOR CONTROL CENTER
19. SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS

C. In accordance with MGL c 149 §44E, each sub-bidder shall list in the Form for Sub-Bid the name and bid price of each person, firm or corporation performing labor or labor and materials for each class of work or part thereof listed below; provided that any sub-bidder may, without listing any bid price, list his own name for any such class of work or part thereof and perform that work with persons on his own payroll, if such sub-bidder, after sub-bid opening, shows to the satisfaction of the Authority that he/she does customarily perform such class of work or part thereof with employees on his own payroll who are mechanics or laborers as referred to in MGL c 149 §26, and is qualified to do so.

1. None

D. Reference Drawings

1. The Work of DIVISION 16, ELECTRICAL for the Base Bid is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 10 ED-001 | 10 ED-002 | 10 ED-003 | 10 E-001 |
| 10 E-002 | 10 E-003 | 10 E-004 | 10 E-005 | 10 E-006 | 10 E-007 | 10 E-101 |
| 10 E-102 | 10 E-103 | 10 E-104 | 10 E-201 | 10 E-202 | 10 E-203 | 10 E-204 |
| 10 E-205 | 10 E-206 | 10 E-301 | 10 E-302 | 10 E-303 | 10 E-601 | 10 E-602 |
| 10 E-603 | 10 E-604 | 10 E-605 | 10 E-606 | 10 E-607 | 10 E-608 | 10 E-609 |
| 10 E-610 | 10 E-611 | 10 E-612 | 10 E-613 | 10 E-614 | 10 E-615 | 10 E-616 |
| 10 E-617 | 15 E-101 | 15 E-102 | 15 E-601 | 15 E-602 | 25 E-101 | 30 E-001 |
| 30 E-101 | 30 E-002 | 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 | 10 FA-101 |
| 10 FA-102 | 10 FA-201 | 10 FA-202 | | | | |

2. The Work of DIVISION 16, ELECTRICAL for Alternative A-1is shown on the Contract Drawing(s) numbered:

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 E-001 | 00 E-601 | 00 E-602 | 20 E-101 | 20 E-102 | 20 E-601 | 20 E-602 |
| 99 E-501 | 99 E-502 | 99 E-503 | 00 FA-001 | 20 FA-101 | | |

E. Requirements for Submitting Subbids

1. Subbids for Work under this section shall comply with the requirements of MGL c.149, s.44F; shall be filed in a form furnished by the Awarding Authority, in a sealed envelope, at the time and place stipulated in DOCUMENT 00010, ADVERTISEMENT FOR BIDS and as specified in DOCUMENT 00200, INSTRUCTION TO BIDDERS. The following shall appear on the upper left-hand corner of the envelope:

Name of Subbidder: _____

Subbid for: DIVISION 16, ELECTRICAL

Town of Orleans, MA

Downtown Area WWTF and Effluent Disposal

Contract No. 2019-1

F. The Work of this Section requires the Subcontractor to install all materials furnished by it unless otherwise specified.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide General Electric Work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Division 1: General Requirements

D. Division 16: Electrical

E. The Diesel Generator System shall be supplied under Section 11398. Provide all conduit, wiring and terminations for system operation as indicated.

F. Provide conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Install vendor furnished cables specified under Specification Section 13300.

G. Provide conduits, wiring and terminations for power feeders for HVAC equipment provided under Division 15 and as shown on the electrical drawings.

H. Provide and install control stations shown on the electrical drawings local to equipment supplied under other divisions.

I. Provide and install safety disconnect switches shown on the electrical drawings local to equipment supplied under other divisions.

J. Motors shall be provided by the Contractor under Section 01171. All associated conduit, wire and terminations of motors shall be provided under Division 16.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop Drawings and Data: Include manufacturer's drawings, bills of material, panel and equipment layouts, catalog data, schematics diagrams, interconnection diagrams, wiring diagrams and other documentary or descriptive information for each assembly submitted in one package.

    1. Bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or identification on all other drawings where item appears.

    2. Submit equipment installation instructions in separate submittals from other shop drawings.

    3. Mark shop drawings and data submitted showing only items applicable to specific contract.

    4. Make submission of drawings for those components where dimensions of equipment, location of conduit entrances, are required to facilitate construction in accordance with the construction schedule.

    5. Include one-line diagrams, schematic diagrams, wiring diagrams, control sequence diagrams, relay diagrams, and metering. Submit only completed drawings showing all local and remote devices associated with each item. Submit one complete package of shop drawings. Partial submittals will be returned without action.

    6. Submit time-current characteristic curves for all circuit breakers and fuses.

    7. Submit instruction manuals for installation, operation, and maintenance of equipment, and parts list. Mark standard publications forming a part of this contract. Cross out, blank out, or otherwise delete non-applicable items. Submittals which do not clearly indicate items and features provided will be rejected.

    8. Install permanent nameplates on all devices or pieces of equipment for which use or identification is not readily apparent, such as starters, relays, contactors, pushbuttons, indicating lights, and switches. Make sure position of nameplates are readable after equipment installation.

    9. Provide services of the manufacturer's representative as specified in the applicable specification sections.

2. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.

3. Submit data sheets for the insulation resistance testing of conductors and equipment prior to performing operating testing. List all cables and equipment to be tested.

4. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide operational systems for both normal and standby electric power systems, normal and emergency lighting systems, security systems, CCTV systems, grounding systems, electrical heat tracing, lightning protection systems, fire alarm systems, radio system and other specified systems, including the installation and wiring of miscellaneous equipment and devices. Perform all Work and testing as indicated and specified to provide operationally ready electrical systems.

1. Provide conduit, wiring and connections for power, motors, motor controllers, control devices, lighting, control panels, instrumentation and alarms and for equipment furnished by others as indicated on the Contract Drawings.

2. Provide temporary circuits, overcurrent devices, conduit and wiring, and other temporary electrical equipment required to complete the Work of DIVISION 16, ELECTRICAL. All other temporary electrical Work including site temporary power service shall be provided under SECTION 01500, TEMPORARY FACILITIES.

3. Disconnect and remove existing electrical systems indicated for demolition under this Contract.

4. Engage the services of an Independent Electrical Testing Firm to perform the field inspections, tests and adjustments specified in SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

5. Provide the services of a specialty firm to provide short circuit, coordination and Arc Flash analysis for the electrical distribution system in accordance with SECTION 16359, ELECTRIAL SYSTEM STUDIES.

6. Provide lightning protection, fire alarm, radio system and telephone systems as specified herein.

7. Install all raceways and equipment to meet the seismic requirements of SECTION 01900, SEISMIC REQUIREMENTS. Raceways supports and equipment anchoring shall be provided as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

8. All electrically powered equipment and devices provided under other Sections are connected to electrical systems as part of the Electrical Work, as indicated. Provide all conduits, wiring and wiring terminations as indicated.

9. Provide all supervision, labor, materials, tools, test instruments or other equipment or services and expenses to test, adjust, set, calibrate, functionally and operationally check all Work and components of the various electrical systems and circuitry throughout the installation.

D. Provide set up, and maintain all derricks, hoisting machinery, staging, and planking and perform all hoisting required to complete the Electrical Work.

E. General Contractor to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints required for Electrical work.

F. Obtain all necessary permits required to complete the work of DIVISION 16 – ELECTRICAL WORK.

**1.07 - QUALITY ASSURANCE**

A. Install electrical Work in conformance with latest rules and requirements of National Fire Protection Association Standard No. 70 (National Electrical Code) and the Massachusetts Electrical Code.

**1.08 - REFERENCES**

A. National Electrical Safety Code (NESC)

B. Occupational Safety and Health Administration (OSHA)

1. OSHA Part 1910; Subpart S, 1910.308

2. OSHA Part 1926; Subpart V, 1926.950 through 1926.960

C. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70B: Electrical Equipment Maintenance

2. NFPA 70E: Electrical Safety Requirements for Employer Workplaces

3. ANSI/NFPA 70: National Electrical Code

4. ANSI/NFPA 780: Lightning Protection Code

5. ANSI/NFPA 101: Life Safety Code

D. National Electrical Manufacturers Association (NEMA)

E. American National Standards Institute (ANSI)

1. ANSI C2: National Electrical Safety Code

2. ANSI Z244-1: American National Standard for Personnel Protection

F. Insulated Cable Consultants Association (ICEA)

G. Instrument Society of America (ISA)

H. Underwriters Laboratories (UL)

I. Factory Mutual (FM)

J. International Electrical Testing Association (NETA) – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD)

K. Institute of Electrical and Electronics Engineers (IEEE)

L. Massachusetts Electrical Code

M. All inspections and tests shall utilize the following references:

1. Project Design Specifications

2. Project Design Drawings

3. Project Short Circuit and Coordination Study

4. Manufacturer’s shop drawings submittals and instruction manuals applicable to each particular apparatus.

N. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - INTERFERENCE AND ERRONEOUS LOCATIONS**

A. Verify in field, all data and final locations of Work installed under other Sections required for placing of electrical Work.

B. Do not run conduit in floor slabs or walls of buildings unless indicated.

**1.10 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on structural drawings and as specified in SECTION 01900, SEISMIC REQUIREMENTS and as specified herein.

**1.11 - APPROVAL AND MARKING EQUIPMENT**

A. All devices and materials shall be listed and/or labeled by Underwriters' Laboratories, Inc., wherever standards have been established by that agency. Where Underwriters' Laboratories listing is not available for equipment, submit certified test reports of recognized, independent testing laboratory, approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements.

B. Mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other information on a nameplate.

**1.12 - ELECTRICAL SYSTEM STUDIES**

A. Provide electrical system studies as specified in SECTION 16359, ELECTRICAL SYSTEM STUDIES. The specialty firm performing the study shall have no contractual or business ties with the electrical distribution system supplier.

B. The electrical system protection trip settings resulting from the study shall be provided to the electrical testing firm specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS to adjust and set the electrical system parameters in the field.

C. The Arc Flash Labels shall be generated by the specialty firm under SECTION 16359, ELECTRICAL SYSTEM STUDIES and installed in the field by the Contractor under Division 16.

**1.13 - ELECTRIC SERVICE**

A. Electrical power system for the facility shall operate at 480 volt, 3-phase, 3-wire, 60-Hertz.

B. Provide electrical low voltage distribution system that operates on 120/208 volt, 3-phase, 4 wire, 60-Hertz obtained from the power system by step down transformer(s).

C. Contact the following organization for coordinating the incoming power requirements for the project:

EVERSOURCE
Kathleen White
484 Willow Street
Yarmouth, MA 02673
Kathleen.white@eversource.com
(508) 790-9021

D. The organization identified above will furnish and install:

1. Pad-mounted transformer, including metering equipment.
2. Primary cable.
3. Connection and terminations of all primary cables at the service transformer.

E. The following shall be provided under other divisions:

1. Poured and pre-cast concrete, construction joints, and form work for ductlines, manholes, and handholes.
2. Concrete pad for transformer in accordance with Eversource standards.
3. Rebar, inserts, embedments, windows, ladders, pulling iron and related material.
4. Excavation and backfill.
5. Manhole and handhole frames and covers.
6. Manhole and handhole waterproofing.

F. The following shall be furnished and installed under this division:

1. Secondary cables of sufficient length for termination at the transformer.
2. Connection and terminations of all secondary cables at the service transformer.
3. Grounding at pad.
4. Hardware in manholes and handholes including cable supports, ground rods, ground cables, and associated equipment.

**1.14 - INCOMING FIBER OPTIC TELEPHONE AND DATA SERVICE**

A. Contact the following organization for coordinating the incoming fiber optic requirements for the project:

OpenCape Corporation
Barnstable County Complex
3195 Main Street
Barnstable, MA 02630
508-362-2224
https://opencape.org/

B. The organization identified above will furnish and install:

1. Telephone and Data Service Conductors from overhead service poles to telephone system handhole (THH.10-1).
2. Comcast network switch and hardware at WWTF telephone/data backboard.

C. The following shall be furnished and installed under this division:

1. Telephone and Data Service Conductors from telephone system handhole (THH.10-1) and WWTF telephone/data backboard at
2. Telephone/data service backboard at the WWTF electrical room.
3. Dual telephone/data service outlets as shown on Contract electrical drawings.
4. Telephone/data service conduit and cabling from Comcast hardware to dual telephone/data service outlets.

**1.15 - EQUIPMENT SPECIFIED ELSEWHERE**

A. Certain items of control equipment and other equipment are indicated on electrical drawings for connection, but are specified and provided in other sections pertaining to plumbing, heating, ventilating and air conditioning, mechanical process, diesel generator system, and instrumentation, etc.

B. Electrical Ductline System:

1. The following shall be provided under other divisions.
    1. Poured and pre-cast concrete, construction joints, and form work for ductlines, manholes, and handholes.
    2. Rebar, inserts, embedments, windows, ladders, pulling iron and related material.
    3. Excavation and backfill.
    4. Core drilling of existing concrete.
    5. Manhole and handhole frames and covers.
    6. Manhole and handhole waterproofing.

2. The following shall be provided under this Division.
    1. Conduit, fittings, and supports.
    2. Hardware in manholes and handholes including cable supports, ground rods, ground cables, and associated equipment.
    3. Wires, cables. And conductors, including splicing.

**1.16 - HAZARDOUS AREAS**

A. Equipment, materials and installation in areas designated as hazardous shall comply with NEC Articles 500, 501, 502 and 503.

B. Equipment and materials installed in hazardous areas shall be UL listed for the hazardous area classification.

**1.17 - CODE, INSPECTION AND FEES**

A. Equipment, materials and installations shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all permits and arrange for all inspections.

**1.18 - TESTS AND SETTINGS**

A. Test systems and equipment furnished under Division 16 and replace all defective Work and equipment at no additional cost. Refer to the individual equipment sections and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS for additional specific testing requirements. Employ the services of an Independent Testing Company, other than the manufacturer of the electrical distribution system, to perform the tests specified.

B. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. A typed test report for each component tested shall be submitted. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Five complete copies shall be provided. Reports shall be signed by the person in charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Subcontractor.

D. In addition to the specific testing requirements listed in the individual sections, the following tests and settings shall be performed:
    1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for operation.
    2. Check the full load current draw of each motor. Check ampere rating of thermal overloads for motors and submit a typed record of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.
    3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.
    4. Check settings of the motor circuit protectors. Adjust settings to allow the motor to be started when under load conditions.
    5. Check motor nameplates for correct phase and voltage.
    6. Check rotation of motors prior to testing the driven load.
    7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function as indicted by control schematic and wiring diagrams.

8. Inspect each piece of equipment in areas designated as HAZARDOUS to make sure that installed equipment has rating as specified in Paragraph 1.14.

9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to “A”, “B” and “C” phases.

**1.19 - INTERPRETATION OF DRAWINGS**

A. Coordinate the conduit installation with other trades and the actual supplied equipment. Coordinate equipment conduits top and/or bottom entries as required for the equipment installation and as specified and indicated on the Contract Drawings.

B. Install each 3-phase circuit in a separate conduit unless otherwise indicated.

C. Install all conduits and wiring system as indicated on and matching the Contract drawings. Conduits shall not be combined unless otherwise indicated on Contract drawings.

D. Conduit shown exposed shall be installed exposed; conduit shown concealed should be installed concealed.

E. All fittings and boxes shall be provided for a complete raceway installation.

F. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installations.

G. Except where dimensions are shown, the locations of equipment, fixtures, and outlets indicated are approximate only. Obtain information relevant to the placing of electrical Work and in case of any interference with other Work.

H. Circuit layouts are not intended to show the number of fittings, pull boxes, or other installation details. Furnish all labor and materials to install and place in operation all power, lighting and other electrical systems indicated.

I. Raceways and conductors for the fire alarm and telephone systems are not indicated. Interconnection descriptions are indicated in their Riser Diagrams as indicated. Provide raceways and conductors, as required by the system manufacturer, for a complete and operating system. Raceways shall be installed concealed in all finished spaces and installed exposed in process spaces.

J. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal systems as specified are not indicated. Raceways and conductors shall be provided for lighting, switches and receptacles for a complete and operating system.

**1.20 - PHASE BALANCING**

A. The drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in SECTION 16120, ELECTRIC WIRES AND CABLES.

**1.21 - SIZE OF EQUIPMENT**

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling.

C. Equipment shall not be physically larger than what is shown on the Contract Drawings.

**1.22 - EQUIPMENT IDENTIFICATION**

A. Identify equipment furnished under Division 16 with the name of the equipment it serves. Switchboard, motor control centers, control panels, panelboards, junction or terminal boxes shall have nameplate designations as indicated. Equipment nomenclature and identification system shall be as specified herein.

B. Nameplates shall be engraved, laminated plastic, 1/16-in. thick by 3/4-in by 2-1/2-in. with 3/16-in. high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using a waterproof epoxy adhesive. Two-sided foam adhesive tape shall not be used. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

**1.23 - SEQUENCING AND SCHEDULING DEMOLITION WORK**

A. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of power. Obtain Owner's consent before removing any circuit from continuous service.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.01 - REMOVAL AND RELOCATION OF MATERIAL AND EQUIPMENT**

A. Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

B. Remove from site and dispose of material and equipment removed.

**3.02 - DEMOLITION**

A. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades and civil site work prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

B. Where equipment is to be removed all associated ancillary components (e.g. supports, handholes, poles, fixtures, etc.) and associated wiring and conduit shall also be removed.

C. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect and remove all electrical power, communications, controls, alarm and signal system.

D. Existing underground electrical systems feeding equipment, building or structures scheduled for complete demolition shall be made safe, disconnected and removed.

E. Equipment scheduled to be turned over to the Owner shall be carefully disconnected, removed and delivered to the Owner where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

F. Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

G. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

H. Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

I. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

L. Trace out existing wiring that is to be relocated or removed and perform the relocation or removed work as required for a complete operating and safe system.

M. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

**3.03 - PROTECTION OF ELECTRICAL EQUIPMENT**

A. Store equipment in compliance with manufacturer's recommendations and as specified herein.

B. Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

C. Do not store equipment outdoors.

D. Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

**3.04 - DEFECTIVE OR DAMAGED EQUIPMENT**

A. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost.

B. All equipment showing signs of damage shall be rejected regardless of dielectric test results.

C. All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

D. Equipment that found to be damaged or failed the field inspection and acceptance tests specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS shall be replaced at no additional cost.

**3.05 - STARTING EQUIPMENT DATA LIST**

A. Obtain data from the equipment supplier shop drawing submittals or equipment nameplates and prepare a complete tabulation of all motors over 1/3 hp, electric heaters over 1 kW, air conditioning units and starting equipment, to be furnished on the project.

1. Include in tabulation form the following information:

a. Name and identification of equipment.

b. Manufacturer.

c. Horsepower or kilowatt rating.

d. Voltage.

e. Phase.

f. Speed.

g. Full load current.

h. Locked rotor current or code letter.

i. Type of enclosure (open drip-proof, totally enclosed, fan cooled, etc.).

j. NEMA size of starter or contactor.

k. Overload heater size.

l. Type of starter (full-voltage, reduced-voltage, autotransformer, etc.).

m. Breaker trip setting or fuse size.

n. Voltage of starter operating coil.

o. If starter is at a motor control center, list motor control center number.

2. Final acceptance of the electrical system is contingent upon submittal of the complete motor and equipment tabulation.

3. Arrange tabulation in groups by building location.

4. Furnish six copies of the tabulation to the Engineer when a submission is made.

**3.06 - EQUIPMENT ENCLOSURE**

A. The equipment enclosure classification of the plant areas are indicated within the Area Classification Schedule shown on the drawings. Provide all equipment, devices, installations and material meeting the requirements of this schedule.

**3.07 - AS BUILT DRAWINGS**

A. At the completion of the Project, provide two sets of contract drawings that are marked to show the as-installed equipment, devices, conduits, underground duct lines locations, layouts, wiring and any revisions to the Contract Drawings occurred during construction. As built drawings markup shall be complete and provide a detailed and accurate representation of as installed field conditions of all equipment provided under this Contract.

**3.09 - INSTALLATION**

A. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions.

1. All dimensions shall be field verified at the job site and coordinated with the Work of all other trades.

2. Provide electrical installation working drawings containing the following:

1. Concealed and buried conduit layouts, shown on floor plans. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, junction or pull boxes, instruments and other electrical devices connected to concealed or buried conduits.

2. Coordinate all Work with other divisions.

**3.10 - SLEEVES AND FORMS FOR OPENINGS**

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions. Locate all slots for electrical Work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other Subcontractors and locate the concealed conduit before the slab is poured.

C. Seal all openings, sleeves, penetration and slots as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

**3.11 - CUTTING AND PATCHING**

A. Arrange installation of all Work such that cutting and patching is not required.

B. Do not cut joints, beams, girders, columns or any other structural members.

**3.12 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16110**

**ELECTRICAL RACEWAY SYSTEMS**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16110, ELECTRICAL RACEWAY SYSTEMS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16110, ELECTRICAL RACEWAY SYSTEMS, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Raceway Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data for all raceway systems, accessories, supports and miscellaneous hardware in accordance with the requirements of SECTION 16050, ELECTRICAL WORK – GENERAL.

2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide raceway systems, with matching accessories, fittings and boxes, as indicated and specified.

D. All raceway runs are indicated diagrammatically to outline general routing of raceway. Unless specifically identified for installation in concrete walls or slabs, raceways shall be run exposed with raceway supporting systems. Avoid interfering with pipes, ducts, structural members, or other equipment.

E. Raceways and conductors between lighting, switches, receptacles and other miscellaneous low voltage and signal systems as specified and indicated are not shown on the Plan View Drawings. Raceways and conductors shall be provided for complete and operating systems. Conduit and wiring descriptions are indicated on the Riser Diagrams for the Fire Alarm, Telephone and Instrumentation Systems. Raceways shall be installed exposed unless otherwise indicated. Avoid conflicts with HVAC ducts, cranes, hoists, monorails, equipment hatches, doors, windows, structural beams and process equipment.

F. Provide raceway systems in accordance with the following:

1. In NEMA 1, NEMA 4 or NEMA 12 areas, use galvanized rigid steel raceway systems, fittings and accessories.

2. In chemical areas and those areas designated NEMA 4X, use PVC coated rigid steel raceway systems, fittings and accessories.

3. In classified hazardous areas designated as Class I, Division I and Class 1, Division 2, use PVC coated rigid steel raceway systems, fittings and accessories with tapered threads and sealing fittings as required by the Massachusetts Electrical Code for hazardous applications.

G. All raceway systems shall be installed in accordance with the criteria described in this section.

1. Use Type 316 stainless steel support systems for exterior application, hazardous areas, NEMA 4 and in NEMA 4X areas.

2. NEMA 1 and NEMA 12 areas shall use hot dipped galvanized steel support systems.

H. Aluminum conduit and boxes shall not be used.

I. Provide fire stops for all electrical penetrations through fire rated walls and floors.

**1.07 - REFERENCES**

A. National Fire Protection Association (NFPA):

1. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriter's Laboratories, Inc. (UL):

1. U.L.-1: Electrical Flexible Metal Conduit

2. U.L.-6: Rigid Metal Electrical Conduit

3. U.L.-360: Electrical Liquid-Tight Flexible Steel

4. U.L.-651: Schedule 40 and 80 PVC Conduit

5. U.L.-886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class 1, Groups A, B, C, and D and Class 11, Groups E, F, and G

D. National Electrical Manufacturers Association (NEMA):

1. RN-1: Polyvinylchloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

2. TC-2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

**1.08 - SEISMIC REQUIREMENTS**

A. All raceways shall be supported to Massachusetts Electrical Code requirements and conform to the requirements as indicated on the structural drawings and as defined in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. Rigid Metal Conduit and polyvinylchloride-coated rigid steel conduit:

1. Triangle/PWC, Inc.

2. Perma-Cote Industries.

3. Republic Steel Corporation.

4. Robroy Industries.

5. Or equal.

B. Polyvinylchloride (PVC) Conduit:

1. Triangle/PWC, Inc.

2. Robroy Industries.

3. Carlon Electrical Sciences, Inc.

4. Or equal.

C. Flexible Conduit:

1. American Flexible Conduit Company.
2. Anamet, Inc.
3. Electri-Flex Company.
4. International Metal Hose Company.
5. Eaton Crouse-Hinds.
6. Or equal.

D. Boxes and Fittings:

1. O.Z./Gedney Company.
2. Crouse-Hinds Electrical Construction Materials.
3. Appleton Electric Company.
4. Or equal.

E. Fiberglass-Reinforced Polyester Boxes:

1. Crouse-Hinds Electrical Construction Materials.
2. Fibox.
3. Hoffman Engineering Company.
4. Vynckier Enclosure Systems.
5. Or equal.

F. Support Systems:

1. Michigan Hanger Co., (O-Strut).
2. Thomas & Betts (Superstrut).
3. Unistrut Corp.
4. Or equal.

G. Fire Stop Material and Barriers:

1. Nelson Fire Stop Products.
2. Dow Corning Corporation.
3. 3 M Company.
4. Or equal.

**2.02 - MATERIALS AND COMPONENTS**

A. Rigid Metal Conduit:

1. Provide galvanized rigid metal conduit, each with a coupling on one end and thread protector on other end.
2. Hot-dip galvanize rigid steel conduit over entire length, along interior and exterior surfaces, including threads. Conduit shall conform to U.L.-6.

B. Flexible-Metal Conduit:

1. Provide flexible-metal conduit for use in NEMA-1 and NEMA-12 dry areas and match fittings, size, and material to rigid conduit to which it is connected. Flexible-metal conduit shall conform to U.L.-1.

2. Provide liquid-tight PVC coated flexible-metal conduit for use in NEMA-4 damp areas consisting of flexible-metal conduit, with liquid-tight, sunlight-resistant jacket extruded over the conduit. All fittings and accessories shall be PVC coated. Provide stainless steel, braided flexible conduit in NEMA 4X, corrosive areas. On larger than 1-1/4-in., furnish separate external ground wire. Liquid-Tight flexible-metal conduit shall conform to U.L.-360.

3. Provide stainless steel braided flexible conduit in all hazardous areas.

C. Polyvinylchloride (PVC) Conduit:

1. Provide PVC conduit, Schedule 40 conforming to NEMA Standard TC-2 and UL-651. PVC Schedule 40 conduit shall not to be used unless embedded in concrete and unless otherwise indicated on the drawings.

D. Polyvinylchloride-Coated Rigid Steel Conduit:

1. Provide polyvinylchloride-coated (PVC-Coated), rigid steel conduit conforming to NEMA Standard RN-1 consisting of hot-dipped galvanized rigid steel conduit, with a polyvinylchloride jacket bonded to the outside of all conduit surfaces with a nominal thickness of 40 mils meeting the requirements of NEMA RN-1, 3.1. The adhesive strength of the bonding to equal or exceed tensile strength of the coating. Provide couplings and fittings for this conduit conforming to the requirements of NEMA RN-1, 3.5.

2. A two-part urethane coating shall be applied to the interior of all conduit and fittings at a two mil thickness. The interior coating shall be flexible to allow field bending without cracking or flaking.

E. Boxes:

1. In NEMA 1 and NEMA 12 areas, provide standard, sheet-metal, outlet and junction boxes constructed of code-gauge, galvanized sheet steel. Size each box by the Massachusetts Electric Code.

2. Provide boxes containing fixture studs for hanging fixtures. Use concrete-tight boxes for installation in concrete. Do not use shallow boxes unless building construction is such that it is impossible to use standard-depth boxes.

3. Provide outlet boxes and fittings for hazardous locations conforming to U.L.-886 for class, group, and division indicated. Outlet boxes and fittings for hazardous areas shall also meet requirements of NEMA 4 areas.

4. Provide boxes and covers for polyvinylchloride-coated steel conduit made of 316L stainless steel or, in classified areas and outside, galvanized cast iron, with a polyvinylchloride factory-applied coating over the galvanizing. Provide coating thickness of 40- mil. Boxes shall have hubs with extruded sleeves extending beyond the hub in the same manner as specified for conduit couplings. Provide cover screws of Type 316 stainless steel.

5. Provide cast boxes with covers or device plates that can be used for the area classification. Use cover screws of Type 316 stainless steel or high brass for iron boxes.

6. Provide boxes for use with polyvinylchloride conduit made of polyvinylchloride for use as junction boxes and provide high impact strength fiberglass-reinforced polyester boxes for use as device boxes, pull boxes, and terminal boxes. Size each box as required by the Massachusetts Electrical Code.

7. Where designated in the drawings, provide pull boxes above or below motor control center installations 20 inches by 20 inches by 12 inches deep. Boxes of dimensions 10 inches by 10 inches by 6 inches deep and larger shall be hung from ceilings constructed of angle or channel frames. Provide neoprene gaskets for sealing. Sectionalize covers longer than 36-in. to facilitate handling and gasket sectionalized covers where covers meet, using angle iron or channel cross members at the joint. Sheet metal shall be No. 12-gauge galvanized sheet steel. Fabricate interior angles and supports of galvanized steel. Provide each box with a grounding lug for connection to the nearest ground bus. Current capacity of ground lug shall be that required by the Massachusetts Electrical Code for the largest feeder entering the equipment.

8. Provide terminal blocks in all terminal boxes, panels, and instrumentation cabinets/panels requiring terminations as indicated or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white markers.

9. In NEMA 4 and NEMA 4X areas, provide 316L stainless steel outlet and junction boxes. Size each box as required by the Massachusetts Electric Code.

F. Fittings:

1. Provide cast-iron fittings of malleable iron or a mixture of gray iron and cast steel.

2. Provide expansion fittings where conduits cross expansion joints. Equip these fittings with grounding straps, clamps, and copper bonding jumpers.

3. For PVC conduit, provide PVC fittings that can be solvent welded to match conduit.

4. Provide PVC-coated coupling and fittings for PVC-coated conduit with an integral, bonded, overlapping pressure-sealing sleeve of the same thickness as conduit coating. Provide extended sleeves one pipe diameter or 2-in. (whichever is less) beyond the end of the coupling so sleeve of coupling makes a watertight fit with the plastic jacket on the conduit when coupled together. Sealing sleeves at threaded connections shall seal out vapors and liquids.

5. Provide PVC coated fittings and accessories with PVC-coated rigid galvanized steel conduit.

G. Supports:

1. Provide raceway component supports which are meant to function with the raceway, and will support the raceway as indicated and meet the NEC and manufacturer’s requirements.

2. Provide Type 316 stainless steel hangers, threaded rods, channels, straps, clips, and clamps for raceways provided in hazardous areas, NEMA-4 and NEMA-4X areas. Provide stainless steel bolts, nuts and washers.

3. Provide hot dipped galvanized steel support system for raceways installed exposed in NEMA-1 and NEMA-12 areas.

4. Provide support for flexible conduit with components which do not compress and do not deform conduit.

**2.03 - FIRESTOP PRODUCTS**

A. Only firestop systems listed and tested to the UL 1479 Standard complete with prototype test data showing their individual applications shall be used.

B. Fire resistance ratings of installed firestop systems shall not be less than the fire resistance rating of the surrounding fire separation or firewall.

C. All listed system designs selected for use shall have a smoke seal incorporated within the rated firestop systems.

D. All firestop materials that will come directly in contact with plastic pipe or plastic coated wire shall have undergone Firestop Material compatibility testing by the Firestop Systems manufacturer and/or the pipe or wire manufacturer.

E. All firestop materials and smoke seals shall have elastomeric characteristics to allow for building settling and seismic movement.

F. All firestop materials and smoke seals shall be free of asbestos.

G. Site firestop systems must be installed in accordance with the UL 1479 Standard listed system design limitations.

H. All listed system designs used must provide a Flame (F), Temperature (T) and Hose (H) stream rating in accordance with those outlined in the most recent BOCA codes, include any additional requirements of the Work in this Section.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide all material, equipment, and labor to install the electrical raceway systems as indicated and as specified herein.

B. Perform all Work in accordance with the Massachusetts Electric Code.

C. Use no conduit less than 3/4-in. in diameter.

D. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's printed instructions.

**3.02 - METHODS OF RESTRAINING RACEWAYS**

A. Utilize threaded rod with rod stiffeners and transverse channel braces at 45 degrees angle, at 15-ft. on center, maximum, and on one side of rod support.

B. Utilize longitudinal bracing with channel braces at 30 feet on center, maximum.

C. Strap raceways directly to transverse channel braces, using pipe strap with both ends of strap bolted into the channel brace.

D. Do not rigidly brace raceways to different parts of a building that may respond differently during an earthquake. Seismic restraints shall not limit expansion and contraction of the raceway support system.

E. Provide flexible connections for conduits 2-in. outside diameter or greater than when terminating to fixed equipment to prevent loss of raceway integrity in the event of an earthquake.

**3.03 - INSTALLATION OF FITTINGS**

A. Install expansion fittings and bonding jumpers wherever conduits cross structural expansion joints. Keep the fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

B. Do not install fittings to replace elbows and pull boxes. Use oversize fittings whenever large cable is installed, in order to maintain bending radius.

C. Terminate ends of all floor conduits installed for future use with couplings and readily removable plugs set flush with finished floor surface. Cap spare wall conduits at wall where they enter building.

D. Equip ends of all conduits with conduit fittings. Fit conduits terminating at motor control center or power distribution equipment, or in box above or below, with grounding type bushings, or solidly ground by locknuts or other fittings. Connect each grounding bushing to ground bus by a bare or green-covered copper wire. Do not use ground wire smaller than 12 awg. Install ground wire larger than 12 gauge when indicated. Where conduits terminate in unprotected areas or where bonding is required over expansion joint, flexible conduit or equivalent; use ground wires No. 6 Awg. copper or larger. Copper bonding jumpers are required over expansion joints.

E. Terminate conduits entering gasketed sheet-metal boxes or gasketed sheet-metal equipment enclosures with gasketed hubs.

F. Terminate conduits entering nongasketed sheet-metal boxes or enclosures with double locknuts and insulated bushings, or equivalent.

G. Make joints tight. Use raceway fittings compatible with raceway use and location.

**3.04 - INSTALLATION OF RACEWAYS**

A. Install exposed raceways parallel or at right angles to walls and ceiling beams. Make all changes in directions with bends, elbows, and pull boxes. Space parallel runs evenly throughout. Attach in place with hangers and fasteners. Ground raceways by connection to grounded enclosures, bonding, or other means, to obtain permanent low resistance path to ground throughout installation. Raceway sections in single run and in parallel runs shall be of same type and finish.

1. Run parallel or banked raceways together, on common supports.

2. Install raceways level and square. Provide minimum 7 ft. headroom.

B. Support raceways concealed above suspended ceilings from slab above ceiling in same manner as exposed raceways. Do not support raceways from ceiling supports.

C. Provide cast-in-place inserts in concrete to support all runs, unless otherwise permitted. Use stainless steel sleeve type concrete anchors for installing boxes, and conduit supports. Provide Type 316 stainless steel nuts, bolts, and washers, for use with concrete anchors. Wedge inserts shall not be used.

D. Support conduits by hangers or pipe straps spaced according to Massachusetts Electrical Code, but in no case more than 10 feet on centers.

E. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with PVC coated rigid steel conduit. Flexible metal conduit may be used 6 inches above the floor.

F. Provide sleeves passing through exterior walls and slabs which are wall entrance seals of watertight construction. Furnish watertight seal between slab and sleeve, and between sleeve and conduit or cable. Use wall-entrance seals of malleable iron with watertight sealing gland which may be tightened any time after installation.

G. Do not use dissimilar metals in conjunction with each other. Use insulation between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. Maintain electrical continuity of system. Use bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers as insulation.

H. Install fittings to match raceway being used.

I. Install expansion fittings wherever conduits cross structural expansion joints. Keep fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

J. Where conduits pass through firewalls, grout hole around the conduit to the full depth of the material penetrated using U.L. listed fire stop material.

K. Provide separate metallic raceways for all low voltage instrumentation raceways 50 volts and below shielded wiring, data highway wiring, and fire alarm wiring and install 12-inches from control and power raceways.

L. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box; use two locknuts, one inside and one outside the box.

M. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

N. Install pull wires in all empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having 200-lb. tensile strength. Leave 12 inches of slack at each end of the pull wire.

O. Keep raceways 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

P. Complete raceway installation before beginning conductor installation.

Q. Use temporary closures to prevent foreign matter from entering raceway.

R. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

S. Conduit in transition (from below to above grade, through walls and through concrete) shall be PVC coated rigid galvanized steel (PVC-RGS). The transition shall be made below grade at the final sweep before the transition for exposed conduit. PVC-RGS conduit shall extend one (1) foot minimum above transition finished floor.

**3.05 – BENDS**

A. Make all bends to prevent distortion of circular cross section. Field bent conduit shall have an inside radius of nine diameters.

B. The maximum number of bends in any single conduit run shall be in accordance with the Massachusetts Electrical Code requirements.

**3.06 - CUTTING, THREADING AND CONNECTING**

A. Make all field cuts in conduits squarely, file cut ends, ream to remove rough edges and thread in accordance with Massachusetts Electric Code. No running thread shall be permitted. Make all connections mechanically strong and tight, with connectors. Where conduit surface coating is damaged or removed in the cutting, threading or reaming process, restore the surface to its original condition.

**3.07 - CONDUIT CLEANING**

A. Clean conduits before and after installation, ream ends free of burrs, and free inside surfaces from all imperfections.

B. After installation of each new conduit run, snake the run with band to which is attached a tube cleaner with cylindrical mandrel of a diameter 85 percent of nominal diameter of conduit. Remove and replace all conduit through which mandrel will not pass.

C. Use a sponge with steel brush to clean steel conduit and use a sponge with nylon brush to clean PVC conduits.

D. After cleaning, protect ends of all conduit with standard caps to prevent entrance of water, concrete, debris, or other foreign substance.

**3.08 - CONDUIT DRAINAGE**

A. Pitch conduit to drain to outlet boxes, or install so as to avoid trapping moisture. Where dips are unavoidable in exposed conduits, install fitting to match conduit system with drain hole at low point.

**3.09 - INSTALLATION OF BOXES**

A. Unless otherwise indicated, install NEMA 1 or NEMA 12 sheet metal boxes only in dry, accessible locations. Install NEMA 4 and 4X rated boxes in exterior concrete or masonry walls, in floor slabs, in basements, all other below grade locations and elsewhere as indicated. Unless otherwise indicated, cast metal boxes shall be used where vapor-tight fixtures are required, for all surface mounting of wall switches and receptacles and for all outdoor use.

B. Install boxes in conformance with all the requirements of Massachusetts Electric Code. Install boxes designed for type of construction involved. Support boxes in same manner as conduit. Size boxes to provide bending radius for wire or cable of eight times diameter or in accordance with Massachusetts Electric Code, whichever is larger.

C. Center all outlets in panels, or spaces and adjust to structural finish. Where specific locations are not indicated, locate outlets with respect to equipment served.

D. Place all outlet boxes, junction boxes and pull boxes, in accessible locations when they are installed above or behind plastered ceilings, furred spaces, or suspended ceilings. Install access panels. Mark all access panels for all boxes so panels can be readily located in future. Mark, using metal tabs or plastic buttons which cannot mark ceilings or walls, that can be used for type of construction being used.

E. Assemble cast-metal boxes with threaded conduit hubs in such manner that conduit connections and gasketed covers are watertight. Close all unused threaded openings with pipe plugs and compound.

F. Provide cast boxes with covers and device plates that can be used for the area classification. Install screws of Type 316 stainless steel or high brass for iron boxes.

**3.10 - FLEXIBLE CONNECTIONS TO MOTORS AND EQUIPMENT**

A. At all motors and electrically operated equipment to which conduit connections are made, install with a connection between end of conduit and terminal box of motor or other equipment.

B. Install the conduits in locations permitting direct connection to motors.

C. Make connections between rigid raceway and motor or equipment subject to vibration and adjustment using flexible conduit. Make each connection with one quarter bend so that no vibration can be transmitted beyond flexible connection.

D. Use maximum of 6 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install liquid-tight flexible metal conduit in areas subject to wetting due to fire protection sprinklers or broken or ruptured water line. Locate conduit to reduce the possibility of damage to the exterior flexible conduit jacket. Use fittings that screw into flexible conduit and provide gaskets. Install separate ground conductor across flexible connections.

**3.11 - HAZARDOUS AREAS**

A. Install all conduits, fittings, equipment and devices within areas to comply with requirements of Massachusetts Electrical Code including Hazardous Locations, Class, Division, and Group as indicated on the Contract Drawings.

B. In such hazardous locations, seal conduits terminating at boxes enclosing circuit-opening equipment at entrance to enclosure with compound-filled, commercial, sealing fittings to prevent passage of explosive or combustible gases through conduits.

C. Seal all conduits leading from or entering such hazardous locations at points of exit or entrance with two-part epoxy sealant.

D. Install conduit connections with five threads tightly engaged, and made up with thread compound.

E. Where drain/seal fittings are required, they shall be of malleable iron construction with an internal drainage path which provides a visual means to see that the compound chamber is filled. The installation shall enable the drain/breather fitting and filler plug to be installed right after the compound is poured.

F. Provide stainless steel braided flexible conduit rated for hazardous area locations when making connection between rigid raceway and motor or equipment subject to vibration and adjustment.

**3.12 - FIRESTOP INSTALLATION**

A. Firestop and smoke seal gaps and holes in all fire separation and firewall construction through which conduit, wire, cable, pass as a result of Electrical Work using a Listed System Design.

B. In combustible construction, firestop and smoke seal all through electrical penetrations of the faces as above and firestop and smoke seal all penetrations that enter or exit (transverse) the edges of one fire separation into another fire separation. (i.e. where the header or sill plate is penetrated in the interior of a wall separation into the hollow ceiling or floor cavity of the adjacent separation.)

C. Apply firestop systems at unpenetrated electrical openings and sleeves installed for future use through fire separations and firewalls.

D. All Electrical items that pass through, transverse or terminate within fire separations or firewalls must be firestopped. Firestopping forms part of the Work of this Section.

E. All recessed electrical boxes or panels in fire separations shall be noncombustile (steel) and must be separated by one stud or joist cavity. Back to back installations and/or combustible (plastic) boxes and panels are not allowed unless the gypsum board trade has constructed a fire rated enclosure equal to that of the fire separation rating around each box or panel.

F. All holes or voids created in fire separations or firewalls for single penetrating wires, cables and conduit the annular spare shall not exceed 1” (25mm) for penetrating items up to 2” (50 mm) in outside diameter. For penetrating items over 2” (50 mm) in outside diameter the annular space must not exceed 1½” (37 mm).

G. All holes or voids created in fire separations or firewalls for multiple penetrating electrical items must have a fill ratio 50% of the overall void or hole size.

H. In all firestop systems that require mineral wood or ceramic fiber backer or filler materials, these materials must be dry and free of other contaminants before, during and after installation of sealant firestop materials. Alkaline water contamination of the backer or filler materials may cause corrosion of metallic penetrating items.

I. Apply firestop systems and smoke seals in strict accordance with manufacturer's instructions and Listed Systems Designs to provide temperature and flame rated seals, to prevent the passage of fire and smoke.

**3.13 - PROTECTION**

A. Provide protection and install in accordance with manufacturer printed instructions such that coatings, finishes, and enclosures are without damage or deterioration at completion of Project.

B. Repair damage to PVC with matching touch-up coating recommended by the manufacturer.

**3.14 - CHECKOUT AND TESTING**

A. Provide in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

B. Check overhead conduit system installation by using the following check list:

1. Conduits are supported on independent supports (i.e., not on process piping, pipe ways, or piping hangers).
2. Exposed conduits are run, parallel or perpendicular to structural members.
3. Conduits are routed far away from fire hazards and heat sources.
4. Conduits are supported at the specified intervals.
5. Pull boxes and fittings are installed so that covers are removable. Verify that covers are installed and tightly bolted with gaskets provided where needed.
6. Circular cross sectional area is same at conduit bends. Single bends do not exceed 90 degrees.
7. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.
8. Conduits joints are tight.
9. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture and gases into equipment and/or where indicated.
10. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture and gases.
11. Flexible conduit is installed at motors and other equipment as specified. Verify that cabling and conduit runs are identified at each end.

**3.15 - CONDUIT SEALS**

A. Furnish and install sealant to maintain fire ratings of walls and floors in annular space between conduit and building finish.

B. Apply sealant after cable installation and all testing.

C. Furnish and install moisture/fire proof sealant in conduit interior and cable interstitial space where conduits enter/leave electric rooms, in all control panels, terminal boxes, motor control centers, and switchboard.

**3.16 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16120**

**ELECTRIC WIRES AND CABLES**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16120, ELECTRIC WIRES AND CABLES is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16120, ELECTRIC WIRES AND CABLES requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electric Wires and Cables as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data for all cables, terminations, terminal blocks, lugs, connectors, fire proofing tape, identification tags, etc. in accordance with the requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.

2. Submit the following data for fire stop material:
    a. Manufacturer’s Listed Systems Designs.
    b. Manufacturer’s Product Data Sheets.
    c. Manufacturer’s Materials Safety Data Sheets.
    d. Manufacturer’s printed instructions for installation on each proposed product. Identify where each material will be used at the Project site.
    e. Manufacturer’s prefabricated devices providing descriptions for identification at the Project site.
3. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Firestop Materials and Smoke Seal materials shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class “A”).

**1.08 - DESCRIPTION**

A. Provide wires, cables, termination and identification materials for complete electrical systems, as indicated and specified.

B. Perform tests on installed wire and cables in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. Provide fire stops for all electrical penetrations routed through fire rated walls and floors.

**1.09 - REFERENCES**

A. American Society for Testing and Materials (ASTM):
    1. B3: Soft or Annealed Copper Wire.
    2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
    3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Massachusetts Electrical Code.

C. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code (NEC).

D. Underwriters Laboratories, Inc. (UL):

1. U.L. 44: Wires and Cables Rubber Insulated.
2. U.L. 83: Wires Thermoplastic-Insulated.
3. U.L. 854: Cables, Service Entrance.
4. U.L. 1479: Fire Tests of through Penetration Firestops.

E. National Electrical Manufacturer's Association (NEMA):

1. WC 5: Thermoplastic Insulated Wire & Cable.
2. WC 8: Ethylene-Propylene-Rubber-Insulated Wire & Cable.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. 600V Cable:

1. Pirelli Cable Corporation.
2. Okonite.
3. The Rockbestos Company.
4. Or equal.

B. Metering and Instrumentation Wire, 600V:

1. The Rockbestos Company.
2. Okonite.
3. Pirelli Cable Corporation.
4. Or equal.

C. Cable Fireproofing Tape:

1. MAC Products, Inc.
2. 3M Company.
3. Thomas & Betts Company.
4. Or equal.

D. Fire Stop Material and Barriers:

1. Nelson Fire Stop Products.
2. Dow Corning Corporation.
3. 3 M Company.
4. Or equal.

**2.02 - MATERIALS AND COMPONENTS**

A. Material and stranding of conductors to conform to ASTM B3, ASTM B33, and to ASTM B8.

B. Wires and Cables for Maximum 600-Volt power: Furnish copper conductors. For No. 8 and smaller, provide THWN/THHN type cable. Provide No. 6 and larger as XHHW/2. Provide No. 12 and No. 10 AWG as solid conductor. Provide No. 8 AWG and larger as stranded conductor. Provide wires and cable conforming to UL 83.

C. Wires and Cables for Maximum 600-Volt control, indicating, metering, or alarm circuits: Furnish copper conductors, type THWN/THHN stranded, rated 75C with thermoplastic insulation and nylon jacket. Provide wires and cable conforming to UL 83. Cables used in fire alarm circuits shall be listed per the requirements of Article 760 of NEC.

D. Shielded Cable for Instrumentation Wiring: Provide 19-strand tinned copper conductors, size No. 16 AWG. Insulate conductors individually with color coded polyethylene or polyvinylchloride. Twist pairs twisted with varying lay (if more than one pair) and cover with cable tape and copper or aluminum coated mylar shielding tape and tinned copper drain wire. Jacket shall be polyvinylchloride. Cables shall be rated 600 volts and 90 degrees C.

E. Category 6 (CAT6) Cable: Category 6 cable shall consist of 4 twisted pairs of different lay and ground wires, enclosed by an overall conductive mylar backed aluminum foil shield. This shall be enclosed by an overall thermoplastic jacket. The cable shall meet the applicable requirements of ANSI/TIA/IEA-568-B.

F. MODBUS RTU Cable: Provide No. 22 AWG, twisted shielded pair, tinned copper with overall braid and foil shield. Jacket shall be polyvinylchloride. Cable shall be designed for EIA RS-485 communications.

**PART 3 - EXECUTION**

**3.01 - GENERAL**

A. Provide all material, equipment, and labor to install the electric wire and cables as indicated and as specified.

B. Perform work in accordance with the Massachusetts Electrical Code.

C. Provide power cable identification as follows:

| System Voltage | Neutral | Phase A | Phase B | Phase C |
|---|---|---|---|---|
| 208/120V | White<br>Black | Red | Blue | |
| 240/120V | White<br>Gray Stripe | Black<br>Blue Stripe | Red<br>Blue Stripe | None |
| 480/277V | Gray | Brown | Orange | Yellow |

D. Use green to identify insulated ground conductors.

NOTE: Colored insulation, tapes or sleeves may be used to provide color coding but they must be installed on all conductors at all pull and junction boxes. Insulated ground conductors must have green insulation.

E. Provide control, indicating, metering or alarm cable identification as follows:

1. AC Control Red
2. DC Control Blue

**3.02 - INSTALLATION OF WIRING**

A. Install wiring in accordance with applicable provisions of Massachusetts Electrical Code, and as indicated.

B. Provide wire and cable sizes as indicated. However, in no case use smaller cable sizes than required by the Massachusetts Electrical Code.

C. Unless otherwise indicated, use no conductor smaller than No. 12 AWG for power, No. 14 AWG for control, and No. 16 AWG for shielded applications.

D. Install conductors for branch lighting circuits so that voltage drop requirements of Massachusetts Electrical Code are met.

E. Install conductors continuous from outlet to outlet and make no splices except within outlet or junction boxes.

F. There shall be no splices between connection points.

G. Draw all conductors contained within a single conduit at the same time.

H. Apply wire pulling compound to conductors being drawn through conduits.

I. Use no cable bend with radius of less than eight times its diameter.

J. Support cables in riser conduits at intervals as required by Massachusetts Electrical Code.

K. Pull cables in underground conduit system without splices. Use lubricants recommended by the cable manufacturer. Do not exceed maximum pulling tension specified by the manufacturer. Use a gauge to measure pulling tension to insure that the recommended limit is not exceeded.

L. Wrap cables in manholes on an individual cable basis with fireproof tape 2 inches wide. Extend fireproofing 1-inch into any duct. Install tape in accordance with manufacturer’s instructions.

**3.03 - CONDUCTOR IDENTIFICATION**

A. Label each wire at both termination points. Label each wire at each end using numbering system consisting of equipment tags, terminal numbers and circuit number where wire is coming from. Carry individual conductor or circuit identification throughout. Random numbering labels similar to what is used for “Quick Pulls” type wiring shall not be acceptable.

B. Identify each wire in junction boxes, cabinets, and terminal boxes. Where no termination is made use a plastic-coated, wire marker and where termination is made use a, plastic, pre-printed sleeve wire marker.

C. In cases where terminal boards are provided for the control, indicating, and metering wires, identify all wires including motor leads and other power wires too large for connection to terminal boards, by sleeve wire markers as specified above.

D. In manholes and handholes, identify each power wire by laminated plastic tag with “to” and “from” destinations identified. Tags shall be located to be visible. Control wires to be bundled and marked with “to” and “from” destinations identified.

**3.04 - CONNECTORS, TERMINAL LUGS AND BOARDS**

A. For wiring of circuits consisting of No. 10 or No. 12 AWG solid wires, such as for lighting branch circuits, utilize self-insulated pressure type connectors for all splices or joints.

B. Terminate all wires and conductors means of ring and tongue, nylon self-insulated, tin-plated copper pressure terminals.

C. Fabricated terminal boards, installed where indicated, of type 600 volts, 30 amperes, screw terminals, with white marking strips for wire identification, of the 4-, 6-, 8-, or 12-pole type.

D. Mark terminal strips with ink or indelible pencil. Mark each wire consistently throughout entire system, using notation of wires given on manufacturer's wiring diagrams.

E. Wire connections for which terminals are not supplied, for example, at solenoids or motor terminal junction boxes:

1. 10 AWG and smaller: Use self insulated pressure-type connectors.

2. 8 AWG and larger: Use insulated, mechanical type with set screw or follower bearing directly on the wire. Split bolt connectors are not acceptable.

**3.05 - INSTALLATION OF FIBER OPTIC CABLE**

A. Install fiber optic cable as indicated on the Contract drawings. Provide all material, equipment, and labor to install the fiber optic cables.

B. Install fiber optic cable in accordance with fiber optic cable manufacturer requirements.

C. Fiber optic cable is supplied under DIVISION 13, SPECIAL CONSTRUCTION in specification SECTION 13345, DATA NETWORK in accordance with Table of Responsibility for Electrical, General and System Integrator on Contract Drawing 00 E-602.

D. Install cable directly from shipping reels. Ensure that cable is not:

1. Dented, nicked, or kinked.

2. Subjected to pull stress greater, or bend radius less, than manufacturer's specification.

3. Subjected to treatment which may damage fiber strands during installation.

E. Conduit: Install fiber optic cable directly in conduit.

F. Identification: Identify each cable on both ends, all pull points it goes through and in all hand holes/ man holes.

G. Sequencing: Provide cables in accordance with sequencing requirements.

H. Handholes:

1. Provide supports for cables at maximum 300-millimeter centers along sides of manholes.

2. Provide a minimum 4-foot coil of spare fiber in each manhole throughout the cable length.

3. Install fiber optic cables in underground ducts. Rod and swab out ducts prior to installing cables.

4. Install fiber optic cables in the conduit systems provided inside buildings and structures.

**3.06 - FIELD CABLE TESTS**

A. Perform cable testing in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.07 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16160**

**PANELBOARDS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16160, PANELBOARDSis a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16160, PANELBOARDS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Panelboards as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Submit time current characteristic curves, short circuit rating and data for each circuit breaker type and rating.
3. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check marked to indicate specification compliance.
    a. Failure to include copy of the marked-up specification section will result in return of the entire submittal without further review and consideration until the mark-up specification are re-submitted with the entire package.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Review the manufacturer’s recommended installation with the manufacturer prior to installation.

**1.08 - REFERENCES**

A. National Electrical Manufacturers Association (NEMA):

1. PB1- Panelboards
2. AB1- Molded Case Circuit Breakers

B. Federal Specifications (FS):

1. W-P-115A - Panel, Power Distribution.
2. W-C-375B - Automatic Circuit Breakers.
3. QQ-S-365B - Silver Plating, Electro deposited, General Requirements for

C. Massachusetts Electrical Code

D. Underwriter's Laboratories, Inc.:

1. U.L. 67 – Panelboards
2. U.L. 489 – Molded Case Circuit Breakers

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawing and as defined in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE PANELBOARD MANUFACTURERS**

A. Eaton

B. Square D

C. GE

**2.02 - PANELBOARDS**

A. Provide factory assembled deadfront type panelboards.

B. Provide panelboards with branch circuit breakers and a main circuit breaker or main lugs only as indicated.

C. Furnish panelboards with full capacity separate ground bus, separate insulated neutral bus and furnish panelboards connected to a 3-phase, 4-wire service or single phase, 3-wire service as indicated. All buses to be tinned copper.

D. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB1, Federal Specification W-P-115A. U.L. 67, and the N.E.C.

E. Furnish the panelboard main and 100% neutral buses, with 98 percent conductivity rectangular copper bars provided with bolted type lugs.

F. Drill buses to fit either "A", "B" or "C" Phase connectors, and make sure that connectors are inter-changeable and installed in a distributed phase sequence.

G. Silver plate copper buses connections and terminals, to a thickness of 0.005-in., conforming to the requirements of Federal Spec. QQ-S-365B.

H. Prevent terminal lugs from turning per NEMA standard PBI and verify they can be used for the conductor material and size.

I. Provide main bus-bracing for each panel board for 10,000 amperes symmetrical short circuit at 240 volts or less and 65,000 amperes symmetrical short circuit at 480 volts unless otherwise indicated.

J. Provide typed panelboard directory cards with the following information:

1. Panelboard name designation.
2. Panelboard voltage rating.
3. Panelboard ampere rating.
4. Panelboard short circuit rating.
5. Panelboard pole/circuit numbers and branch circuit description as wired in the field.
6. Indicate 2 pole and 3 pole branch circuit breakers.
7. Label spare circuit breakers “spare”.

**2.03 - CIRCUIT BREAKERS**

A. Furnish bolt-on type branch and main circuit breakers. Furnish frame sizes, trip settings and number of poles as indicated. Clearly and visibly mark circuit breakers with ampere trip rating. Furnish breakers meeting the requirements of F.S. W-C-375B and NEMA AB1. Provide circuit breakers marked with ampere trip rating that can be read at a distance of two feet from the panel. Provide breakers meeting the requirements of Fed. Spec. W-C-375B and NEMA AB1.

B. Furnish all breakers with quick-make, quick-break, toggle mechanisms and thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Automatic tripping indicated by the breaker handle assuming a clearly distinctive position from the manual ON and OFF position. Furnish breaker handle that is trip-free on overloads.

C. Provide circuit breakers rated 200A and larger shall have solid state adjustable trip units having long-time, short-time and instantaneous protective relaying.

D. Do not use single pole breakers with handle ties or bails in lieu of multipole breakers.

E. Furnish handle lock device on breakers to prevent the manual opening of the selected breakers.

F. Furnish padlocking device on all breakers to prevent the opening of circuit breakers.

G. Voltage and interrupting rating of all breakers in a panelboard shall not be less than voltage and short circuit rating of the panelboard main buses, as indicated. Series rated circuit breakers shall not be used. Furnish breakers to operate satisfactorily at the frequency indicated.

H. Furnish ground fault interrupter circuit breakers for circuits as indicated. The circuit breaker shall be UL listed, Class A, Group I device (5 milliamp sensitivity, 25 millisecond trip time or 30 ma for heat trace circuits).

I. Furnish single pole breakers with full module size. Do not install two pole breakers in a single module.

J. Furnish time-current characteristic curves and catalog information and data for each size of breaker furnished.

K. Provide transient surge protective devices in accordance with SECTION 16400, SURGE PROTECTION DEVICES, as specified herein and as indicated.

**2.04 - CABINETS**

A. Provide cabinets without knockouts. Drill cabinets only for the exact conduit entrances and mounting bolts. NEMA rating of panels to match areas as denoted on the drawings.

B. Finish cabinet fronts, trims and surface-mounted boxes in ANSI No. 61 or 49, light-gray enamel over a rust-inhibitive primer. Front covers shall be hinged to cabinets and shall be double door (door in door) construction. Provide cabinets for surface or flush mounting as indicated.

C. Unless otherwise specified, construct panelboard cabinets of code-gauge galvanized, sheet steel and equip with gutters for the risers and outgoing circuits.

D. Provide all panelboard locks keyed alike.

E. Provide cabinets drilled only for the exact conduit entrances and mounting bolts.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Mount panelboards such that the height of the top operating handle does not exceed 6 ft. 6-in. from the floor.

B. Hang each door of the cabinet on semi- or fully-concealed hinges with a combination catch and lock.

C. On cabinets 48 in. high and over, install a 3 point catch assembly latching at top, bottom and middle.

**3.02 - CHECKOUT AND TESTING**

A. Provide checkout, field, and functional testing in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16260**

**LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Low Voltage Variable Frequency Dive Units as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

2. Shop Drawings: Provide a complete list of equipment components, and materials, including manufacturer's descriptive and technical literature, and catalog cuts. Provide complete wiring, system interconnection and schematic diagrams for the equipment and controls furnished including external interlocked and controlled components, equipment layout, time versus current curves for protective devices and any other details required to demonstrate that the system and the required external controls have been coordinated and will function as specified and indicated.

    a. Provide data to verify that drives can be used for motor lead lengths up to 100 feet without output filters. Include information from the VFD manufacturer or output filter manufacturer stating that the motor terminal voltage limitations as defined by NEMA Standard MG-1 are met. For VFDs located more than a cable length of 100 feet from the motor load provide output filter at VFD.

    b. Provide enclosure drawings and details showing all dimensions and construction details. Provide enclosure elevation drawings showing internal and external components with and without doors.

3. Submit a written statement signed by the VFD manufacturer that the VFD manufacturer has received the required information from the pump and motor manufacturers for the driven equipment. Submit statement from each driven equipment manufacturer indicating that the VFD drive submitted is compatible with driven equipment and is rated for the specified application. Statement shall certify that that the VFDs, motors and associated process equipment have been review and coordinated with the equipment selections.

4. Submit VFD wiring schematics showing all termination and required field wiring.

    a. Wiring schematics shall include project specific equipment tags in accordance with Electrical drawings including pump, fan, and motor tags.

    b. Wiring schematics shall use project specific device tags and loop numbers for all hardwired interlocks from devices including but not limited to temperature switches, pressure switches, emergency stop push buttons, etc.

    c. Submit Bill of Materials for each VFD including manufacturer, model number, and quantities of drive components.

5. Submit catalog cutsheets for drive components that clearly indicate all options being provided.

6. Harmonic Analyses Report:

    a. Submit harmonic analysis report including project specific load data for (2) scenarios as Specified in Section 2.02 – Harmonic Analysis.

    b. Submit a statement indicating that the harmonics limits specified are met.

    c. Harmonic loads to be used for analysis are as indicated in Attachment A of Specification 16260.

7. Provide installation and anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.

8. Submit manufacturer’s printed installation instructions.

9. Spare Parts Data: Submit a list of spare parts.

10. Operating and Maintenance Instruction Manuals:
    a. Furnish:
        (1) Operating instruction manuals outlining step-by-step procedures required for system startup and operation.
        (2) Manufacturer's name, model number, service manual parts list.
        (3) Brief description of equipment and basic operating features.
        (4) Maintenance instruction manuals outlining maintenance procedures.
        (5) Troubleshooting guide listing possible reasons for breakdown(s) and repair(s).
        (6) Point-to-point connection wiring diagram for the system.
11. Performance Test Reports: Upon completion of installed system, submit in booklet form all shop and field tests performed to prove compliance with specified performance criteria.
12. Provide any specialty software and all required tools required for programming of the provided VFD units.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide quality assurance in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL, SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provide services of Service Technician, specifically trained on type of equipment specified.
    1. Start-up and testing:

       2 person-days
    2. Vendor Training

       2 person-days
    3. Person-day is defined as one 8-hour day, excluding travel time.

**1.08 - DESCRIPTION**

A. Provide complete IGBT (Insulated Gate Bipolar Transistors) type variable frequency drive (VFD) units and appurtenances including drive reactors, transformer, DC chokes, harmonic filters, output filters, enclosures, control circuits and auxiliary items in a single line-up. Provide all drive components specified housed within one enclosure.

B. VFD manufacturer shall be the same manufacturer of the motor control center specified in SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS.

C. Floor mounted VFD units shall not have overall measurements larger than what is shown on the Contract Drawings.

D. Coordinate the VFD units with the driven equipment manufacturers.

E. VFD units shall be manufacturer's standard technology and in production for no less than 5 years.

F. Provide control system operation, input and control signals, status signals and devices as specified herein and as indicated on the Contract Drawings.

G. Provide UL listed and labeled drives.

H. Coordinate VFD input harmonic filter with results of final harmonics study outlined in Paragraph 2.02.

I. VFD units rated 50 HP and larger shall be 18 pulse type. VFD units smaller than 50 HP shall be 6 pulse type with an integral 5% impedance line reactor.

J. Provide standalone VFDs and VFD’s integral to Motor Control Centers specified under specification SECTION 16920 – 600V MOTOR CONTROL CENTERS as indicated on the Contract single line diagrams.

K. For VFDs located more than a cable length of 100 feet from the motor load provide output filter at VFD.

L. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

**1.09 - REFERENCES**

A. Institute of Electrical and Electronics Engineers (IEEE)

B. Massachusetts Electric Code

C. National Electrical Manufacturers Association (NEMA): MG 1

D. National Fire Protection Association (NFPA):

A. NFPA-70 National Electric Code.

B. Underwriter's Laboratories Inc. (UL):

1. UL-508 Electrical Industrial Control Equipment

**1.10 - SEISMIC REQUIREMENTS**

A. Conform to the requirements specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS and as specified herein.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Manufacturer shall have five years, all within the last 10 years, commercial experience in the manufacture, operation and servicing of equipment of type, size, quality, performance, and reliability equal to that specified.

B. VFD manufacturer shall be the same manufacturer of the motor control center specified in SECTION 16920, 600 – VOLT MOTOR CONTROL CENTERS.

C. Acceptable Variable Frequency Drive Units:

1. Eaton

2. Square D

3. GE

**2.02 - HARMONIC ANALYSIS**

A. The VFD manufacturer shall perform a detailed harmonic analysis as described under this section based on loads included in Attachment A to this Section.

B. The VFD manufacturer shall submit a statement that the harmonics limits specified are met.

C. The VFD system shall be provided such that there is less than 5% voltage total harmonic distortion at the point of common coupling (PCC). Current distortion at the terminals will be in accordance with Table 2.02A.

**TABLE 2.02A**

**MAXIMUM HARMONIC CURRENT**

**DISTORTION IN PERCENT ISC/IL ODD HARMONIC**

| Ratio | 5 to 9 | 11 to 15 | 17 to 21 | 23 to 33 | 35 + | TDD |
|---|---|---|---|---|---|---|
| Less than 20 | 4.0 | 2.0 | 1.15 | 0.6 | 0.3 | 5.0 |
| 20 to 50 | 7.0 | 3.5 | 2.5 | 1.0 | 0.5 | 8.0 |
| 50 to 100 | 10.0 | 4.5 | 4.0 | 1.5 | 0.7 | 12.0 |
| 100 to 1000 | 12.0 | 5.5 | 5.0 | 2.0 | 1.0 | 15.0 |
| 1000 + | 15.0 | 7.0 | 6.0 | 2.5 | 1.4 | 20.0 |

Notes:

1. Even harmonics are limited to 25% of odd harmonics.
2. DC offset distortions not allowed.
3. Ratio = Isc/IL where
4. With phase shift transformers or converters with pulse number (q) higher than six (6) are used, the limits for the characteristic harmonic orders are increased by a factor equal to the square root of q divided by 6 provided that the amplitudes of the non-characteristic harmonic orders are less than 25% of the limits specified in the table.

   Isc = Maximum short circuit current at PCC.

   IL = Maximum demand load current at PCC (fundamental frequency component)

   TDD: Total Demand Distortion

D. The harmonic analysis performed shall be based on the following:

   1. Point of common coupling (PCC) shall be plant main switchboard SWBD.10-1, 480 VAC bus.
   2. Harmonic analysis shall be performed for two cases.
      a. When the system is fed by the electrical utility.
      b. When the system is fed by the onsite standby generator GEN.10-1.

E. The analysis shall include an explanation of all assumptions, sources of data, methodologies and formulas used in the study and a summary of the study results.

F. Based on the harmonic study results, supply the VFD units with any additional filtering equipment required to meet the harmonic requirements specified herein.

**2.03 - PROVISIONS**

A. Service conditions shall be as follows:

1. Ambient Temperature Range: 0 deg. C to 40 deg. C.
2. Operational Humidity: Up to 90 percent non-condensing.
3. Environment: As indicated on enclosure schedule.
4. Altitude: Below 3,300 ft. above sea level.
5. Input Power:
    a. Nominal voltage - 460 volts (plus 10 percent or minus 10 percent), 3-phase, 3 wire
    b. Nominal Frequency - 60 Hertz (plus or minus 2 Hz.)

B. Drive Systems:

1. General:
    a. Furnish solid state variable frequency, microprocessor type with Pulse Width Modulated (PWM) output wave form converter. The VFD shall employ a full wave rectifier, a DC bus choke, DC bus capacitors and Insulated Gate Bipolar Transistors (IGBT) as the output switching device to convert nominal 480 volts, 3 phase, 60 Hertz, 3 wire input power into adjustable-frequency 3 wire system at 0 to 480 volts, 3 phase, 0 to 60 Hertz output power.
    b. Motor control circuits shall be wired in accordance with the requirements specified herein and as indicated.
    c. The Contractor shall be responsible for the successful compatibility and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all loads, torque, speed and performance requirements from the pump and motor manufacturers and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.
    d. Provide constant torque drives or variable torque drives based on the type of the driven equipment load. Constant torque drives “CT” are indicated on Contract single line diagrams.
    e. Provide VFD control so that there is accurate zero to full load torque control at low frequencies, including zero speed, with torque repeatability accuracy of 2% or better and torque response time less than 20 ms.
    f. Provide on drive thermal magnetic type, 480 volts circuit breaker to be used as main disconnecting device and fixed diode input rectifier for a constant power factor.
    g. For units 50HP and larger, provide VFD with three phase, PWM rectifier section, 18-pulse, or higher full wave diode bridge. Provide phase shifting transformer within enclosure at input bridge to provide appropriate phase shift.
        (1) The transformer shall provide for the cancellation of the positive and negative sequence harmonic currents at the primary connection.
        (2) The transformer shall reduce voltage and current distortion on the primary side and voltage distortion on the secondary side.
        (3) The VFD shall be optimized for harmonic rich and high neutral current environment.
        (4) Harmonic cancellation shall be by electromagnetic means only, capacitors or electronics shall not be used.
        (5) Provide a primary to secondary phase shift by use of multiple secondaries.
    h. RMS harmonic output of the drive not to provide more than 5 percent increase in motor heating over similar operation of the motor with zero harmonics in the current.

i. The unit shall withstand drive output terminal line-to-line and line-to-ground short circuits without component failure during start-up and during operation. Drive to safely shutdown until short is cleared.

j. Provide enclosures rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

k. Provide NEMA-1 drives with gasketed type cabinets.

l. Provide drive output such that the motors have a base rating voltage less than or equal to 600 volts and that the peak instantaneous voltage shall be limited to 1600 volts or less, with a voltage rise time greater than or equal to 0.1 micro-seconds per NEMA Standard MG-1, Part 31.40.4.2.

m. The drive unit shall be of modular design to provide for ease and speed of maintenance.

n. Control circuits shall be isolated from power circuits. Unit to accept a 4-20 mA DC speed control signal from an isolated, ungrounded transmitter with unit in remote mode and from local door-mounted manual speed potentiometer or micro-processor type keypad with unit in local mode. The input 4-20 mA signal to be optically isolated from the drive run control circuit. Furnish door-mounted switch on the enclosure for local/remote mode. Manual speed potentiometer or keypad controls to have adjustable minimum speed setting of 10 to 80% of full speed and maximum speed setting of 50 to 100% of full speed. The total speed setting to follow a linear time ramp, adjustable from 1-300 seconds for acceleration and deceleration control. Provide output 4-20mA signal for VFD speed statues.

o. Harmonic filters shall be provided with contactors and controlled by the VFD to remove them from the line when the drive is not operating. Contactors shall be provided with spare contacts for remote alarm and to energize status lamp at VFD enclosure.

p. VFD shall be capable of full rated output when powered by incoming voltage with Total Harmonic Distortion (THD) in excess of 10%.

q. Furnish series choke and capacitors on DC bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

r. Size enclosure to dissipate heat generated by VFD within limits of specified service conditions. Provide integral fans or cooling systems. VFD enclosures to have keypad controls located on exterior of enclosure. Provide visual alarm indicator on cabinet door.

s. Provide oversized cable lugs for incoming and outgoing cables. Cable lugs size shall be per cables as indicated.

2. Performance characteristics:

a. Continuous current rating (amps): Minimum of 110 percent of motor rated full load amps, continuous.

b. Acceleration time to top speed, 1-60 seconds, adjustable.

c. Deceleration time from top speed, 1-60 seconds, adjustable.

d. Frequency stability: +/- 0.5% (at 25 degrees C, +/- 10 degrees C) after reaching operating temperature.

e. Output voltage: Proportional to frequency with low speed boost.

f. Combined drive/and filtering efficiency, defined as VFD output KW divided by VFD input KW, shall meet the following requirements at the specified operating points:

(1) 96 percent minimum at 60 Hz VFD output and 100 percent load.

(2) 92 percent minimum at 50 Hz VFD output and 60 percent load.

g. VFD fundamental power factor shall be 0.95 or higher at all speeds and loads.

h. The VFD shall be capable of sustaining continued operation with a 30% dip in nominal line voltage.

i. Losses to be utilized in drive system efficiency calculation shall include the input isolation transformer, harmonic filter and power factor correction if applicable. Auxiliary controls such as internal VFD control boards and cooling fans shall be included in all loss calculations.

3. Drive Protection:

a. General - Fault detection and trip circuits shall protect VFD and connected motor against line voltage transients, single-phase, power line over-voltage and under-voltage, output over-voltage and over-current, and VFD over-temperature. The VFD shall employ three (3) current limit circuits to provide trip free operation. The slow current regulation limit circuit shall be adjustable to 125% of the VFD's variable torque current rating. The rapid current regulation limit shall be adjustable to 170% of the VFD's variable torque current rating. The current switch off limit shall be fixed at 225% of the VFD's full load current rating.

b. Internal Protection: Provide circuitry as follows:

(1) Current limiting, fast acting, semiconductor input fuses for protection of internal power semiconductors.

(2) Instantaneous output over-current trip max. - 200 percent.

(3) DC bus and control circuit transformer fusing.

(4) Grounded control chassis.

(5) Under and over voltage trip, 3 phases.

(6) Motor overload protection, with solid state relays.

(7) Main circuit breaker, with door interlocked handle. Provide means to allow entry into panel by authorized personnel. Circuit breaker to be rated 65,000 AIC.

(8) Fault reset push button.

(9) Line to ground faults.

(10) Input metal oxide varistor and input line reactor for transient protection.

(11) VFD over-temperature.

c. Troubleshooting: Provide diagnostic aids to indicate cause of fault; used to assist in troubleshooting circuit problems. Isolated Form C contacts for remote indication of alarms to include the following:

(1) Over/under voltage indication.

(2) Over-current trip indication.

(3) DC bus charged indication.

(4) Fault detection indication.

(5) Recycle start indication (to indicate that the unit tried to pick up load for three previous tries and failed).

d. Provide power loss ride through capability which will allow the logic to maintain control due to load inertia without faulting. The number of restarts on power loss condition shall be programmable.

4. Auxiliary Systems - Provide variable frequency drive unit with appropriate power circuitry and auxiliary contacts, etc. for energizing and controlling the variable frequency drive as indicated.

C. Control Features:

1. Provide VFD control circuit as indicated on Contract Electrical Drawings.
2. Accept a grounded, isolated, 4-20 mA input remote speed control signal from an external device.
3. Provide a 4-20 mA output signal proportioned to VFD output frequency for remote speed indication.
4. Jog permissive input. When activated along with remote run contact, VFD will run at a pre-set speed.

D. Devices:

1. Provide operating, monitoring or alarm indicating devices, door mounted, as indicated on the Contract Drawings and as follows:
   a. Separate adjustable speed potentiometer switch to adjust VFD frequency when operated in manual mode.
   b. Speed indicating meter in Hz and rpm to indicate frequency and motor speed of the motor.
   c. Control relays as indicated.
   d. Provide LED cluster type alarm and status lights. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.

**2.04 - SHOP TESTING**

A. For VFD units 50 HP and larger, provide a factory performance test for each variable frequency drive unit. The test to consist of simulating the expected load to be driven. The drive to operate the actual motor load through the expected speed ranges. Test length to be two hours. Provide proto-type factory test results of similar VFD units for units up to 50 HP.

B. Provide a factory burn-in test and a control and alarm test on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.

C. Provide prototype factory test data for a similar size and type VFD unit for short circuit testing. Data to verify that each drive can be started into a line-to-line fault and line-to-ground fault on the drive terminals. Each drive can be operating at full load and be subjected to a line-to-line fault and line-to-ground fault on the drive terminals. All phases (A, B & C) to be included in test data.

D. Provide certified documentation of all tests performed.

E. Provide above stated tests in addition to routine factory tests.

**PART 3 – EXECUTION**

**3.01 - INSPECTION**

A. Examine VFD location for preparation in accordance with manufacturers written instructions. Check conduits and raceway location for connection to units.

B. Visually inspect delivered unit(s) and accessories for conformance with specification and drawings.

C. Verify availability of appropriate pacing signal and program motor protection relay settings.

**3.02 - INSTALLATION**

A. The VFDs shall be installed as indicated and in accordance with the manufacturer’s installation instructions.

B. Factory-trained service technician, other than sales representatives, shall supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested.

C. The VFD units speed input and speed feedback shall be programmed in Hz.

**3.03 - FIELD TESTING**

A. Perform testing checkout, and start-up for variable frequency drive equipment under technical direction of manufacturer's service technician.

B. Coordinate all testing with electrical testing performed under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. Field Tests:

1. Test each drive over the total speed range that it will be required to operate through for the load being driven for two hours. Determine for each drive, motor, and load combination the following at minimum speed, maximum speed, and at 1/3 and 2/3 points between the minimum and maximum speeds:

   a. Input power (kW), voltage, current and RMS power factor on the line side of the drive isolation device.

   b. Output to the driven load in kilowatts.

   c. For each drive, measure the harmonic voltage distortion and harmonic current distortion for each harmonic at the main distribution bus for maximum and minimum load conditions.

   d. Measure the total harmonic voltage distortion and total harmonic current distortion at each PCC, while all drive loads are running. The test results shall confirm the harmonic study results and should prove that harmonic distortion limits specified in Paragraph 2.02 have been met. If testing results are not within the specified limits, provide additional filtering equipment to meet the harmonic distortion limits specified.

2. Test each drive by using the actual control signal for remote and local operation.

3. Test each driver alarm functions.

4. Perform all tests in the presence of the Owner’s representative.

5. Perform the above test in addition to the manufacturer's normal field tests and driven equipment testing as specified in Division 11.

6. Submit final test report with summary comparing field test data with harmonic analysis design calculated values for each drive.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

See Attachment A

ATTACHMENT A

| Waste Water Treatment Facility<br>Equipment List | | | |
|---|---|---|---|
| **Equipment** | **Total Quantity** | **Quantity Operating** | **HP/AMPS/kVA/kW** |
| **Non VFD Loads** | | | |
| SBR MIXER 1/2 | 2 | 2 | 10 HP* |
| ODOR CONTROL FAN | 1 | 1 | 30 HP* |
| EQ. MIXER 1/2 | 2 | 2 | 5 HP* |
| 10-SF-3A/3B | 2 | 1 | 1.5 HP* |
| 10-SF-4 | 1 | 1 | ¾ HP* |
| DP.10-1 | 1 | 1 | 79.38 KVA |
| DP.10-2 | 1 | 1 | 43.9 KVA |
| DP.10-3 | 1 | 1 | 43.9 KVA |
| DP.10-4 | 1 | 1 | 53.75 KVA |
| DP.10-5 | 1 | 1 | 74.91 KVA |
| DP.20-1 | 1 | 1 | 46.31 KVA |
| SEPTAGE RECEIVING | 1 | 1 | 2 HP* |
| DISK FILTERS 1/2 | 2 | 2 | 2 HP* |
| **VFD Loads** | | | |
| SBR MIXING BLOWERS 1/2 | 2 | 2 | 50 HP*** |
| SBR MIXING BLOWER 3 | 1 | 1 | 30 HP** |
| SBR MIXING BLOWER 4 | 1 | 1 | 40 HP** |
| SBR BLOWERS 1/2/3 | 3 | 3 | 50 HP*** |
| EFFLUENT PUMPS 1/2/3 | 3 | 2 | 30 HP** |
| SBR TRANSFER PUMP 1/2/3 | 3 | 3 | 25 HP** |
| THICKENED SLUDGE PUMP 1/2 | 2 | 1 | 20 HP** |
| SLUDGE TRANSFER PUMP ½ | 2 | 1 | 10 HP** |
| PLANT WATER PUMPS 1/2/3 | 3 | 2 | 30 HP** |
| FROTH SPRAY PUMP | 1 | 1 | 5 HP** |
| 10-EF-1 | 1 | 1 | 3 HP** |
| 10-EF-2 | 1 | 0 | 5 HP** |
| 10-EF-5 | 1 | 1 | ½ HP** |
| 10-EF-7 | 1 | 1 | ¾ HP** |
| 10-EF-10 | 1 | 1 | ½ HP** |

| | | | |
|---|---|---|---|
| 10-EF-11 | 1 | 1 | ¾ HP** |
| BLR RECIRC. PUMP 1/2 | 2 | 1 | 3 HP** |
| BLR HEATING PUMP 1/2 | 2 | 1 | 3 HP** |
| 10-SF-1 | 1 | 1 | 3 HP** |
| 10-SF-2 | 1 | 1 | 5 HP** |
| 10-SF-5 | 1 | 1 | ½ HP** |
| 10-SF-7 | 1 | 1 | 1HP** |
| 10-SF-8 | 1 | 0 | 5HP** |

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor.

*** Motor is provided with 18-pulse variable frequency drive.

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**SECTION 16320**

**GENERAL PURPOSE DRY-TYPE TRANSFORMERS**

**(Filed Sub-Bid Required)**

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1.02 - MEASUREMENT AND PAYMENT ..... 2
1.03 - DEFINITIONS ..... 2
1.04 - SUBMITTALS ..... 2
1.05 - PRODUCT HANDLING ..... 2
1.06 - DESIGN CRITERIA ..... 3
1.07 - DESCRIPTION ..... 3
1.08 - REFERENCES ..... 3
1.09 - SEISMIC REQUIREMENTS ..... 3
1.10 - REQUIREMENTS OF REGULATORY AGENCIES ..... 3
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3.02 - CHECKOUT AND TESTING ..... 5
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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16320, GENERAL PURPOSE DRY-TYPE TRANSFORMERS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16320, GENERAL PURPOSE DRY-TYPE TRANSFORMERS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide General Purpose Dry-Type Transformers as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data of the transformer, enclosure, core and coil, insulation system and all specified accessories.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the mark-up specification sections will result in rejection of the entire submittal with no further review and construction.
3. Provide manufacturer’s printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - DESCRIPTION**

A. Provide copper-wound, dry-type transformers as indicated and specified.

B. Provide transformer windings and enclosures rated for the installation location and in accordance with the requirements herein.

**1.08 - REFERENCES**

A. Underwriters' Laboratories, Inc. (UL):

1. UL 506 - Transformers, Specialty.

B. National Electrical Manufacturers Association (NEMA):

1. ST 20 - Dry-Type Transformers for General Applications (ANSI C89.2).
2. TP-1 – Guide for Determining Energy Efficiency for Distribution Transformers.

C. American Society for Testing and Materials (ASTM):

1. D 635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

D. Massachusetts Electrical Code.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**1.10 - REQUIREMENTS OF REGULATORY AGENCIES**

A. Furnish transformers in accordance with NEMA ST 20 and UL 506.

B. Furnish transformers with UL listing mark.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. Eaton Corporation

B. Siemens

C. Schneider Electric

D. Or equal.

**2.02 - TRANSFORMERS**

A. Provide copper-wound, dry type transformers.

B. In NEMA 1 and NEMA 12 designated areas, furnish general purpose, ventilated, dry-type transformers in indoor-style enclosure. On single-phase transformers and three-phase transformers above 9 KVA, provide two windings per phase.

C. Auto transformers shall not be used in place of general purpose dry-type transformers.

D. Furnish two 2-1/2 percent full capacity taps above and below nominal in high voltage winding for transformers rated above 15 kVA. Provide two five percent taps below rated voltage for transformers rated 15 kVA and below.

E. Furnish transformers, single-phase or three-phase, as indicated. Furnish transformers with kVA ratings as indicated.

F. Furnish three-phase transformers, Delta-Wye, Delta-Delta or Wye-Wye connected as indicated and conforming with latest NEMA standards. Scott Tee connected transformers above 9 kVA shall not be used.

G. Furnish transformers with primary and secondary voltages and frequency, wye connected, as indicated for secondary windings, with neutral brought out for cable termination.

H. Furnish transformers that have continuous operation at rated kVA with normal life expectancy as defined in NEMA ST 20.

I. For transformers rated 30 kVA or less, furnish 180 deg. C insulation. Performance shall be obtained without exceeding 115 deg. C average temperature rise by resistance or 145 deg. C hot spot temperature rise in 40 deg. C maximum ambient and 30 deg. C average ambient. Maximum coil hot spot temperature shall not exceed 185 deg. C.

J. Transformers rated greater than 30 kVA shall be provided with 220 deg. C insulation materials with proven reliability and low-loss 80 deg. C full load operating temperature rise rating.

K. Furnish transformers made of flame retardant materials that will not support combustion as defined in ASTM D 635.

L. Furnish core mounting frames and enclosures of welded and bolted construction with mechanical rigidity and strength to withstand shipping, erection and short circuit stresses.

M. Transformers located in sprinkled areas shall be provided with NEMA 2 rated enclosure to protect transformer from water falling at an angle of 75 degrees from the vertical.

N. Furnish transformers that meet UL thermal overload test of 200 percent of rated current for one half hour.

O. Furnish transformers not to exceed the 65 deg. C rise established by UL as safe limit for maximum surface enclosure temperature.

P. Furnish transformers with sound level not exceeding:

| Trans. kVA | Average Sound Level in dB NEMA ST 20 |
|---|---|
| 0 - 09 | 40 |
| 10 - 50 | 45 |
| 51 - 150 | 50 |

Q. Install transformers with sound levels greater than 50 dB on resilient vibration isolating mounts to prevent amplification of sound. Transformers rated 15 kVA and larger to be provided with rubber washer anti-vibration pads and molded neoprene assemblies to isolate noise from the transformer to the mounting surface.

R. Provide a grounded copper electrostatic shield between the primary and secondary windings. The design of the shield shall be to shunt noise and transients to the ground path.

S. Furnish transformers sized and configured for 100 percent neutrals for the secondary full load current.

T. Furnish transformers with copper windings.

U. Furnish transformers that meet efficiency guidelines of NEMA Standards in accordance with the Department of Energy (DOE) requirements.

**2.03 - SHOP TESTING**

A. Furnish results of audible-sound-levels tests in accordance with NEMA ST 20 of similar size transformer.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Install and guard transformers as specified by latest Massachusetts and ANSI standards, and in accordance with manufacturer's printed instructions.

B. Install transformers so that there is space around transformer to dispose of transformer full load losses by ventilation without ambient temperature reaching 40 deg. C. maximum as specified in Paragraph 2.02.

C. Unless otherwise indicated, wall mount with supports, transformers rated 15 kVA and below. Floor mount transformers rated above 15 kVA.

D. Provide lifting lugs and jacking plates on transformer enclosure.

E. Provide concrete pad for all floor mounted transformers.

### 3.02 - CHECKOUT AND TESTING

A. Provide in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

### 3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16359**

**ELECTRICAL SYSTEM STUDIES**

**(Filed Sub-Bid Required)**

PART 1 - GENERAL ..... 1
1.00 - SUBBID REQUIREMENTS ..... 1
1.01 - SCOPE ..... 1
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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16359, ELECTRICAL SYSTEM STUDIES is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16359, ELECTRICAL SYSTEM STUDIES requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical System Studies as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

   a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review until marked-up specification are resubmitted with the entire package

2. Short circuit and protective device coordination study concurrent with the preliminary shop drawing submission for the main electrical distribution system equipment and overcurrent protective devices. Submit an initial study and a final study, with all electronic files, at the completion of the project.

   a. The study shall be performed using the latest edition of one of the following commercial software program.

      (1) Paladin Design Base

      (2) EasyPower

      (3) SKM System Analysis

   b. The study shall consider the effects of motor contribution during fault conditions, at various buses in the system.

   c. The study shall include cable sizes, cable lengths and raceway types for considering the effects of cables impedance in the system based on information to be provided by the Contractor.

d. The maximum fault contribution at the incoming source(s) shall be documented via correspondence from the authority responsible for this source(s).

e. Transformer inrush points and damage curves shall be plotted on coordination curves.

f. Obtain from the engine generator supplier, reactance values, protective device type and data and generator decrement curves.

g. Plot on common drawings, single line diagrams and the curves for each protective device to verify proper selectivity and protection for all components of the system for both the normal utility and standby generator source. Label each device uniquely.

h. Identify recommended settings for all devices.

i. Devices which do not provide full selectivity and coordination are not to be used as a recommended device in the study.

j. Submittals of electrical distribution equipment affected by the study are not to be submitted until successful completion of the specified electrical study.

3. After completion of the coordination study, the Contractor shall set all devices based on the study.

4. Qualifications of specialty testing and/or study firm, as specified.

5. Provide electronic files of the performed studies electrical model including all input data base information.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - DESCRIPTION**

A. Provide electrical system studies as indicated and in compliance with Contract Documents.

1. Provide a short circuit, protective device coordination and arc-flash study for the electrical distribution system constructed under this contract as shown on the electrical single line drawings. The study shall consider the electrical utility system upstream protective devices down to the 208Y/120V transformer secondary. The study shall include data to verify the short circuit ratings of the electrical distribution equipment to be provided under this contract and to identify the required settings of associated protective devices.

a. Provide a report summarizing the study including: one-line of system, relay and breaker setting tabulation, relay, circuit breaker, and fuse protective device coordination and short circuit analysis, all prepared by an independent specialty firm. Device calibration and settings are to be based on the results of this coordination study.

B. The firm performing the Work of this Section shall not be part of or affiliated with the electrical equipment supplier organization(s) or manufacturer(s) or the Electrical Contractor.

C. Contact the electrical utility to obtaining the available fault current and utility protection equipment data.

D. Changes and additions of equipment characteristics, based on the actual equipment supplied may be suggested by the results of the short circuit and protective device coordination studies. Submit suggested changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the accepted short circuit and protective device coordination studies shall be provided at no additional cost.

E. The studies shall be performed for two operating conditions:

1. The system is powered by the electrical utility.

2. The system is powered by the on-site generator.

**1.08 - REFERENCE**

A. Institute of Electrical and Electronics Engineers (IEEE):

1. C37.010: Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

2. 242: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

3. 519: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power System.

4. 1584: IEEE Guide for Performing Arc-Flash Hazard Calculations

B. National Fire Protection Association (NFPA):

1. 70E: Standard for Electrical Safety Requirements for Employee Workplaces.

C. Massachusetts Electrical Code.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - QUALIFICATIONS OF SPECIALTY FIRM**

A. Submit evidence of the following:

1. Firm's experience:

a. Specialty firm shall have been in the business of the type of work specified, for at least the past five years.

b. The firm shall have a minimum of five projects of equal or greater size, service, and the type of equipment specified.

c. At least the following information must be submitted:

(1) The number of years the firm has been in the business of performing coordination studies.

(2) Summary of five previously performed studies including:

(a) A brief description of each study.

(b) Name of owner of installation on which study was performed with address, telephone number, and contact person.

(c) Date of study.

(3) List of projects and contact persons for which protective device settings were performed.

(4) Any other information indicating the firm's experience, ability to perform the work, and business status.

B. Firm shall have a licensed Professional Electrical Engineer, licensed in Massachusetts, supervise all work and seal all reports.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION**

**3.01 - SHORT CIRCUIT STUDY**

A. Perform a short circuit study in accordance with ANSI Standard C37.010 to verify the adequacy and correct application of circuit protective devices and other electrical system components.

B. The study shall address the case when the system is being powered from the utility source as well as from the on-site generating facilities. Minimum and maximum possible fault conditions shall be covered in the study.

C. Include the fault contribution of all non VFD driven motors. Calculate short-circuit momentary duties and interrupting duties on the basis of an assumed bolted 3-phase short circuit at each bus. The short circuit tabulations shall include X/R ratios, asymmetry factors, kVA and symmetrical fault-current. Where ground fault protection is specified, provide a ground fault current study for the same system areas, including the associated zero sequence impedance diagram. Include in tabulation form, fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

D. The studies shall include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

**3.02 - PROTECTIVE DEVICE COORDINATION STUDY**

A. Provide a protective device time current coordination study with coordination plots of current limiting devices, plus tabulated data, including ratings and settings selected. In the study, balance shall be achieved between the competing objectives of protection and continuity of service (with emphasis on continuity of service) for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

B. Provide separate plots for utility and generator operation as applicable. Show maximum and minimum fault values in each case. Multiple power sources shown in one plot is not acceptable.

C. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults. Separate low voltage circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults. Separate protective relays by a 0.4 second time margin when the maximum 3 phase fault flows to assure proper selectivity. The protective device characteristics or operating bands shall be terminated to reflect the actual symmetrical and asymmetrical fault-currents sensed by the device. Provide the coordination plots for 3 phase and phase-to-ground faults on a system basis. Include all devices down to largest branch circuit feeder circuit breaker. Include all adjustable setting ground fault protective devices.

D. Identify discrepancies in the conclusions and recommendations of the report. Upon resolution of discrepancies and recommendation, update all associated analyses and revise the affected studies.

E. The coordination plots shall graphically indicate the coordination proposed for the several systems centered on full scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated upstream power system relays, fuse or system characteristics, significant motor starting characteristics, significant generator characteristics, complete parameters for power, and substation transformers, complete operating bands for low voltage circuit breaker trip devices, fuses, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required. The short-time region shall indicate the relay instantaneous elements, the magnetizing inrush, and ANSI transformer damage curves, the low voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault-currents.

F. The thermal limit of all feeder cables to each bus and large motors, where applicable in the study, shall be shown.

G. No more than six devices shall be shown on one coordination plot. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots in order to provide cross reference. Give each unique protective device curve in the study a study-unique number or letter identifier to permit cross reference between plots. Do not use identifier letters or numbers more than once.

H. Each primary protective device required for delta-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to assure protection for secondary line-to-ground faults.

I. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings. Include C.T. ratio, burden and all other calculations required for the determination of settings.

**3.03 - ARC FLASH HAZARD ANALYSIS**

A. Perform arc flash hazard analysis for the following items:

1. Switchboards
2. Distribution Panels
3. Panelboards
4. Control panels with voltage over 50 Volts
5. Motor Control Centers
6. Transformers that have auxiliary electrical devices operating at over 50 Volts
7. Automatic Throw Over Systems
8. Variable Frequency Drives
9. Disconnect Switches

B. Methods of performing analysis:

1. Use IEEE 1584 calculations.
    a. If the conditions fall within the IEEE 1584 parameters use the IEEE 1584 calculations based on actual OCPD curves and settings.
    b. If the conditions do not fall within the 1584 parameters, use the Lee method.

C. Provide color coded arc flash labels for each equipment item for which the calculations were performed with the following information:

1. Limited approach boundary
2. Information required by NFPA 70E, 130.2(D)(2).
3. Restricted approach boundary
4. Personal protective equipment required within restricted approach boundary
5. Flash protection boundary
6. Personal protective equipment required within flash protection boundary
7. Prohibited approach boundary

**3.04 - FIELD TESTING**

A. Integrate results of this study with functional testing of the contract electrical equipment in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16366**

**LOW VOLTAGE SWITCHBOARD**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16366, LOW VOLTAGE SWITCHBOARD is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16366, LOW VOLTAGE SWITCHBOARD requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Low Voltage Switchboards as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

C. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.

D. Shop drawings shall contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, power cable termination material and size data, and any other details required to demonstrate that system has been coordinated and will properly function as a unit.

E. Wiring schematics showing required power and control wiring terminations and output contacts for switchboard monitoring and control contacts.

F. Submit catalog cut sheets and time current characteristic curves, short circuit rating and data for each circuit breaker type and rating.

G. Submit data on Arc Reduction Maintenance System (ARMS).

H. Automatic throwover system control strategy.

I. Operating and Maintenance Instruction Manual.

J. Performance Test Reports: Upon completion of installed system, submit field tests performed.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide UL listed equipment.

B. Services of Service Engineer, specifically trained on type of equipment specified.

**1.08 - DESCRIPTION**

A. Provide a 480 volt, 3 phase, 3 wire, service entrance rated switchboard with neutral connecting pads. The switchboard shall be indoor type free-standing construction with individually mounted, electrically operated main breakers and group mounted feeder, circuit breakers, power monitors, power monitoring network, Surge Protection Devices (SPD) and circuit breakers based automatic throwover system as indicated. Provide front accessible switchboard with a minimum, ampacity and short circuit rating as indicated on the contract drawings.

B. Provide Surge Protection Devices (SPD) as specified in SECTION 16400, SURGE PROTECTION DEVICES.

**1.09 - REFERENCES**

A. National Electrical Manufacturers Association (NEMA):

1. PB-2, Switchboards.
2. AB-1, Molded Case Circuit Breakers.

B. Underwriter's Laboratories (UL):

1. UL-489, Molded Case Circuit Breakers
2. UL-891, Switchboards.
3. UL-1008, Transfer Switch Equipment

C. Federal Specifications (FS):

1. W-P-115-B, Panel, Power Distribution.
2. W-C-375, Molded Case Circuit Breakers.
3. QQ-S-365B, Silver Plating, Electro-Deposited.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.10 - SEISMIC DESIGN REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS. Provide equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

**PART 2 - PRODUCTS**

**2.01 - SWITCHBOARD MANUFACTURERS**

A. Eaton

B. Square D

C. GE

**2.02 - SWITCHBOARD EQUIPMENT**

A. Structure:

1. Totally enclosed switchboard dead front, free standing, front and rear aligned with top and bottom feeds as required.
2. NEMA-1 general purpose switchboard with frame-work of UL gauge formed steel and channels and secured together to support all cover plates, bussing and component devices during shipment and installation. Formed removable closure plates on the front, rear and sides. Closure plates shall be single tool, screw removable.
3. Each section includes a single-piece removable top plate.

B. Incoming Line and Bus Tie Sections:

1. Breakers shall be, UL listed, solid state, fixed, individually mounted, electrically operated insulated case circuit breaker.
2. Main circuit breakers shall have true RMS, microprocessor based trip unit to provide undervoltage trip, phase failure and phase reversal protection. Main breakers shall be equipped with alarm switch, auxiliary switches, long time, short time, instantaneous trip, ground fault delay and trip adjustments.
3. Provide "push to trip" push button on circuit breaker to allow manual trip without risking exposure to live parts.
4. Provide trip indicator to identify type of fault. Provide trip unit with LED type display.
5. Breaker to be provided with capability of locking in the open position.
6. Provide mechanical pop-out type fault indicator to indicate a fault trip has occurred, which also prevents closure of the circuit breaker after a fault event unless reset.
7. Provide spring charging motor. The motor shall automatically charge the stored energy mechanism when the circuit breaker closes. Provide with operation counter, spring-charged switch, closing and opening coils and anti-pumping function.
8. Breakers shall be equipped with stored energy electrical operated mechanism.
9. Provide breaker integral ground fault test feature to allow ground fault testing.
10. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the contract drawings.
11. Provide Red, Green and Amber LED indicating lights to indicate breaker open, closed and trip position.
12. Provide normally open auxiliary contact, to indicate breaker open, close and trip position. Auxiliary contacts shall be wired to facility PLC system.
13. Provide main breakers with Arc Reduction Maintenance Switch (ARMS).

C. Feeder Sections:

1. The switchboard mounted circuit breaker branch devices shall be front accessible fixed mounted, group mounted circuit breakers.
2. Feeder breakers shall be fixed mounted, molded case type breakers. UL Listed circuit breakers conforming to NEMA Std. ABI.
3. Feeder breakers less than 200 amps frame shall have a fixed thermal magnetic trip.
4. Feeder breakers having frames 200 amps and higher shall incorporate solid state, adjustable trip units having long-time pickup and delay, shirt time pickup and delay, instantaneous, ground fault and delay, local trip indicators (overload, short circuit and ground fault).
5. The circuit breaker connections to the distribution bussing shall be such that the connections grip the bus bars firmly under high-fault conditions.
6. Provide wiring gutters of sufficient space to allow cable termination.
7. Provide covers for gutter space and future breaker space with formed sheet steel.
8. Circuit breakers shall have a minimum symmetrical interrupting capacity as the switchboard indicated on the Contract drawings. Series rated circuit breakers are not acceptable.

D. Buses:

1. Line side tinned copper bus, terminals fitted with two hole, compression-type lugs for four copper cable conductors per phase.
2. Compression type copper terminals.
3. Load side tinned copper bus with rating and bracing as indicated on contract drawings.
4. Tinned copper ground bus 1/4 in. X 2 in. extended and tied through to all adjoining sections.

**2.03 - AUTOMATIC THROWOVER CONTROL SYSTEM**

A. Automatic throwover control system shall be integral to the low voltage switchboard and utilize fixed mounted power case circuit breakers.

B. System shall be dual source open transition type, circuit breaker based.

C. System shall be rated for continuous duty, repetitive switching of all types of loads or transfer between two active power sources.

1. Eversource Utility Power (MV.T-1)
2. Standby Generator Power (GEN.10-1)

D. System shall be open delayed transition with a time delay, adjustable from 0 to 120 seconds.

E. The logic for the throwover system functions shall be provided via a microprocessor-based automatic transfer controller with:

1. Field adjustable set points without the use of special tools.
2. Test pushbutton.
3. LED indicating lights to indicate Normal Utility and Standby Generator positions.
4. LED indicating light for circuit breakers in disconnected position.
5. LED light to indicate load energized.
6. Historical transfer information on front panel.
7. 2-position selector switch for two modes of transfer system control operation: AUTO/MANUAL.
8. Programmable generator exercise timer.

F. Ratings shall be as per the contract drawings. Circuit breakers shall be UL listed for application for 100% of their continuous ampere rating. Breakers shall be electrically operated.

G. Each circuit breaker with shall incorporate solid state, adjustable trip units having long-time pickup and delay, shirt time pickup and delay, instantaneous, ground fault and delay, local trip indicators (overload, short circuit and ground fault).

H. System shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions.

I. The system shall have draw-out multi-tap transformers connected to the switchboard Bus A and Bus B. The multi-tap transformers shall be sized to handle the load of the system and to provide control power to operate the switchboard power monitoring units and the electrically operated breakers.

J. Sequence of Operation – Automatic Mode:

1. The transfer control system shall automatically open the Main Breaker that has lost power, and send a signal to the standby diesel generator (GEN.10-1).
2. When power is available on the line side of the Generator breaker the transfer control system shall automatically close the Generator breaker.
3. When the failed source has been restored to 90% of rated voltage, and after a time delay, adjustable from 0.5 to 32 minutes the Generator breaker shall open. After an adjustable time delay the source breaker shall close.

K. Sequence of Operation – Manual Mode:

L. While in manual mode, breakers shall be capable of being opened and closed using control switches. Electrical interlocking shall be provided to prevent the closing of Main and Generator breakers simultaneously.

M. The system control panel shall include 6 user configurable inputs. Inputs to be user configured to one of the following features:

1. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic retransfer shall occur in the event that source 2 power is lost.
2. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic retransfer shall occur in the event that source 2 power is lost.
3. Input to enable or disable manual retransfer to source 1.
4. Input to initiate manual retransfer to source 1.
5. Input to initiate a remote engine test. The test will run using the programmed engine test set points.
6. Input to select source 1 or source 2 as the preferred source.
7. Input to bypass time delays.

N. The system control panel shall include 6 user configurable outputs. Inputs to be rated for 10 Amp at 250VAC and 10 Amp at 30 VDC and user configured to one of the following features:

1. Source 1 connected
2. Source 2 connected
3. Transfer system in test
4. Transfer system not in automatic mode (Monitor Mode)
5. General Alarm indication for failure to transfer, mechanical fault, or electrical fault
6. Engine Test Aborted
7. Engine cool down in process
8. Engine start contact status
9. Emergency inhibit on
10. Load sequence – Output used to signal select loads to disconnect prior to transfer and reconnect 0-120 seconds after. Loads are reconnected sequentially.
11. Pre and/or post-transfer signal – A pre and/or post-transfer time delay output adjustable from 0-120 seconds.

O. One Form C auxiliary contact to indicate source 1 position and one Form C contact to indicate source 2 position. The contacts shall be rated for 10 Amp, 1/3 Horsepower at 250 VAC and 10 Amp at 30 VDC.

P. One Form C contact for Normal Power Available. The contacts shall be rated for 10 Amp at 250 VAC and 10 Amp at 30 VDC.

Q. One Form C contact for Generator Power Available. The contacts shall be rated for 10 Amp at 250 VAC and 10 Amp at 30 VDC.

R. One Form C contact for Loss of Normal Power. The contacts shall be rated for 10 Amp at 250 VAC and 10 Amp at 30 VDC.

S. One form C contact for Loss of Generator Power. The contact shall be rated for 10 Amp, at 250 VAC and 10 Amp at 30 VDC.

T. Provide Auto/Test switch to test operation of the system by simulating a loss of the Normal Power Source.

**2.04 - POWER MONITORING**

A. Provide power monitors as indicated on the Contract Drawings. Power monitors shall include the following:

1. Current transformers. Current transformers shall be wired to shorting type terminal blocks.
2. Microprocessor based metering system as follows:
   a. Comply with ANSI C12.16, Class 10.
3. Display data:
   a. Current A, B, C, Average, Ground
   b. Voltage:
      - Phase to phase
      - Phase to ground
      - Average values
   c. Power:
      (1) Watts
      (2) VAR
      (3) VA
      (4) Phases A, B, C and System
   d. Energy:
      (1) KWH
      (2) KVARH
   e. Frequency
   f. Demand:
      (1) System Current
      (2) KW
      (3) KVAR
      (4) KVA
   g. Power Factor – Phases A, B, C, System
   h. % THD Current – Phases A, B, C, N

i. % THD Voltage- Phase to phase

j. Minimum and maximum values

k. History log that monitors and records past events and thresholds for a minimum of 50 events. The history log shall include power quality log, waveform log, trigger log and snapshot log.

4. Auxiliary output contact to indicate loss of utility power on the main breaker unit. Contact shall be wired to the facility SCADA system.

**2.05 - ENCLOSURE – GENERAL REQUIREMENTS**

A. Switchboard shall be completely self-supporting structure of the required number of vertical sections bolted together to form one metal-enclosed switchboard 90 in. high.

B. Sides, top and rear covers shall be code gauge steel, bolted to the switchboard structure.

C. The frame structure members shall be die-formed, 12-gage steel bolted together and reinforced at corners with rugged gussets internal and external to the structure members.

D. The switchboard frame shall be mounted to sills embedded in a concrete housekeeping pad.

E. Switchboard shall include all protective devices as specified in these specifications with necessary interconnection, instrumentation and control wiring.

F. All buses are tin plated copper, supported with high impact, non-tracking insulating material, and braced to withstand mechanical forces exerted during short circuit conditions. All bus connections shall utilize silver plated bus bar surfaces.

G. The vertical main bus bars are furnished for future branch devices. Device mounting bolts and bus connecting straps are supplied with future unit devices. Full height bus bars shall be supplied.

H. All vertical sections comprising the switchboard are front-aligned.

I. All steel surfaces shall be chemically cleaned and pre-treated with an iron-phosphate pre-treatment or equivalent process, providing a bond between paint and metal surfaces to help prevent the entrance of moisture and formation of rust under the paint. The switchboard exterior shall be finished with ANSI-61 light gray paint. Provide touch-up paint for coatings nicks and scratches after installation and testing.

J. Control wiring, fuse blocks and terminal blocks within the switchboard shall be furnished when required. All control wires leaving the switchboard shall be provided with terminal blocks with numbering strips.

K. All hardware used on conductors shall have a high tensile strength, and a protective finish.

L. Switchboard shall be provided with lifting means, and capable of being rolled or moved into installation position and bolted directly to floor sills.

M. Make provision for conduit and cable entrance from top or bottom as indicated on the drawings.

**2.06 - SWITCHBOARD SILLS**

A. System shall be rated for continuous duty, repetitive switching of all types of loads or transfer between two active power sources.

B. Provide steel channel sills with drilled holes for mounting, aligning and bolting switchboard in place. Method of mounting as indicated. Provide in size recommended by switchboard manufacturer. power sources.

**2.06 - SWITCHBOARD INSTRUMENT TRANSFORMERS**

A. Switchboard main compartments shall include 480 to120 Volt potential and control power transformers as indicated.

B. Provide current transformers by metering phase current as indicated.

C. Tie instrument transformer outputs to power monitor and as indicated.

**2.07 - ARC ENERGY REDUCTION**

A. Provide circuit breakers rated 1200 and higher with Arc Energy Reduction in accordance with NEC, by means of energy-reducing maintenance switching (ARMS) with local status indicator.

B. Provide dry contact for remote indication of system “In Maintenance Mode” to plant SCADA (WWTF-PLC).

**2.08 - SWITCHBOARD FACTORY TESTS**

A. The switchboard shall be completely assembled, wired, adjusted, temporarily powered and tested at the factory. Provide test results for approval.

B. The fully assembled switchboard shall be given operational, dielectric, and all other standard tests.

C. Factory testing shall be witnessed.

**2.09 - WIRING**

A. Conductors: Copper; size as required by load, except that no control wire is smaller than No. 14 AWG. Use insulation that is flame retardant, and moisture and heat resistant.

B. Cables and conductors: Bundled and tie wrapped securely in wireways furnished.

C. Identify internal wiring at terminations by T&B wire markers or equivalent.

D. All spare auxiliary contacts shall be wired to terminal blocks.

E. Terminal Blocks:

1. Rated 600 volt for power with current rating as required by loads.

**2.10 - SPARE PARTS**

A. Provide recommended spare parts list.

**2.11 - NAMEPLATES**

A. Provide switchboard section and breakers with engraved nameplates. Provide nameplates with nomenclature labels as indicted on the Contract Drawings.

B. Provide nameplates of laminated sheet plastic, 1/16-in. thick, engraved to provide white letters on black background. Fasten nameplates in place with corrosion resistant screws.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide all material, equipment and labor to install switchboard as indicated and as specified.

B. Install equipment on channels set flush with concrete pads. Set and level channel sills in block-outs in the equipment pad. After leveling channel sills, grout sills. Equipment may not be set on sills until grout is cured.

C. Interconnect equipment as a complete operating system.

D. Paint completed sills with two coats of polyamide epoxy paint or other acceptable corrosion-resistant finish before setting in place.

**3.02 - FIELD TESTING**

A. Provide checkout, field, and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

B. Field testing to include opening, closing, and tripping of circuit breakers in accordance with the method of operation as shown on accepted shop drawings.

C. Perform breaker open, close, and trip operation. Verify breaker operation in accordance approved shop drawing schematics.

D. Perform automatic transfer system functions by simulating loss of utility power, switching to standby power, powering the system from the standby generator and switching back to utility when power is restored.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16400**

**SURGE PROTECTION DEVICES**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16400, SURGE PROTECTION DEVICES is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16400, SURGE PROTECTION DEVICES requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Surge Protection Devices (SPDs) as specified herein and/or as shown on the Contract Drawings.

B. Provide Surge Protection Devices (SPD) integral to the electrical distribution system equipment as indicated. The distribution system includes switchboard, motor control centers, 480V distribution panels and 120/208V panelboards.

C. The components shall provide protection for electrical and electronic devices against the damaging effects of surges, transients and electrical line noise.

D. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.

2. Shop drawings, manufacturer's product data, and component ratings in accordance with this section and the requirements of Section 16050.

3. Provide verification that the SPD complies with the required ANSI/UL 1449 listing by UL.

4. Submit SPD type, model number, system voltage, phases, modes of protection, voltage protection rating (VPR) and nominal discharge current (In).

5. Provide outline drawings and internal wiring diagrams.
6. Submit factory test data.
7. Operating and Maintenance Instruction Manuals:
    a. Operating instruction manuals outlining step-by-step procedures for system startup and operation and in accordance with SECTION 01300, SUBMITTALS.
    b. Manufacturer's name, model number, service manual parts list.
    c. Brief description of equipment and basic operating features.
    d. Maintenance instruction manuals outlining maintenance procedures.
    e. Troubleshooting guide listing possible breakdown and repairs.
    f. Simplified connection wiring diagrams for each circuit.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. SPD units and all components shall be designed manufactured and tested in accordance with the latest applicable UL Standard (ANSI/UL 1449 3rd Edition).

B. SPD units shall be UL approved for use with Lightning Protection Systems.

**1.08 - REFERENCES**

A. Underwriters Laboratory (UL):

B. Massachusetts Electric Code.

C. American National Standard Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):
    1. ANSI/IEEE C62.41 - IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits
    2. ANSI/IEEE C62.45 - IEEE Guide for Surge Suppressor Testing
    3. National Electrical Manufacturers Association (NEMA):
    4. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)
    5. NEMA LS 1 - Low Voltage Surge Protection Devices

D. Military Standard: 220A - Radio Frequency Interference and Electromagnetic Interference.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.01 - ACCEPTABLE MANUFACTURERS

A. Transient voltage surge suppression components.

1. Eaton-Cutler Hammer
2. Schneider Electric
3. Siemens
4. Or equal.

### 2.02 - GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

| | Protection Modes | | | |
|---|---|---|---|---|
| Configuration | L-N | L-G | L-L | N-G |
| Wye | ● | ● | ● | ● |
| Delta | N/A | ● | ● | N/A |
| Single Split Phase | ● | ● | ● | ● |
| High Leg Delta | ● | ● | ● | ● |

5. Nominal Discharge Current ($I_n$) – All SPDs applied to the distribution system shall have a 20kA $I_n$ rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an $I_n$ less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

| Modes | 208Y/120 | 480Y/277 |
|---|---|---|
| L-N; L-G; N-G | 400V | 800V |
| L-L | 800V | 1800V |

7. ANSI/IEEE C High Let-Through Voltage – The let through voltage based on an ANSI/IEEE C62.41 Category C High waveform (10kV, 10kA) shall not exceed the following:

| Mode | 208Y/120 | 480Y/277 |
|---|---|---|
| L-N | 560V | 960V |

8. ANSI/IEEE Cat. B Ringwave Let Through Voltage – The let-through voltage based on an ANSI/IEEE C62.41 Category B Ringwave (6 kV, 500 amps) shall not exceed the following:

| Mode | 208Y/120 | 480Y/277 |
|---|---|---|
| L-N | 160V | 165V |

B. SPD Design:

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      (1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

      (2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

      (3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Surge Counter

(1) The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

(2) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection - The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements - SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

**2.03 - SYSTEM APPLICATION**

A. The SPD applications covered under this section include distribution and branch panel locations, motor control centers (MCC), and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

| Minimum surge current capacity based on ANSI / IEEE C62.41 location category | | | |
|---|---|---|---|
| Category | Application | Per Phase | Per Mode |
| C | Service Entrance Locations (Switchboards and MCC) | 250 kA | 125 kA |
| B | 480 VAC Distribution Panelboards | 160 kA | 80 kA |
| A | 208/120 VAC Panelboards | 120 kA | 60 kA |

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

**2.04 - LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS**

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Switchboard and MCC Requirements

1. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchboard and MCC.
3. The SPD shall be factory installed inside the switchboard and/or MCC, at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchboard and/or MCC, as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

**2.05 - SHOP TESTING**

A. Provide a factory performance test for each unit. The tests shall be in accordance with the latest version of NEMA and UL Standards:

**PART 3 - EXECUTION**

**3.01 - INSPECTION**

A. Visually inspect delivered unit(s) and accessories for conformance with the Contract Drawings and specifications.

**3.02 - INSTALLATION**

A. Install unit in compliance with the manufacturer’s printed instructions. All electrical installation Work shall be in accordance with UL Listing Requirements and applicable Massachusetts Electrical Codes.

**3.03 - CHECKOUT AND TESTING**

A. Provide checkout, field, and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16402**

**UNDERGROUND DISTRIBUTION SYSTEM**

**(Filed Sub-bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16402, UNDERGROUND DISTRIBUTION SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16402, UNDERGROUND DISTRIBUTION SYSTEM requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Underground Distribution Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturers' product data for all components and materials used in the construction of underground distribution systems in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Provide "As-Built" drawings of underground ductbank system in accordance with SECTION 01030, SPECIAL REQUIREMENTS and 01300, SUBMITTALS.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE.

**1.08 - REFERENCES**

A. Massachusetts Electrical Code.

B. National Electric Safety Code.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - DESCRIPTION**

A. Provide underground distribution system as indicated and specified.

B. Conform to lines, grades, elevations, and dimensions. Resolve interferences with other underground conduit, piping or equipment, either new or existing with the Authority. Match components for installation.

C. Provide Schedule 40 polyvinylchloride (PVC) conduits for power and control circuits. Provide rigid galvanized steel conduits for instrumentation, communication, I/O, fire alarm and data highway cable circuits.

**1.10 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on the Structural Drawing S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. Polyvinylchloride (PVC) Conduit:

1. Specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEM Paragraph 2.01.B.

B. Rigid Steel Conduit, Galvanized:

1. Specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEM Paragraph 2.01.A.

**2.02 - MATERIALS AND COMPONENTS**

A. Conduit Spacers: Furnish conduit spacers made of plastic to maintain spacing between conduits.

B. Cable Supports in Handholes shall be provided as follows:

1. Cable racks, stainless steel.

2. Cable supports, stainless steel.

3. Insulators, high grade dry-process porcelain.

## PART 3 - EXECUTION

### 3.01 - GENERAL

A. Perform Work in accordance with the Massachusetts Electrical Code and as indicated and as specified.

### 3.02 - INSTALLATION OF CONDUITS

A. Lay conduits, indicated to be direct buried in the ground.

B. Provide separation of power and control conduits of 3 inches both vertically and horizontally. Build ductbank layer by layer. Coordinate with General Contractor to backfill and compact each layer to provide support for next layer.

C. Separate power and control ducts from instrument telephone, fire alarm and signal ducts by 12 inches.

D. Provide yellow ductbank marker tapes, reading "Caution - Electrical Lines Below", over entire length of ductline. Locate tapes 12 inches below grade. Provide a tape for every 12 inches of width of ductline.

E. Install conduit, with spacers as specified. Rigid galvanized steel conduits to be painted with bituminous paint by others under SECTION 09940, FIELD PAINTING.

F. Install conduit runs following routing on drawing and running in straight lines. Provide end bells where ducts enter handholes of the same material as the duct system. Terminate steel conduit entering hand holes in grounding bushing. Where deviation from a straight line becomes necessary, install bends of radius which allow for rodding and installation of cable.

G. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having radius of curvature of 25 ft. Manufactured bends can be used at ends of short runs of 100-ft. or less, and then only at or close to the end of run. Provide long sweep bends made up of one or more curved or straight sections and/or combinations thereof. Install manufactured bends with radius of 36-in. where larger radius cannot be used.

H. Lay ductlines to slope of 4 inches per 100-ft. and slope to handholes from a high point between the handholes. Ductlines are to slope away from buildings.

I. Install spacers at intervals of 4 ft. and stagger between tiers of ducts to provide 12-in. of longitudinal separation. Install base spacers to provide 3-in. between bottom of trench and underside of bottom conduits. Coordinate with General Contractor to fill space with concrete under SECTION 03300, CAST-IN-PLACE CONCRETE. Firmly wire conduits and spacers together before concrete is placed.

J. Prior to placing of concrete under SECTION 03300, CAST-IN-PLACE CONCRETE, General Contractor to remove all dirt, sand, and any other debris from between conduits and from trench bottoms under SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING. Hold conduits in place to prevent floating or accidental movement.

K. Stagger joints in conduits 6-in. Do not allow couplings to rest on bottom of trench. Install couplings for plastic conduit in accordance with manufacturer's recommendations.

L. General Contractor to install concrete encasements under SECTION 03300, CAST-IN-PLACE CONCRETE so clearance of 12-in. from concrete to parallel pipes, lines, and structures, is maintained. Where ducts cross, clearance of 6 inches is required.

M. At a point close to the handhole wall, drive a ground rod into earth. Extend ground rod 6-in. above finished handhole floor. After completion of handhole by General Contractor under SECTION 03300, CAST-IN-PLACE CONCRETE connect 6 foot length of No. 4 bar copper ground wire to ground rod. Connect grounding bushings, cable racks, covers, other metallic parts, splices, and ground wire installed with each feeder to ground loop.

N. Keep conduits clean of concrete, dirt, and other substances during the course of construction. After the ductlines have been completed, pull a standard flexible mandrel not less than 12-in. long, having a diameter 1/4-in. less than the inside diameter of the conduit, through each conduit, after which pull a brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Replace conduit runs that do not allow the passage of the mandrel at no additional cost to the Authority. Pneumatic rodding may be used to draw in the lead wire. Install in spare conduits a pull wire or rope, and plug and seal spare conduits after cleaning.

**3.03 - AS-BUILT DRAWINGS OF UNDERGROUND WORK**

A. Provide one set of marked copies of contract drawings, showing exact routing and depths of all underground conduit and duct handholes. Provide scaled plot plans, showing principal outline of buildings and structures. Reference conduits, ducts, and all bends deviating from straight line, dimensionally from fixed objects or structures.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16450**

**GROUNDING**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16450, GROUNDING is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16450, GROUNDING requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Grounding as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

   a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.

2. Submit shop drawings and manufacturers' product data in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

A. American National Standards Institute (ANSI):

1. ANSI C2: National Electrical Safety Code

B. National Fire Protection Association (NFPA):

1. NFPA 70: National Electric Code
2. NFPA 780: Lightning Protection Code

C. Massachusetts Electrical Code

D. American Society for Testing and Materials (ASTM):

1. B3: Soft or Annealed Copper Wire.
2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

E. Underwriters Laboratories, Inc. (UL):

1. U.L. 44: Wires and Cables Rubber Insulated.
2. U.L. 83: Wires Thermoplastic-Insulated.

F. National Electrical Mfg's Association (NEMA):

1. WC 3: Rubber Insulated Wire & Cable.
2. WC 5: Thermoplastic Insulated Wire & Cable.
3. WC 7: Cross-Linked-Thermosetting Polyethylene-Insulated Wire & Cable.
4. WC 8: Ethylene-Propylene-Rubber-Insulated Wire & Cable.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.08 - DESCRIPTION**

A. Provide a single, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the Massachusetts Electrical Code Article 250 and the National Electrical Safety Code.

B. Include grounding of switchboard, motor control centers, electric equipment enclosures, generators, transformers, ground grid systems with ground rod and water pipe connections; structural steel, and lightning protection system.

C. Include grounding conductors completely inter-connecting water supply pipe, ground grid, substation, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

**1.09 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on the structureal drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

## PART 2 - PRODUCTS

### 2.01 - ACCEPTABLE MANUFACTURERS

A. Ground Rods:

1. Erico Products Inc.
2. Galvan Electrical Products.
3. Nehring Electrical Works.
4. Or equal.

B. Exothermic Welding:

1. Erico Products, Inc.
2. American Brass Mfg. Co.
3. Orgo-Thermit, Inc.
4. Or equal.

C. Connecting Hardware:

1. American Brass Mfg. Co.
2. Thomas and Betts
3. Anderson Electric Corp.
4. Or equal.

### 2.02 - MATERIALS AND COMPONENTS

A. Conductors:

1. Provide tinned copper grounding conductors , sized as indicated . Provide protection of conductors if physical damage would result from direct exposure.
2. Provide uninsulated conductors where conductors are buried in the earth or where they are embedded in the concrete.
3. In buildings, provide insulated grounding conductors with green insulation. Provide insulated grounding conductors with insulation rated at 600 volts.

B. Ground Bus:

1. Provide a 2-in. by 1/4-in. tinned copper bar with bolted type connectors as indicated.

C. Ground Rods:

1. Provide copper-clad steel or galvanized steel ground rods; type, diameter and length as indicated on drawings. Make cable to ground rod connection without passing over end of ground rod.

D. Connections:

1. Provide silicon bronze ground clamps for use on copper or brass pipes which are UL listed.
2. Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material.
3. Furnish ground clamps, for use on pipes, with rigid metal base providing solid contact by seating on the pipe. Do not use strap type clamps.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION OF GROUNDING CONDUCTORS

A. Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

B. Run grounding conductors associated with direct burial cables in common trenches above or if indicated beside cables.

C. Bury equipment grounding conductors 30 inches deep. Bring loops or taps up for connection to equipment or other items to be grounded.

D. Where raceways are used to contain and protect grounding conductors, install in accordance with Sections 16110 and 16402.

E. Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

F. Install loop type, low impedance, grounding system interconnecting all components so two grounding connections are provided for each item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

G. Connect structural steel at locations indicated to the grounding loop and connect to each vertical column by loop or tap. Provide exothermic weld connections. Connect two opposite points on external loop to two different points on grounding system.

H. Buried and concealed ground connections are to use exothermic welding.

I. Make accessible connections to structural members by exothermic welding process. Connections to equipment or ground bus shall be by bolted connectors.

### 3.02 - INSTALLATION OF GROUND RODS

A. Install ground rods in manholes and handholes in accordance with requirements specified under Section 16402, UNDERGROUND DISTRIBUTION SYSTEMS. Connect each grounding conductor entering a manhole or handhole to ground rod by exothermic weld.

B. Install ground rods where indicated. Install the top of the rod 12-in. below the ground surface.

C. Make connection to overall grounding system as indicated.

D. Ensure that final resistance of interconnected ground system is 3 ohms, or less. Measure ground resistance in normally dry conditions, and not less than 48 hours after rainfall.

### 3.03 - EQUIPMENT GROUNDING

A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment with copper wire sized in accordance with Massachusetts Electric Code. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600-volt insulation. Ground conductors are in addition to and not to be considered as the neutral wire of the system.

B. Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

C. Connect two separate ground connections from ground grid to ground bus of switchgear assemblies, motor control centers and outdoor generator. Confirm that each connection for item of equipment is from different section of ground grid.

D. Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

E. Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on one end of conduit run.

F. Install a separate grounding conductor from ground system to motors of 100 hp. and larger, in addition to raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

G. Connect grounding conductors from equipment in area where ground bus is required to ground bus. Connect ground bus to grounding system. Mount ground bus on 600V pedestal insulators.

H. Connect lightning arresters to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, confirm that separate grounding conductor connects lightning arresters with system ground.

I. Connect generator neutral to grounding system by a grounding conductor of size required by NEC, unless a larger size is indicated. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

J. Ground each street lighting standard or pole by ground rod driven near base of standard, in accordance with requirements of National Electric Safety Code. Connect ground rods to grounding conductor brought with street lighting feeder cable.

K. Ground transformers, lightning arresters, insulators and other appurtenances, installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Protect grounding conductor by molding applied for 8 ft. above ground, with both molding and conductor stapled. Install ground rod where indicated and driven until top of rod is 1 ft. below ground.

L. Interconnect the water piping systems with the grounding system per the Massachusetts Electrical Code.

M. Ground wire fences when used to enclose electrical equipment or when overhead electrical lines cross fence. Unless otherwise indicated, provide grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

N. Connect the ground rods to the grounding conductor run with the direct burial cable.

**3.04 - SIGNAL GROUNDING**

A. Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

B. Where convenient several signal bonding conductors may be conbined, providing that all the following conditions are met:

1. The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.

2. The combined signal bonding conductor shall be isolated from the equipment grounding conductor.

3. Where two signal bonding conductors are combined use a three port insulated splice.

4. Where three or more signal bonding conductors are combined, use a copper bus mounted on 600V insulators. Attach each conductors to the bus using an insulated ring tongue lug and screw terminal.

**3.05 - TESTS AND CHECKOUTS**

A. Provide checkout and testing of the entire grounding system in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

**3.06 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16481**

**ELECTRIC HEAT TRACING**

**(Filed Sub-Bid Required)**

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1.04 - SUBMITTALS ..... 2
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1.06 - DESIGN CRITERIA ..... 3
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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16481, ELECTRIC HEAT TRACING is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16481, ELECTRIC HEAT TRACING requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electric Heat Tracing as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.
2. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.
3. Complete wiring and schematic diagrams for the equipment furnished at each piping location.
4. Isometric piping layout indicating power and splice connections.
5. Other details required to demonstrate that system has been coordinated and will properly function.
6. Test Reports: Upon completion of installed system, submit in booklet form, all field tests performed.
7. A report for the system provided indicating the number of circuits and the required watts per foot of cable for each system layout. The report shall include the length of heat trace cable to establish circuit breaker requirement for each circuit.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Conduit size and wire quantity, size, and type shall be suitable for the equipment supplied. Contractor shall review the proper installation of each type of device with the equipment supplier prior to installation.

**1.08 - REFERENCES**

A. Underwriter's Laboratories (UL):

1. UL 515: Electrical Resistance heat Tracing for Commercial and Industrial Applications.

B. National Fire Protection Association (NFPA):

1. NFPA 70: National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):

1. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

D. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE Std. 515: Testing, Design, Installation, and Maintenance of Electrical Resistance heat Tracing for Commercial Applications.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - DESCRIPTION**

A. Furnish, install, and test a complete electrical heat tracing system as indicated on the electrical drawings, and as specified herein.

B. The installed system will be required to provide freeze protection for the liquid in the pipes around which the electrical heat tracing is placed.

C. Provide pipe heat tracing continuing below grade for 4’-0”.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Chromalox Industrial Heating Products.

B. Tyco.

C. Delta-therm.

D. Or equal.

**2.02 - HEAT TRACING CABLE**

A. Provide heating cable consisting of flat, flexible parallel copper bus wires with a continuous inner core of self-regulating semi-conductive material. Provide cable with overall metal-braid and overall jacket. Cables are to operate at voltage shown on Electrical Drawings.

1. Cable shall be of parallel construction to allow cutting to length without changing power output per unit length.
2. The heater cable assembly shall have a monolithic heating core construction consisting of two parallel nickel-plated copper bus conductors with a semi conductive Positive Temperature Coefficient (PTC) polymer extruded over and between these parallel conductors. A polyethylene dielectric insulating jacket shall be extruded over the heating element core.
3. The semi conductive heating matrix and primary insulating jacket shall be cross-linked by irradiation.
4. The basic cable will be covered by means of a metallic braid of tinned copper. The braid will provide a nominal coverage of eighty percent (80%).
5. The cable shall be covered with a corrosion resistant over jacket of thermoplastic elastomer for possible exposure to aqueous solutions, mold acids or based) or fluoropolymer (for possible exposure to organic chemicals or corrosives).
6. Long term stability shall be established by the service life performance test per IEEE Standard 515.
7. The installation shall be rated either Class I, Division 1 or Class I, Division 2 when installed in hazardous areas as indicated on the drawings.

B. Provide on pipes a cable to maintain the medium in the pipe at a temperature of 50 deg. F. Provide cable for the following conditions:

1. Minimum Outdoor Temperature: 0 deg. F.
2. Maximum Wind Velocity: 50 mph.
3. Maximum Wattage Per Foot: 9 watts.

C. Provide on valves and other pipe fittings, additional wrapping with the heat tape. Base additional wrapping on fitting size.

**2.03 - CONTROLS**

A. Provide controls located in non-hazardous areas rated NEMA 4X. Provide devices rated in accordance with the Area Classification Schedule on Contract electrical drawing 00 E-601.

B. Provide UL listed heat trace control panels.

C. Provide 208VAC rated control panels.

D. Controls shall incorporate local control panels, electronic controllers, indicating lights, thermostats, switching the heating system via electrical contactors and output contacts.

E. Provide power connection boxes, devices, end seals, mounting hardware, all controls, wiring and conduit for operating heat tracing systems.

F. Provide thermostat to control the desired pipe temperature as specified in 2.02 B.

G. Temperature sensing shall be performed by bulb and capillary style thermostats mounted on the pipe within the insulated system. Provide with heavy duty, 22 amp rated contacts. Thermostat sensing bulb and capillary shall be stainless steel.

H. Control enclosure shall provide sufficient terminals for all power and field cable connections.

I. Provide heat trace control panel with output contacts to WWTF-PLC for Run Status and Fault Alarm.

J. Provide an end-of-line LED white indicating lamp at heat trace control panels to show power is available to the entire heat-traced run.

K. Where indicated on the drawings, provide systems certified and constructed for use in Class I, Division 1 or Division 2, Group D, hazardous areas. Connections and wiring between the thermostats and heater junction box shall be protected by rigid conduit, complete with seal off fittings and sealing compound as per hazardous area wiring requirements.

**2.04 -GROUND FAULT PROTECTION**

A. All heat tracing systems shall be provided with ground-fault protection. Ground-fault breakers with 30 ma trip shall be provided as required.

B. The metallic covering on all heating cables shall be grounded.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide pipe heat tracing as called for in the drawings.

B. Heat trace cable shall be taped secure to the piping and located inside piping insulation.

C. Provide all material, equipment, and labor to install the electric heat tracing system as specified.

D. Install the system in accordance with manufacturer's instructions and reviewed shop drawings.

E. Minimize splices. Install a marker located at each splice on outside of insulation where the splice is concealed by insulation.

F. Locate a weatherproof label at 15 ft. intervals stating “CAUTION – ELECTRIC TRACED” and affix to the insulation system.

**3.02 - CHECKOUT AND TESTING**

A. Provide checkout, field and functional testing in accordance with SECTIONs 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

B. Measure the resistance between the heating cable bus wires and the braid.

C. Measure the insulation resistance between the braid and metal pipe.

D. Do not allow test leads to be in contact with junction boxes, which can cause inaccurate readings.

E. All insulation resistance values should be greater than 1000 megohms.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16601**

**LIGHTNING PROTECTION**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Lightning Protection as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.
2. List of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.
3. Detailed shop drawings, drawn to scale, indicating type, placement, and location of protection devices, including cable attachments, grounding, mounting and any other details integral with the system for each structure.
4. Submit a Certificate of Delegated Design Services signed and sealed by a registered professional Massachusetts engineer stating the system meets the specified requirements and the applicable codes and standards.
5. Spare Parts Data: Provide a list of recommended spare parts for the material and equipment to be provided, including current unit prices and source of supply.
6. Inspection and Maintenance: Provide a written recommended inspection and maintenance procedure, including periodicity of inspections.

7. As-Built Drawings: Provide a complete set of "as-built" drawings showing the location of all grounds as well as a detailed layout of type, size, location and method of installation of all downleads, roof cables, bonding leads and connections, air terminals, and in the case where structural steel is used for downleads, the method and location of all roof and ground connections to the steel must be clearly detailed.

8. Submit U.L. MASTER LABEL Certificate of Compliance for the work performed.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Conduit size and wire quantity, size, and type shall be useable for the equipment supplied.

B. Provide systems furnished and installed by trained Service Technicians.

C. Provide UL listed components.

**1.08 - REFERENCES**

A. Underwriters' Laboratories, Inc. (UL):

1. UL-96: Lightning Protection Components.

2. UL-96A: Installation Requirements for Lightning Protection Systems.

B. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code.

2. NFPA-780: Lightning Protection Code.

C. Massachusetts Electrical Code.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - DESCRIPTION**

A. Provide lightning protection system for the buildings, tanks and structures as indicated on the contract drawings. The system shall consist of air terminals, conductors, ground terminals, interconnection conductors, arresters, and other connectors or fittings for a complete system.

B. All systems are to be provided and installed by a trained Service Technicians having five (5) years active experience. Provide proof of previous MASTER LABEL installations receiving the U.L. “C” plate of acceptance.

**1.10 - REQUIREMENTS OF REGULATORY AGENCIES**

A. Conform to UL 96 and 96A and NFPA-78.

**1.11 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. National Lightning Protection.

B. Lightning Master Corp.

C. Alltec Corp.

D. Or equal.

**2.02 - MATERIALS**

A. Class I Materials: Provide conductors, fittings, and fixtures to protect ordinary buildings and structures not exceeding 75 feet (23 m) in height.

B. Materials, Class I. Table I gives sizes and weights for air terminals, and main and secondary conductors. Secondary conductors which are used for bonding and interconnecting metallic bodies to the main conductor, and which will not be required to carry the main lightning current, may be reduced in size to No. 6 AWG copper. Provide main conductor size for interconnection to metal water systems, steam or hot water heating systems, or other metallic masses having a low resistance to ground.

C. Table I: Class I Material Requirements:

| | | Tinned Copper | |
|---|---|---|---|
| **Type of Conductor** | | **Standard** | **Metric** |
| Air Terminal, Solid | Diameter | 1/2 inch | 9.5 min |
| Air Terminal, Tubular | Diameter | | 15.9 mm |
| | Wall Thickness | .032 inch | 0.8 mm |
| Main Conductor, Cable | Size ea. | 17 AWG | |
| | Strand Wgt. | 187 lbs/1000 ft. | 478 g/m |
| | Per Length | 57,400 cm | 29 square mm |
| | Cross Sect. Area | | |
| Main Conductor, Solid Strip | Thickness | 16 AWG | |
| | Width | 1 inch | 25.4 mm |
| Secondary Conductor, Cable | Wire Size | 17 AWG | |
| | Number of Wires | 14 | 14 |
| Secondary Conductor, Solid Strip | Thickness | 16 AWG | |
| | Width | 1/2 inch | 12.7 mm |

D. Class II Materials: Provide conductors, fittings and fixtures necessary to protect ordinary buildings and structures exceeding 75 feet (23 m) in height; or one of any height which has a structural steel frame that may be substituted for lightning down conductors. Table II gives sizes and weights for air terminals and secondary conductors for Class II structures.

E. Table II: Class II Material Requirements:

| Type of Conductor | | Tinned Copper | |
|---|---|---|---|
| | | **Standard** | **Metric** |
| Air Terminal, Solid | Diameter | 1/2 inch | 12.7 mm |
| Main Conductor, Cable | Size ea. | 16 AWG | |
| | Strand Wgt. | 375 lbs/1000 ft. | 558 g/m |
| | Per Length | 115,000 cm | 58 square mm |
| | Cross Sect. Area | | |
| Secondary Conductor, Cable | Wire Size | 17 AWG | |
| | Number of Wires | 14 | 14 |
| Secondary Conductor, Solid Strip | Thickness | 16 AWG | |
| | Width | 1/2 inch | 12.7 mm |

F. Where any part of a protection system is exposed to mechanical injury, provide protection using molding or tubing with non-metallic clamps. If ferrous metal pipe or tubing is used around the conductor, connect the conductor electrically to the pipe or tubing at both ends.

G. Furnish all conductors of stranded tinned copper, annealed to 98 percent conductivity, unless specifically otherwise stated by the Contract Documents. Provide all fittings, connectors, clamps and fasteners of high corrosion resistant materials that can be used for the intended environment and compatible with copper conductors.

H. Provide all fastening devices compatible with surface materials they are to be attached. Direct copper to aluminum contact is not allowed.

I. Copper-clad steel shall have a copper covering permanently welded to the steel core, in such proportions that conductance is 30 percent of the conductance of an equivalent cross section of solid copper.

J. Where the installation requires aluminum materials, aluminum is acceptable as a substitute for copper in lighting protection, with the stipulations that: (a) aluminum shall not be used underground, in contact with ground or where air may be laden with corrosive elements, such as ocean air; (b) when an aluminum system is joined with copper or copper-clad grounds, the union shall be made with bimetal connectors; (c) precautions be taken at connections with dissimilar metals; and (d) cable conductors be of electrical conductor grade aluminum.

K. Material such as galvanized steel is not acceptable.

**2.03 - AIR TERMINALS**

A. Air terminals shall be provided and located to intercept a direct lightning strike.

B. Air terminals shall be 1/2 inch as indicated. Air terminals shall extend above the protected object between 10 inches and 36 inches. If over 24 inches high, air terminals shall be braced.

C. Air terminals up to 24 inches high shall be spaced at intervals of 20 feet or less; those 24 inches or higher shall be spaced 25 feet or less. Terminals shall be placed on the ridges of gable, gambrel, and hip roofs of ordinary or high slope, and at the perimeters of flat or low-slope roofs. A shed roof with a high or normal slope shall be considered as half of a gable roof. There shall be an air terminal within two feet of the end of each ridge or each corner of a flat or low-slope roof.

D. Air terminals shall be placed within two feet of the edge along the perimeter of a flat or low-slope roof. A low-slope roof is one which is 40 feet wide or less and has a pitch of 1/8 or less; or is over 40 feet wide and has a pitch of 1/4 or less. The center of such a roof shall have intermediate air terminals at intervals not exceeding 50 feet.

E. Chimney air terminals may be anchored directly or attached by a metal band around the chimney. No outside corner of a chimney shall be more than two feet from an air terminal. Copper chimney air terminals and all related components shall be hot-dip lead coated to prevent corrosion.

## PART 3 - EXECUTION

### 3.01 - INSTALLATION

A. Provide all material, equipment, and labor to install the lightning protection system as indicated and as specified. Equipment shall be installed by Service Technician specifically trained on installing lightning protection.

B. Main conductors shall: (a) interconnect air terminals in a direct or closed-loop roof system; (b) serve as downleads from the roof system to the ground system; (c) connect metal bodies of inductance or conductance to the main conducting system; and (d) serve as ground electrodes in some cases, or to connect ground rods in certain other cases.

C. Bend of conductor shall form an included angle of 90 degrees and have a radius of bend of 8 inches (203 mm).

D. Interconnect all conductors, air terminals to form a two-way path from each air terminal horizontally or downward to connections with ground terminals.

E. Conductors may be coursed through air without support for a distance of 3 feet (900 mm) or less. With a 5/8 inch (15.9 mm) rod or its equivalent as a support, fastened at each end, a conductor may be coursed through air for a distance not to exceed 6 feet (1800 mm).

F. Install roof conductors to interconnect all air terminals and provide a two-way path to ground horizontally or downward from the base of each terminal.

G. Metal roofing and siding, eave troughs, downspouts, and other metal parts are not acceptable as substitutes for lightning conductors.

H. Install two down conductors on any kind of structure. Location depends on placement of air terminals, size of structure, most direct coursing, security against displacement and location of metallic bodies, water pipes, and ground conditions. Separate down conductors. For structures over 200 feet (71 m) in perimeter, install one additional down conductor for each additional 100 feet of perimeter or fraction thereof.

I. The structural steel columns on the outside perimeter of the building shall not be utilized as the main down conductor from roof to ground for the lightning protection system. No parts of the structural steel structure shall substitute for lightning down conductors. The steel columns around the outside perimeter of the building shall be grounded at every other column and in no case shall average over 60-ft. apart. A through the roof connector shall be installed where a conductor penetrates the roof, by the Lightning Protection Subcontractor. The through the roof connector shall be 1/2-in stainless steel threaded rod equipped with neoprene washers and stainless nuts for a watertight seal.

J. Terminate each down conductor at a ground rod.

K. Use connector fittings on all lightning conductors at "end-to-end" "tee" or "Y" splices. Attach them so as to withstand a pull test of 200 pounds (890 N). Make fittings for connection to metal tracts, gutters, downspouts, ventilators, chimney extensions, or other metal parts about the structure tight to the object by compression under bolt heads. Both crimp type and exothermic weld splicers of stamped or cast metal are acceptable under Class I requirements. Do not use crimp type clamps and splicers in Class II installations. Use exothermic welds for all below grade system connections.

L. Attach conductors to the building or other object upon which they are placed. Use fasteners not subject to breakage. Furnish nails, screws and bolts, with which fasteners are attached, of the same material as the conductor or of such nature that there will be no electrolytic corrosion in the presence of moisture because of contact between the different parts. Space conductor fasteners not more than 3 feet apart on all conductors.

M. All requirements covering exposed systems apply to concealed installations. Conductors are coursed the same except that they may be coursed behind the exterior wall facing, in concealed or embedded conduit, or embedded directly in concrete.

N. Materials, installation methods and procedures are to be in accordance with UL-96 and 96A, NFPA 780, NEC and local electrical codes. Provide for and obtain a "U.L. Certificate of Compliance" for the Work performed.

**3.02 - SYSTEM TESTING**

A. Perform system testing as part of the grounding system tests identified in SECTIONS 16450, GROUNDING AND 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16721**

**FIRE ALARM SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16721, FIRE ALARM SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK -.

B. The Work of SECTION 16721, FIRE GENERAL ALARM SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide, test, and place into operating condition an electrically operated, microprocessor based, UL listed, four-wire, analog/addressable, electrically supervised, Class “A” fire detection and evacuation system as indicated and specified.

B. The System shall include, but not be limited to: Fire Alarm Control Panels FACP or panels required for each building, remote annunciator panel, power supplies, fire alarm initiating and indicating devices including addressable monitor and control modules, fire alarm dialer, fire alarm radio communicator, interfaces to building sprinkler system, conduit, wire, fittings, and accessories required to provide a complete operating system. All devices and units shall be located in accordance with the Contract Drawings.

C. The fire alarm system shall be tied into the Town of Orleans, Massachusetts Fire Alarm System Remote Monitoring Service provider via radio transmitted signal.

D. Provide radio fire alarm communicator hardware in accordance with the Town of Orleans Fire Department requirements. Provide radio Intellinet 7788F-ULP Series with accessories 7041E (Subscriber Handheld Programmer) and 7794 (IntelliPro Fire Full Data Module) or equal. Provide the main Fire Alarm Panel with compatible means to network with the specified radio communicator for full data reporting.

E. Prior to the installation of the system, the manufacturer of the system and system installer shall obtain from the Town of Orleans, an Application for Fire Alarm Service, and a copy of all local requirements and obtain all permits and approvals.

F. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1) Failure to include a copy of the marked-up specification sections will result in return of the entire submittal with no further review and consideration.

2. Submit installer and system supplier qualifications and list of three similar projects with name and phone number of contact person.
3. Provide a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop drawings shall contain complete wiring and schematic diagrams for the equipment furnished, riser diagrams with cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.
4. Submit manufacturer's printed installation instructions.
5. Submit a statement indicating that the battery size selected is a minimum of 125% of the provided system load. The specified limit shall include supervisory power requirements for all equipment, and alarm power requirements for all equipment.
6. Submit a statement indicating that voltage drop is within ratings of all devices.
7. Wiring diagrams from the fire alarm system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.
8. Spare Parts Data - Submit list of spare parts provided.
9. Operating and Maintenance Instruction Manuals:
    1) Operating instruction manuals, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features.
    2) Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.
    3) Performance Test Reports: Upon completion of the installed system the Electrical Subcontractor shall submit in booklet form all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.
10. Submit Certificate of Compliance, signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.
11. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1. Type of System

a. Fire Alarm System: The fire alarm system shall operate as a low voltage analog/addressable type system and shall automatically initiate fire alarm signals whenever any manual or automatic fire detecting devices are placed into an alarm mode. The system shall indicate areas of alarm and sound local alarms. Alarm signals shall be consistent throughout the building. Initiating loops and bell loops shall be wired as four-wire class A loops. All initiating loops and horn/light loops shall be complete with necessary switches, meters, relays, pilot lights, surge arresters and addressable modules as required. A minimum of one thermal cut-out or fuse and surge arrestor for every bell circuit shall be provided.

b. The system shall be capable of operating with a single break or ground fault condition in the initiating or alarm sounding circuits.

c. Evacuation Alarms: Coded evacuation alarm: A fire alarm signal shall be employed for notifying the occupants to evacuate. An annunciator shall indicate the specific location of the fire. The fire alarm system security provider shall be signaled automatically through the fire alarm radio reporting system.

d. Trouble Signals: During abnormal conditions such as an open wire or a ground fault, or where both conditions occur at one point, the system shall be capable of automatically transmitting clear, intelligible trouble signals.

e. Power Supply for the System: A dedicated branch-circuit for supplying power to the alarm system shall be provided for the Fire Alarm Control Panel (FACP). The branch circuits shall be automatically energized from an auxiliary electrical power system during failures of the normal power supply. Battery backup power shall be through use of rechargeable, sealed type storage batteries and battery charger.

f. The system shall interface to HVAC and fire sprinkler system, and other building systems as required by applicable codes to provide monitoring and control functions as described herein.

2. Network Communication

a. The network architecture shall be based on a Local Area Network (LAN), a firmware package which utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent.

b. There shall be no master, polling computer, central file computer, display controller or other central element.

c. There shall be no cascading of CPUs or master-slave relationships at the network level to facilitate network communications.

d. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations.

3. Sequence of Operation

a. When a fire-alarm condition is detected by one of the system's initiating devices, the following functions shall immediately occur:

1) All automatic programs assigned to the alarm point shall be executed and the associated indicating devices and relays activated.

2) All fire-alarm horns/strobes and beacons shall operate.

3) The system alarm on the Fire Alarm Control Panel and Remote Annunciator Command Center will indicate condition.

4) The Town Fire Alarm System Remote Monitoring Service provider shall be signaled automatically via transmitted radio signal.

5) Fan systems, i.e., shutdown, exhaust and pressurization operations to be initiated.

6) Auxiliary contact shall be provided to connect to facility PLC system to indicate fire alarm condition.

b. When a trouble condition is detected by one of the system's initiating or indicating circuits, the following functions shall immediately occur

1) System Trouble will be indicted on FACP and Annunciator Command Center.

2) A local trouble-sounding device in the FACP and Annunciator Command Control shall be activated. This sound shall be distinct from the alarm sound.

3) The appropriate message will appear on the LCD display at the FACP and Annunciator Command Center.

4) Auxiliary contact shall be provided to connect to facility PLC system to indicate system trouble.

C. Seismic Design Requirements

1. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900. SEISMIC AND WIND REQUIREMENTS.

**1.07 - QUALITY ASSURANCE**

A. Regulatory Agencies:

1. National Fire Protection Association (NFPA)

2. Underwriters' Laboratories (UL)

3. Massachusetts Electrical Code

4. Town of Orleans Fire Department

B. Standard Products: Material and equipment shall be the latest standard products of a single manufacturer regularly engaged in the manufacture of the product for the 5 years as a minimum.

C. Qualifications of the installer before commencing work: Submit information demonstrating that the supplier has successfully installed fire alarm systems of the same scope, type and design as specified.

1. Submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

2. Installer shall be qualified by the Underwriter's Laboratories to certify the complete system to be UL listed upon completion of the installation.

D. Nameplates: All components of equipment shall have the manufacturer's name, address, type or style, and catalog number on a plate securely attached to the equipment.

E. Tags: Tags with stamped identification number shall be furnished for keys and locks. Tags shall be furnished to identify cable and conduit runs, wiring circuits, and all spare parts.

F. Keys and Locks: All locks shall be keyed alike.

G. Onsite Technician Services

1. Provide the services of a representative or technician certified by the manufacturer of the system, experienced in the installation and operation of the type of system provided.

2. The representative shall be licensed in the State.

3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system, and Underwriters Laboratories listing certification requirements.

4. Provide services of the manufacturer's service representative during installation, startup and testing, for a period of three (3) working day(s) plus travel where a working day is equivalent to 8 hours.

5. Provide one person-day of vendor training.

**1.08 - REFERENCES**

A. NFPA-13 Standard for the Installation of Sprinkler Systems

B. NFPA-13A Recommended Practice for the inspection, Testing and Maintenance of Sprinkler Systems

C. NFPA-70 National Electrical Code (NEC)

D. NFPA-72 National Fire Alarm Code

E. NFPA-90A Air Conditioning and Ventilating Systems

F. NFPA Life Safety Code Handbook 94

G. Fire Protection Regulation 527 CML

H. UL Fire Protection Equipment Directory

I. Factory Mutual Systems Approval Guide

J. NFPA-1221 Public Fire Service Communication Systems

K. Underwriters' Laboratories (UL)

1. UL 1971, Standard for Visual Signaling Appliances

2. UL 864, Control Units for Fire Protective Signaling Systems

L. BOCA National Building Code and the BOCA Fire Code; Standard Building Code and the Standard Fire Code; Uniform Building Code, Uniform Fire Code or other State and Local Building Codes as adopted and/or amended by the Authority Having Jurisdiction (AHJ).

M. Department of Justice Rules for Building Accessibility by the Handicapped, and/or State and local equivalency standards as adopted by local AHJ’s.

N. Local requirements for the Town of Orleans, Massachusetts.

O. Massachusetts Electric Code.

P. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Simplex.

B. Honeywell, Inc.

C. Notifier.

D. Or approved equal.

**2.02 - MATERIAL AND EQUIPMENT**

A. Provide following system:

1. Provide an analog and addressable fire detection system. System shall be fully programmable at the FACP interface without the need for any external communication/programming device.

B. General Product Description:

1. The Fire-Alarm Control Panel (FACP) shall be capable of fire detection, equipment supervision and control, alarm management, and historical data collection and archiving.

2. The fire detection system shall have the following features:

   a. Analog/Addressable Devices

   b. Field programmability

   c. Individual ground fault annunciation

C. Communications

1. The FACP shall have sufficient memory to support its operating system and databases including:

   a. Fire management

   b. Alarm management

   c. Historical/Trend Data

   d. Maintenance Support Applications

   e. Custom Processes

   f. Operator/IO

2. Communication Ports: Provide data communication ports for simultaneous operation of devices such as industry standard printers, programming terminal, PC, transponder and annunciator.

3. Integrated On-Line Diagnostics: The FACP shall continuously perform self-diagnostics, communication diagnostics and diagnostics on all subsidiary equipment.

4. Surge and Transient Protection: Isolation shall be provided at all field point terminations to suppress induced voltage transients where required. Surge arrestors shall provide protection from all non-signal electrical surges that could cause damage to the equipment. Line surge arrestors shall be isolated from the electrical circuitry that they are protecting.

D. System Software Features:

1. All necessary software to form a complete operating system as described in this specification shall be provided.

2. The software programs specified in this section shall be provided as an integral part of the panel and shall not be dependent upon any higher-level computer for execution.

3. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. The control unit shall have capability of performing alarm analysis and signaling. At no time shall the panel's ability to report alarms be affected by operator activity.

4. Status Change Report: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

5. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided.

6. Report Routing: Alarm reports shall be archived for future recall.

7. Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.
8. The FACP shall be capable of storing a library of at least 900 events.
9. History Mode:
    a. The system shall be able to store and display at least 900 system events that have occurred in a non-volatile buffer memory.
    b. Display of these events shall be accomplished on-site through the use of the front control panel indicators and switches.
10. Field Configurable:
    a. The system shall be fully configurable and expandable without the need for EPROM programmers. All configuration shall be accomplished through downloading of programs from a computer.
    b. Reconfiguration shall not require knowledge of any programming languages or require any special training.
    c. All programs shall be stored in non-volatile memory.
    d. Entry into program mode shall require a special key and a special password entered into the front panel.

E. Analog Device Interface:

1. The Analog Device Interface will be capable of supporting devices as indicated on drawings with minimum of 25% spare capacity for future devices.
2. The analog addressable device interface shall contain its own microprocessor control.
3. The analog addressable device interface shall communicate and provide power to all devices on its loop over a single pair of wires. The fire-alarm system shall function as a Class A system.
4. The analog interface board shall receive analog information from all intelligent detectors and shall process this information to determine normal, alarm, or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.
5. Communication with all connected devices shall be performed every 5 seconds or less. Average time to detect an alarm shall be less than 10 seconds (longer for alarm verification detectors).

F. Notification Appliance Circuit:

1. The FACP shall provide supervised Class A notification circuits as indicated on drawings with 50 percent spare capacity for future devices. The circuit capacity shall be 2.0 amperes maximum per circuit, maximum of 8.0 amperes from the FACP's power supply. If a short-circuit trouble occurs on one of the circuits, it will not affect the operation of the remaining circuits.

G. Function Relays:

1. The FACP shall provide of Form "C" relay contacts, quantity as required, rated at 2 A at 120 VAC. These relays may be programmed to activate on alarm from any initiating zone or any combination of initiating zones, analog devices or addressable modules.

H. Central Processing Unit (CPU)

1. The CPU shall communicate with the operator interface, LCD display, LED display and control all other modules in the panel. Removal, disconnection or failure of any control panel shall be detected and reported by the Central Processing Unit.

2. The CPU shall contain and execute all control-by-event programs for specific action to be taken if a fire situation is detected in the system. Such control-by-event programs shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs. The CPU shall also provide a real time clock for time annotation on the display and remote optional printer.

I. Operator Display

1. The operator display shall provide all controls and indicators used by the system operator. The display shall contain, and display as needed, custom alphanumeric message for all intelligent detectors and addressable modules. Such message information shall be stored in programmable non-volatile memory.

2. The display board shall provide an 80-character alphanumeric Liquid Crystal Display (LCD). It shall also 24 LEDs for system indication such as AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; ACKNOWLEDGE; SIGNAL SILENCE, etc.

3. Factory programmable system indications and keys shall be available for unique functions. Keys shall be referred to as “Hot Keys”.

4. The Display Interface shall provide a 15-key touch keypad with control capability to command all system functions, and entry of any numeric information. The keypad shall include means to enter a minimum of two different passwords to prevent unauthorized manual control.

5. Ground fault indication shall be displayed on a system and initiating zone basis.

J. Communications Ports

1. The system shall provide the following interfaces:

a. One port for remote annunciator command center

b. One port for Central Station/Town-tie connection

c. One port for service and field programming

d. One port for Printer

K. Mechanical Design

1. The Fire Alarm Control Panel (FACP) shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include an opening for viewing.

2. The FACP shall be modular in structure for ease of installation and maintenance.

L. One Person Test Feature

1. The control unit shall include a special one-person test feature, which will allow a single person to test all initiating devices and indicating appliance in a system without returning to the panel to reset the system. A special password shall be required to enter the test mode. The service-technician shall be able to re-select the initiating and indicating circuits that are to be included in the one-person test mode. The Walk-Test shall include a special audible indication that a trouble has been detected on an analog device, for the service-technician to check proper system wiring.

M. Provide addressable monitor modules to interface manual FACP to stations, sprinkler system pressure switches, and other detection components as required.

N. Provide isolator modules in addressable loops between groups of devices in a loop to isolate short-circuit problems to within a section of a loop. The module shall be capable of being mounted in a 4 x 4 x 2 1/8-inch junction box.

O. Fire-Alarm Initiating Devices

1. Addressable Devices: All addressable detectors shall:

   a. Provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

   b. Provide address-setting means on the detector head using rotary decimal switches. The detectors shall also store an internal identifying code which the FACP shall use to identify the type of detector.

   c. Provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

   d. Include a twist-lock base.

2. Addressable pull stations shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. All operated stations shall have a positive, visual indication of operation and utilize a key type reset. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Mount stations inside a red, weatherproof enclosure with a clear polycarbonate hinged front cover where station is indicated on the drawings as NEMA 4, NEMA 4X and hazardous areas.

3. Beam Smoke Detector shall be provided as indicated on the Contract Drawings and shall consist of infrared light beam based transmitter/receiver unit and a reflector mounted on the opposite wall. The Beam Smoke Detector shall be provided with a reset device.

4. Analog/Addressable Thermal Detectors: Thermal detectors shall use an electronic sensor to respond to temperatures exceeding 135 deg. F or 190 deg. F as noted on the plans. Sensing elements shall be replaced without removing the detector base. The detector shall, on command from the control panel, send data to the panel representing the analog temperature level. These addressable detectors shall connect with two wires to one of the control addressable input circuits.

5. Thermal detectors provided in NEMA-4 and NEMA-4X areas shall be rate compensation type as manufactured by Edwards Series 302, Honeywell Series 302 or approved equal.

6. Each detector shall be provided with a steel mounting plate, and the entire unit shall mount on a double gang electrical box.

7. Sprinkler System Pressure and Tamper Switches: Furnish and wire addressable monitor modules to send signals to the FACP for monitoring of sprinkler system flow and pressure tamper switch operation where indicated on drawings.

8. Provide devices to match the NEMA ratings indicated within the Area Classification Schedule on the Contract Electrical Drawing 00 E-601.

P. Fire Alarm Indicating Devices

1. Visual appliances shall be installed as shown on the drawings in accordance with the requirements of the U.L. 1971 standard and NFPA 72. Where multiple visual signals are visible from any location, circuitry shall be incorporated for the synchronization of the flash rate.

   a. UL 1971 Listed for Emergency Devices for Hearing Impaired in all public mode installations.

   b. Strobes shall meet UL 1971 flash rate.

c. All visual signals shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.

d. The strobe intensity shall be rated per UL 1971.

e. The strobes shall be available for semi-flush or surface mounting and in conjunction with audible signals as required.

2. Alarm Horns: Audible evacuation signals shall be furnished and installed as shown on the drawings meeting the following requirements:

a. Audible Notification appliance shall be electronic and use solid state components.

b. Each electronic signal shall provide four (4) field selectable alarm tones. The tones shall consist of slow hoop, continuous, temporal or interrupted.

c. The device shall provide U.L. dBA measurement at 10 feet shall be a minimum of 85 dBA for separately mounted audible signals.

d. The device shall have provisions for standard reverse polarity type supervision and in/out field wiring using terminals that accept #14 AWG wiring.

3. Audiovisual Alarm Horns: Audiovisual Alarm Horns shall have a high intensity flashing light and alarm horn as an integral unit. Both audio and visual components shall operate from the 24 volt dc polarized indicating circuits. The horn assembly shall be housed in a rugged, die-cast enclosure, and the electronic light source shall be sealed in silicone and protected by a Lexan lens. The word FIRE shall appear on the lens. Audiovisual alarm devices shall meet the requirements of visual appliances and alarm horns above. Single and/or dual projectors shall be supplied as shown on the plans.

4. In NEMA-4 and NEMA-4X areas provide weatherproof rated indicating devices or devices enclosed in weatherproof enclosure with clear Polycarbonate front cover.

Q. Power Supply

1. The power supply for the FACP and fire alarm peripherals shall be integral to the FACP. The power supply shall provide FACP and peripheral power needs.

2. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs.

3. Input power shall be 120 VAC 60 Hz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be sized as required to meet system requirements.

4. The main power supply shall provide a battery charging circuit consisting of a fully automatic standby battery charger, rate compensated, capable of maintaining battery in fully charged state and be capable of recharging batteries to 70% of alarm capacity within 12 hours. Provide for normal operation of entire system for 24 hours with power remaining to sound alarms for 5 minutes.

5. Provide charger with the following supervised functions: circuit protection for shorts, open, disconnected or reversed polarity battery connection, supervision or protection of high or low voltage, overcharging and charger failure. Automatic load shedding or battery disconnect on deep discharge to prevent battery damage.

6. Batteries shall be 24 V, rechargeable, gelled electrolyte, totally sealed, fully charged with al interconnections ready for service, maintenance free, long-life.

R. Wiring: Wiring shall be in accordance with NFPA No. 70 and as indicated. All wiring shall be color coded.

S. Remote Annunciator Command Center

1. The remote Annunciator Command Center shall be an 80 (4 x 20) character back-lit LCD type capable of displaying up to 3200-point messages. The remote annunciator shall have the capability of driving up to 576 LEDs for future graphic notification. They shall be sixteen switch inputs that can be used for various system functions; lamp test, trouble silence, general alarm, scroll, system reset, network reset, etc. All fire-alarm controls shall be operational from the Annunciator Command Center.

2. The remote annunciator shall have non-volatile memory. Annunciators which rely on the FACP for memory will not be accepted.

3. The remote Annunciator Command Center shall be flush mounted with switches located with a locked panel, and easily visible through a glass or plastic viewing plate. Panel door shall have a keyed lock identical to the lock on the main fire alarm control panel (FACP).

T. Duct Mounted Smoke Detectors:

1. Furnish and install all duct mounted addressable type smoke detectors in accordance with NFPA 90A and 72. Detectors shall be 4-wire, addressable, Class A. Duct mounted smoke detectors shall be of the self-contained ionization type used for duct mounting rated for the air speed to be encountered in the duct, and with sampling tube and box assembly. Each smoke detector shall be provided with double pole, double throw alarm contacts. The locking cover box shall house a POWER ON light, an alarm indicator light, a reset switch, and a detector, all prewired ready for final wiring connections. Sampling tubes shall extend the full width of the ducts in which they are mounted. Each smoke detector shall be provided with remote test station capable of reset and detector status and alarm test function. Smoke detectors shall be as listed by the U.L., Inc. When any one of the smoke detectors is activated it shall:

e. Activate a visual alarm at the smoke detector and a visual and audible alarm at fire alarm system.

f. Close relay dry contracts wired to its associated temperature control panel terminal strip, to close a remote alarm.

**2.03 - SPARE PARTS AND SPECIAL TOOLS**

A. Provide one spare FACP mother board and two (of each type provided) of the following:

1. Pull Stations
2. Manual Pull Stations
3. Smoke Detectors
4. Thermal Detectors
5. Alarm Horns
6. Alarm Strobes

B. Three sets of special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps for each type shall be furnished. Spare parts shall be listed on submittal list.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Install fire alarm system as indicated on the drawings, in accordance with the manufacturer's diagrams and printed instructions, except where otherwise indicated.

1. Wiring: Wiring for systems shall be installed in rigid conduit, as specified in Section 16110: ELECTRICAL RACEWAY SYSTEMS.

2. External wiring between the control panel and the stations and horns/lights shall connect to terminal strips in accessible locked cabinets. Connections to the terminal strips shall be made with terminal spade lugs or with approved type terminal blocks. Terminal cabinets shall be installed at each point where a station circuit riser originates or any point along a circuit where a tap is made. The conductors for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit. Gutter space to accommodate all necessary wiring shall be provided.
3. Panels: Panel enclosures shall comply with the requirements of UL 864. Enclosures having doors over 48 inches in height shall be provided with a three-point catch and lock; all other doors shall contain a cabinet type cylinder lock. Inserts shall be blind fastened so that no screws show on the panel front.
4. Detectors: Detectors shall be installed in accordance with manufacturer's printed instructions.
5. All wiring for the system shall be in accordance with Massachusetts Electric Code.
6. Provide complete wiring and conduit between all equipment. All devices shall be mounted upon UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.
7. All junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings.
8. Fire Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled “FIRE ALARM.”

**3.02- PERMITS AND CERTIFICATIONS**

A. Obtain all required local permits.

1. Provide UL certification of the installation.

**3.03 - FIELD TESTING**

A. Notify the Owner 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Owner or his authorized representative. Furnish all instruments and personnel required for the tests. Tests shall be conducted for the following:

1. Verify that the system is free of grounds or open circuits. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. The FACP shall indicate when a ground or open circuit exists.
2. All alarm initiating devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
3. Verify that all strobes, horns, stations, transmitters, automatic detectors and supervisory devices are functioning as specified.
    a. Strobes and horns shall deliver the correct foot-candle and sound pressure levels decibels of the specified device.
    b. Stations shall close the circuits specified and deliver specified alarm codes.
    c. Automatic detectors shall actuate the specified zones when the appropriate fire or smoke conditions are generated. The detectors shall be exposed to actual smoke used to simulate this test on each and every smoke detector as located in the building; no other test will be accepted.
    d. Panels and supervisory devices shall display and control functions as specified. Loss of AC system power shall also be tested.
    e. Radio communication of alarms to the Town fire alarm security provider shall be demonstrated and documented.

B. System tests to be performed under the supervision of the fire alarm system contractor's qualified representative and the local fire authority.

C. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance-inspector, shall be corrected.

D. Perform all tests to verify the correction of any defect found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform all required work and retest the system.

**3.04 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16724**

**SECURITY ALARM SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16724, SECURITY ALARM SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16724, SECURITY ALARM SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide and test a complete security detection and alarm system as indicated and specified. Contract Drawings contain plan and riser diagrams showing the location and type of all alarm points and equipment.

B. The security alarm system shall monitor the integrity of all alarm initiating circuits and shall be provided with automatically charged standby batteries to maintain system operation for 4 hours in the normal supervisory mode plus have sufficient capacity to operate in the alarm mode for 15 minutes at the conclusion of this supervisory time period. Batteries shall be supervised for connection to the system and a low voltage threshold. The automatic battery charger shall be capable of charging fully the discharge system batteries to 100 percent in 8 hours.

C. All equipment and components shall be Underwriters Laboratory (UL) listed.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings in conformance to UL 1076 and UL 681 and consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts and battery sizing calculation.
2. Submit complete system wiring schematic diagrams and point to point wiring diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that system has been coordinated and will properly function as a unit.
3. Provide a list of recommended spare parts.
4. Provide Operating and Maintenance Instruction Manual.
5. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed to prove compliance with specified performance criteria including final position of controls.
6. Provide a final as-built system wiring diagrams.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with Section 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Sequence of Operation

1. Door or window entry will be annunciated at the control panel and will initiate a remote alarm to Distributed Control System. Keypad bypass switches shall be provided at all doors.

D. Service

1. The equipment manufacturer shall have a local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

**1.07 - QUALITY ASSURANCE**

A. Standard Products: Material and equipment to be the latest standard products of a manufacturer regularly engaged in the manufacture of the products.

B. Nameplates: Major components of equipment to have the manufacturer’s name, address, type or style, and catalog number on a plate securely attached to the equipment.

C. Tags: Tags with stamped identification number to be furnished for keys and locks and all spare parts furnished for the Authority’s stock to maintain the system. Furnish and install tags to identify cable and conduit runs and wiring circuits on the installed system.

D. Keys and Locks: Key all locks alike.

E. Accessibility: Provide enclosures with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, provide the units installed in a single cabinet large enough to accommodate all units, and allow ample gutter space for interconnections of panels and field wires.

F. Verify that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation.

1. Provide Services of Service Technician, specifically trained on type of equipment specified.

G. 1.09 - SEISMIC DESIGN REQUIREMENTS

1. Conform to the requirements indicated on the structural drawing S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

2. It shall be the responsibility of manufacturer and supplier along with the Electrical Contractor to conform to the seismic design requirements for this project and for the work of this specification section.

**1.08 - REFERENCES**

A. National Fire Protection Agency (NFPA)

1. NFPA 72: National Electrical Code (NEC)

B. Underwriter's Laboratories, Inc. (UL).

1. UL 1076: UL Standard for Safety Proprietary Burglar Alarm Units and System.

2. UL 681: UL Standard for Safety Installation and Classification of Mercantile and Bank Burglar Alarm Systems.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 - PRODUCTS**

**2.01 - MANUFACTURERS**

A. Robert Bosch, Inc. ON, Canada.

B. Honeywell, Inc., S. Minneapolis, MN.

C. Tyco Simplex Grinnell, BC, Canada.

D. Or equal

**2.02 - ALARM SYSTEM OPERATION**

A. The system shall be comprised of ten zones. Zones shall be programmable for Instant, Delay, Day Supervisory, Silent, Priority (non shuntable). Loop Response Time shall be programmable. System shall detect faulty read only memory (ROM) on power up. System shall be continually supervised by a watch dog Microprocessor Timer.

B. The system shall be armed, disarmed, reset, monitored and altered by the use of the system main keypad. The system shall provide fail safe arming preventing arming of the system if a zone has been violated or is not fully closed. System shall indicate which zone has door(s) not fully closed.

C. Actuation of any device shall cause the following to occur.

1. Sound the interior audible device at the Control Panel.

2. Activate the built-in digital telephone dialer or communicator, seize the protected premises telephone line and automatically report the alarm to a remote location.

3. Indicate the alarm condition at keypads.

D. Acknowledgment of alarms or troubles, in conjunction with interrogation of other systems activity (i.e. alarm memory, bypassing of zones, etc) shall require the use of a Personal Authorization Code (PAC) number to be entered in the keypad.

E. Up to ninety (30) user PAC codes can be utilized with the system. Programming of these codes shall be field programmable into EEProm memory without the use of any special programming tools (i.e. Prom burners or factory programming methods). Programming will occur through the systems digital remote keypad. A user programming code will be required to make such changes. The remote keypad shall provide a means to verify programmed instructions through binary information displayed by the system’s status indicators. No special displays or other associated hardware will be permitted to review program contents. Power outages or complete battery discharge shall not affect programmed field instructions.

F. Provide capability for all door entrances to be programmable for exit/entry time delays (1 to 255 seconds), providing a warning tone when in the timing sequence. All other system contacts shall provide an instant alarm if system has been armed and in the timing sequence.

G. During a daytime disarmed condition, all door or window switches or any initiating alarm appliance shall be indicated through the system status indicators if in alarm condition. If the panel is armed these appliances will actuate the control, sound the signals and alert the monitoring station through the built in communicator.

H. Signal cut off time shall be programmable from 1 to 255 minutes.

I. The panel shall contain a daytime disarmed supervisory mode. It shall be configurable to either provide a latching or auto-restore mode of operation. With this function any zone that is violated will provide local annunciation without sounding the signals or activating the communicator. If in the auto-restore mode, the keypad sounder will activate and restore when the contact is open then closed. If in the latching mode, the keypad will sound until reset from the keypad with the PAC code. A SPDT relay will be provided in the control to activate auxiliary sounding devices.

J. The system shall incorporate a door strike output timed or toggled (on/off) to provide either automatic timed entrance when disarmed or manual activation through the keypad with PAC number.

K. System alarms shall be retained in EEProm memory until reset using the PAC number. Complete power outage shall not affect alarm memory recall.

L. An auxiliary beacon at the front door shall be provided when system is alarm.

M. The system shall include the following features as a minimum.

1. Supervised monitoring of all indicating appliance wiring both in the daytime or bypassed condition.
2. Separate alarm, trouble, bypass, ready to arm and secure indicators at each keypad control station. Keypads shall be flush mounted.
3. Dead front design control panel/with all indicators and control switches located behind a locked door.
4. Automatic transfer to standby batteries upon power failure.
5. Inclusion for a digital dialer compatible with Owner's requirements and all major receivers including Adcor; Ademco; Franklin; Osborne; Hoffman; Radionics; Sescoa; ADT; Silent Knight and Varitech.
6. Watch dog microprocessor monitoring.
7. Fully field keypad programmable EEProm memory.
8. Dynamic 24 hour battery load test.
9. Continuous monitoring of fuses for auxiliary voltage outputs.
10. Six stage lightning protection.
11. Shunt by zone from keypad.
12. Zone auto shunt or auto/restore after alarm.
13. Retained alarm memory.
14. Digital communicator shall be approved to comply with applicable FCC codes. Unit shall feature either pulse or touch tone dialing. "Call Waiting" tones shall not prevent proper operation. The following communicator parameters shall be programmable from the keypad and not require either Prom burners or other factory programming methods.
    a. Report by zone.
    b. Single or two line extended reporting.
    c. Two account codes.
    d. Split reporting.
    e. Opening and closing reports by user codes.
    f. Closing ring back.
    g. Restoral reporting.
    h. Programmable abort.
    i. Supervisory reporting of all trouble conditions.
    j. Programmable delay before dialing.

k. Programmable dial attempts.

l. Programmable delay between dial attempts.

m. Programmable test reporting for intervals of 12 hours up to 7 days.

n. Shunt by zone reporting.

o. AC failure and AC restoral reporting.

p. Low battery and battery restoral reporting.

q. Memory error reporting.

r. Listen in capabilities.

15. Bell test on arming.

16. Auxiliary light output during alarm conditions.

17. Door strike output either timed or keypad accessible.

18. Keypad tamper.

19. Uploading of memory contents available to IBM PC compatible host.

20. Provide optional cellular telephone service as back-up system should phone lines be interrupted.

21. Output contacts to transmit a signal to the General Alarm Panel.

22. Output contacts to transmit a signal to the Distributed Control System.

**2.03 - ALARM SYSTEM COMPONENTS**

A. System shall include a local security alarm control panel with alarm indicating lights, door switches, window detectors, motion detectors, key pad by-pass switches, power supply, conduit, and wiring. Quantity of contacts to be monitored as required.

1. Provide multi-zone control panel surface mounted as indicated.

2. Control panel shall have built-in battery backup and shall provide up to 900 mA power auxiliary devices. Voltage shall be regulated at 13.8 VDC. Automatic system shutdown will occur at 7.5 VDC to prevent false alarming.

3. During alarm condition sup to 3.0 Amps of power shall be available to drive sirens and auxiliary functions.

4. Control panel shall be provided with a two sound siren driver.

5. Control panel shall be listed UL Commercial Grade A Local Burglar, Grade B and C Central Station Burglar. Unit shall be provided with a Simplex; Honeywell; Johnson & Controls or equal, attack proof enclosure featuring heavy gauge/welded seam construction and be provided with two tamper switches to supervise front and rear tampering.

6. Provide zone expander module permitting the connection of 3 N/O zones in addition to the basic eight zones.

7. Provide equipment and enclosures to comply with National Electric Code including Hazardous Locations, Class, Division, and Group as indicated on Contract Drawings.

8. Keypads - Provide weatherproof keypads as indicated. Keypads shall be provided with a built in sounder for audible system signaling. Keypads are not to be externally mounted unless mounted in weatherproof enclosures. Keypads shall operate via multiplex communications to provide total system indication and access code authorization over four conductors.

9. Door/Window Contacts/Switches - Provide UL listed magnetic flush mounted contacts and magnets. Each contact shall be provided with matching magnet. All contacts shall be hermetically sealed for long term 10,000,000 cycle contact. Switch contacts shall be of the reed blade type with rhodium plating eliminating cold-welding; sticking and resistance build-up. All switches shall be 100 percent factory tested prior to installation.
10. Outside High Powered, Weather Resistant, Siren Speaker - Provide, as indicated, weatherproof 30 Watt Siren Speaker. Unit shall feature 125 dB at 10-ft. sound output and shall be provided with N/C tamper loop to supervise against removal.
11. Outside Tamper Resistant Weatherproof Enclosure - Provide tamper resistant enclosure provided with two tamper switches to supervise against front cover and wall mounting.
12. Glass Break Detectors - Provide UL listed Glass Break Detectors as indicated. Units shall feature state of the art, thick film technology and be of the solid state Piezo electric glass break detector type. Device type shall contain discriminating circuits that detect only the specific mechanical ultrasonic frequencies generated by breaking glass. Sensors shall protect a 10-ft. radius of glass area. Sensors shall be of the N/C variety and shall each feature a latching LED to indicate the appropriate detector in alarm.
13. Provide programmable timers for entry delay, exit delay, access, alarm cut-off, and audible output.
14. Provide zone alarms which are selectable as instant or delay.
15. Electronics provided with memory to retain arm and disarm status and alarm memory.
16. Microprocessor monitoring circuit shall be provided.
17. Lightning and surge protection devices shall be provided.
18. Provide resonating type sounder device for the annunciation of an alarm condition at the panel.

B. Provide touch tone digital communication device with primary and secondary dialing capability.

C. Size and type of wire for the systems shall be as recommended by the system supplier.

**2.04 - SPARE PARTS**

A. Provide recommended spare parts list.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide security system complete and operating as indicated and specified. Provide all equipment, wiring, conduit and outlet boxes required for the installation of a complete and operating system in accordance with applicable codes, the manufacturer's recommendations, as indicated and this Section. All wiring shall be a completely separate conduit system. Color coded wires shall be used throughout. Wiring shall conform to the National Electrical Code.

B. Devices and Panel: Install security alarm devices and panel in accordance with manufacturer's printed instructions.

**3.02 - FIELD TESTING**

A. Provide checkout, field and functional testing to verify all features of the system are fully operational.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16761**

**VIDEO SURVEILLANCE SYSTEM**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16761, VIDEO SURVEILLANCE SYSTEM is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16761, VIDEO SURVEILLANCE SYSTEM, requires the Subcontractor to perform all Work specified under this section.

### 1.01 - DESCRIPTION

A. Provide and test a fully-integrated Video Surveillance System to accomplish the specified access control and monitoring functions.

B. Include all system design, configuration, programming, installation, wiring, electrical service, connection to the monitoring system, mounting hardware, appurtenance, and testing necessary for a fully functional Video Surveillance to meet operational requirements.

C. Provide and test all wiring and cabling required for the Video Surveillance System to operate in compliance with the specified requirements. Include system component installation, interfacing equipment items, and interconnecting wiring.

D. Provide all software, hardware, devices, workstations, power supplies, accessories, wiring, special cables, training, and support required for the specified system operation.

E. Provide all required electrical work in accordance with Division 16.

F. Provide specific design with detail drawings and associated documentation extending the general requirements specified into a complete and operating system.

G. Connect, test, demonstrate and commission all system hardware, software, and system controls.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Provide Bill of Materials with manufacturer catalog cut sheets that are clearly annotated to show which devices and options are being submitted.

2. Provide CCTV control panel dimensional drawings and panel elevations showing component layouts. Drawings shall be to-scale.

3. Provide control panel wiring schematics clearly indicating all required field wiring.

4. Indicate all components and network topology. Include the following as a minimum:

   a. Overall system block diagram, hardware placement, rack and equipment panel arrangements and layouts.

   b. A functional description of the block diagram. Describe the overall system operation, interaction between system elements, and system operator interactions.

   c. Include the manufacturer’s name and model number for each hardware item shown on the block diagram, as well as auxiliary equipment such as power supplies.

   d. Include a system architecture drawing showing the system controller, monitors, recorders, cameras and point-to-point connection diagrams showing cable types and device terminal numbers; layout drawings for the control consoles, including front, side and plan views with all components identified; and pole, pole base and mounting bracket detail drawings.

   e. Include web-based connections between facilities on system architecture drawings.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified.

D. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. System Description

   1. Work includes furnishing, calibrating, adjusting, testing, documenting, and start-up of a complete video surveillance, recording, and access control system.

   2. Provide equipment for a complete and operational system.

   3. Provide system architecture as shown on Contract drawings.

   4. Provide electrical and communications wiring and installation required for a fully functional system. As part of the system, provide all appurtenance, including electrical service and mounting hardware to make the system complete, including all duct banks, CCTV camera poles, conduit and wire, and transformers required for the CCTV system.

**1.06 - QUALITY ASSURANCE**

A. Standard Products: Material and equipment to be the latest standard products of a manufacturer regularly engaged in the manufacture of the products. All equipment shall be new. Provide quality assurance in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL.

B. Accessibility: Provide enclosures with ample clearance to allow proper separation between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, provide the units installed in a single cabinet large enough to accommodate all units, and allow ample clearance for interconnections of panels and field wires.

C. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation. Services of Service Technician specifically trained on type of equipment specified. Person-day requirements listed exclusive of travel time.

1. Assist in location of devices, methods of mounting, and field erection -2 person-day
2. Start-up and testing -2 person-day
3. Person-day is defined as one 8-hour day, excluding travel time.

**1.08 - REFERENCES**

A. Underwriters Laboratories (UL).

B. American National Standards Institute (ANSI):

1. ANSI C136.3 – Roadway Lighting Equipment-Luminaire Attachments.

C. American Society for Testing and Materials (ASTM)

D. National Electrical Manufacturers Association (NEMA).

E. Electronic Industries Association (EIA).

F. National Electrical Code (NEC).

G. Massachusetts Electrical Code.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**PART 2 – PRODUCTS**

**2.01 - CCTV CAMERAS**

A. Provide quantities of cameras at locations shown on Contract drawings.

B. Provide CCTV Cameras with:

1. Pan/tilt drives and weatherproof housing.
2. Hardware for building and pole mounting.
3. CCTV infrared illuminators.
4. Power over Ethernet (PoE).

C. CCTV cameras shall continuously monitor:

1. WWTF entrances and exits.
2. WWWTF main site entrance gate.
3. Locations as indicated on Contract electrical drawings.

**2.02 - CONTROL PANELS**

A. Provide CCTV Control Panels (CCTV CPs) as indicated:

1. Waste Water Treatment Facility CCTV Control Panel (CCTV-CP.10-1)

B. Provide 120VAC rated, UL listed Control Panel with:

1. Uninterruptable power supplies (UPS) to supply standby power to entire camera, monitoring and recording system. UPS shall be sized to provide 15 minutes of operation time upon loss of normal power.

2. Surge Protection Devices (SPD)

3. Power supplies as required for CCTV system devices

**2.03 - CCTV WORKSTATION**

A. Provide a dedicated CCTV Monitoring Workstation at the Waste Water Treatment Plant Control Room (RM 116).

B. Provide CCTV Display Monitor:

1. Flat Screen CRT display monitor with minimum viewable image size of 19.8 inches.

2. 300 cd/m2 minimum brightness.

3. Digital on-screen controls.

4. Maximum resolution of 1600x900@85Hz or better.

C. Provide CCTV Monitoring Workstation with:

1. Flat Screen CRT display monitor with minimum viewable image size of 19.8 inches.

2. Video management software

3. Video storage

4. Programmable automatic controls for CCTV equipment.

5. System software capable of web-based monitoring of remote facility CCTV camera feeds.

6. Power supply: 110 VAC, 60Hz. Power cords supplied.

7. Audio: 1-channel (line in or microphone in, line out).

**2.04 - WIRE AND CABLE**

A. Provide wire, cable and raceways in accordance with Div. 16 requirements and in accordance with SECTION 16120 – ELECTRIC WIRES AND CABLES.

1. Communications cabling and ancillary components necessary to provide a complete and functional system.

a. Links between CCTV-CP.10-1 (Network Rack) cameras shall be Ethernet.

b. Provide web-based link for the CCTV camera system to allow remote viewing.

**PART 3 – EXECUTION**

**3.01 - EXAMINATION**

A. Inspect facility that is to be monitored by this Section.

**3.02 - INSTALLATION**

A. Configure, install, interconnect, and test all system equipment as specified.

B. Provide all labor, materials and equipment necessary to furnish and install the CCTV System as specified.

C. Install in accordance with the manufacturer's instructions and locate equipment as indicated, unless otherwise directed.

D. Installation shall be in accordance with the Massachusetts Electrical Code.

E. System Grounding: Isolate video components from multiple grounds by use of insulating spacers, nylon camera mounting bolts, and electrical tape around coaxial splices.

F. Provide terminal blocks for all necessary interconnecting wiring. Secure all cable bundles with cable ties. Provide support bars in enclosures for cable bundles.

G. Label all indicators, switches, monitors, jacks and controls. Permanently tag all cables with wire markers covered with clear heat-shrink tubing.

H. Terminate spare equipment outputs with appropriate terminators.

I. Provide continuous wiring between equipment or junction box terminals.

**3.03 - ADJUSTING**

A. Conduct process operational assistance for each system component as placed into service.

**3.04 - DEMONSTRATION**

A. Provide start-up services, include programming required to make the system fully functional, energizing all equipment, testing each camera, testing viewing and recording system, and fully demonstrating each component of the system.

B. Start up

1. Inspect each System for conformity and compliance of materials, equipment and construction.

2. Adjust all control components to provide stable control of System.

**3.05 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16900**

**ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT**

**(Filed Sub-Bid Required)**

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## PART 1 - GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Control and Miscellaneous Electrical Equipment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

### 1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data, brochures including wiring diagrams in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Wiring diagrams to show control interface points provided with other equipment.

3. Shop drawings to include:
    a. Outline drawings with elevations.
    b. Equipment arrangement drawings.
    c. Anchor bolt location drawings.
    d. Electrical schematics and wiring diagrams.
    e. Electrical fuse/circuit breaker characteristic.
    f. Equipment performance curves and technical data.
    g. Bill of installation/assembly materials.
    h. Equipment weights.
    i. Completed manufacturer’s data sheets.
    j. Assembly sizes and weights.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - REFERENCES**

A. Underwriter's Laboratories, Inc. (U.L.):
    1. UL-467: UL Standard for Safety, Grounding and Bonding Equipment.
    2. UL-489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
    3. UL-823: Electrical Heaters for Use in Hazardous (Classified) Locations.

B. National Electrical Manufacturers Association (NEMA):
    1. 250: Enclosures for Electrical Equipment (1000 volts maximum).
    2. ICS 1: General Standards for Industrial Control and Systems.
    3. ICS 2: Industrial Control Devices, Controllers and Assemblies.
    4. ICS 4: Terminal Blocks for Industrial Use.

C. American Society for Testing and Materials (ASTM) Publications:
    1. D 178: Specification for Rubber Insulating Matting.

D. National Fire Protection Association (NFPA):

1. NFPA-70 National Electric Code (NEC).

E. Massachusetts Electric Code.

**1.08 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on Structural Drawing 00-S-001 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

**1.09 - DESCRIPTION**

A. Provide and connect the electrical control equipment and miscellaneous electrical equipment, including such instruments and devices indicated and specified. Device enclosures for electrical equipment shall comply with the requirements of Massachusetts Electric Code including Hazardous Locations, Class, Division, and Group as indicated.

**PART 2 - PRODUCTS**

**2.01 - ACCEPTABLE ELECTRICAL DISTRIBUTION MANUFACTURERS**

A. Allen-Bradley.

B. General Electric Company.

C. Cutler-Hammer.

D. Square D Company.

E. Appleton Electric Company.

F. Crouse-Hinds Company.

G. O-Z/Gedney.

H. Or equal.

**2.02 - ACCEPTABLE STAINLESS STEEL/GALVANIZED STEEL CHANNEL MANUFACTURERS**

A. Unistrut Corp.

B. Power-Strut.

C. B-Line Systems, Inc.

D. Or equal.

**2.03 - ACCEPTABLE FIBERGLASS CHANNEL MANUFACTURER**

A. Omnistrut, Champion Fiberglass.

B. Durostrut, Enduro Composite Systems.

C. Struttech, Entrum Industries.

D. Or equal.

**2.04 - SAFETY DISCONNECT SWITCHES**

A. Provide heavy duty type, safety switches, with external operating handles, 3 PST, rated 600 volt, 60 Hertz with ampere rating as indicated, and having provisions for padlocking.

B. Provide rejection type fuses, 600 volts, 200,000 A.I.C., dual element, time delay, Class RK-5.

C. Heavy duty safety switches to be UL listed, and meet or exceed NEMA Standard KS1.

**2.05 - PUSHBUTTON AND SELECTOR SWITCH STATIONS**

A. Provide RUN-OFF-REMOTE (ROR) switches, start-stop, push buttons, tumbler switches and other accessory devices as necessary for the control of motors and other electrical equipment or devices as indicated where shown on the wiring schematics and/or plan drawings.

B. Provide pushbutton and selector switch stations made for heavy-duty service and with momentary or maintaining contacts as indicated or as necessary for starting and stopping of equipment with 10 amp contact ratings.

C. Acceptable manufacturers of heavy-duty switches and pushbuttons are Square D, Cutler-Hammer, Allen Bradley or equal. Indicating lights to be led cluster type.

D. At stations provide nameplates with white letters on black background.

E. Provide explosion proof stations approved for use in Massachusetts Electric Code, Class I, Division 1, Group C & D areas. Stations shall also meet NEMA 4X area requirements.

F. Provide galvanized cast-iron enclosures for NEMA Type 4 watertight stations.

G. Provide fiberglass reinforced polyester NEMA Type 4X enclosures for stations located in highly corrosive areas. Provide gaskets and Type 316 stainless steel screws, to prevent entry of chemicals.

**2.06 - MANUAL MOTOR STARTERS**

A. Provide manual motor starters where indicated and for 120-volt, 60-Hertz fractional horsepower motors.

B. Provide each manual motor starter with overload heater or heaters of suitable capacity for motor-running over-current protection for motor it controls. Provide manual starters as single or 2 pole, as necessary, and with toggle mechanisms indicating OFF and ON positions. Provide manual starters with built-in HAND-OFF-AUTO switches. Provide enclosures as indicated.

C. Manual starters to be located within sight of motors, as defined by Massachusetts Electric Code.

**2.07 - WALL-MOUNTED COMBINATION STARTERS**

A. Unless otherwise indicated, provide each combination starter with motor circuit protector and full-voltage magnetic starter. Provide starters in an enclosure that meets the requirements of the enclosure schedule. Provide motor circuit protectors and starters as specified in SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS.

B. Indicating lights shall be LED cluster type, heavy-duty, oil-tight units. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.

**2.08 - CONTROL PANELS AND ELECTRICAL ENCLOSURES**

A. Provide enclosures with back panels constructed of at least 14 gage steel and provided with terminal blocks for connection of external wiring. Provide door and body stiffeners in panels over 36 inches in length. NEMA 4 and NEMA 4X panels shall be provided with hand operated quick disconnects of 316 stainless steel material.

B. Provide UL listed and NEMA rated pushbuttons, LED cluster type indicator lights and switches of heavy duty, oil tight types. Provide relays of industrial types, with 120-volt, 60-Hertz operating coils, and contacts rated for intended service. Power from fused control power transformers.

C. Provide nameplates for each panel and each device on panel. Nameplates of laminated plastic material, at least 3/32 in. thick, and with white letters on a black background.

D. Secure nameplates with self-tapping, Type 316 stainless steel metal screws.

E. Terminal Blocks:

1. Provide terminal blocks rated for 600 volts with screw type terminals.

2. Terminal blocks to be one piece with full barriers.

3. Acceptable manufacturers of terminal blocks are General Electric, Marathon, Weidmuller or equal.

F. Provide print pocket on inside of enclosure and include as-built drawings.

G. Where 480V AC and 120 VAC are required within the same enclosure, install components to insure separation of wiring for the panel voltage circuits.

H. Free standing enclosures shall be provided with light fixtures, light switch and 20 amp GFI protected receptacle. Light fixtures shall be UL listed for wet locations and provided with glass globe, metal guard and 100 watt incandescent lamp.

I. Where visual strobe or warning lamps are required, provide heavy duty beacon. Acceptable manufacturers are Edwards Signal Catalogue No. 93, Hubbell, Gamewell or equal.

J. Where audible horn alarms are required, provide from the following acceptable manufacturers: Edwards Signal 870P, Simplex, Faraday, or equal.

K. Where intrinsically safe wiring is required within the panels, the following requirements shall be met:

1. Within enclosures, conductors or intrinsically safe (IS) circuits shall be separated two inches from conductors of any non-intrinsically safe circuit. Within the enclosure the conductors shall be secured.

2. Intrinsically safe wiring shall not be routed in the same conduit as non-IS wiring.

3. Terminals in panels with IS wiring shall be identified in a manner that will prevent unintentional interference with the control circuits during testing and servicing.

L. All indicating lamps to be LED cluster type. Provide “Red” lights to indicate equipment on status. Provide “Green” lights to indicate equipment off status. Provide “Amber” to indicate alarm conditions.

M. Provide enclosures types to meet the requirement of the area classification schedule indicated on the Contract Electrical Drawings.

**2.09 - RUBBER MATS**

A. Provide insulating rubber mats conforming to ASTM D-178 Type I, Class I: Mats shall be 3 ft. wide and have a length equal to the equipment before which they are to be placed. Provide two spare mats, each 12-feet long as spares.

B. Provide mats for transformers, switchboard, panelboards, motor control centers, control panels, SCADA racks, Fire Alarm Panels and variable frequency drives.

**2.10 - CONTACTORS AND RELAYS**

A. Provide mechanically held, heavy duty industrial type contactors (relays) for lighting control, rated 30 amps, 600 volts, with number of poles as indicated.

B. Provide contactor in the required NEMA enclosure suitable for wall mounting. Provide circuit breaker or fuse protection on each ungrounded pole. Provide mechanically held contactor from the following acceptable manufacturers: Automatic Switch Company 917 series, Cutler-Hammer, Square D or equal.

C. Provide control power transformer with primary and secondary fuse protection. Control power to be 120 volts, single phase.

D. Provide solid-state, industrial grade timing relays from the following acceptable manufacturers: Allen Bradley Series 700, Cutler-Hammer, Siemens or equal.

E. Provide industrial grade relays, NEMA rated, from the following acceptable manufacturers: Square D Class 8501, Cutler-Hammer, Allen Bradley or equal.

**2.11 - NAMEPLATES**

A. Provide nameplates for equipment (including pushbutton and selector switch stations) listed in this Section to designate the equipment controlled and their function.

B. Nameplates shall be laminated black bakelite with one-quarter inch (1/4-in.) high, white, recessed letters. Securely attach to the equipment with Type 316 stainless steel screws, or rivets. Adhesives, glue or cements will not be permitted.

C. Provide all junction boxes, pull boxes, disconnect switches and control panels with a nameplate to designate the system wiring contained within.

D. Install nameplates in a location near or on the equipment or devices.

**2.12 - TERMINAL BLOCKS**

A. Provide terminal blocks in all terminal boxes panels, control and instrumentation cabinets/panels requiring terminations as indicated on drawings or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white wire markers.

**2.13 - CHANNEL**

A. Provide Type 316 stainless steel channel or fiberglass channel with corresponding accessories as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS and herein.

B. Provide hot-dipped galvanized after fabrication for steel channel and accessories.

C. Provide channel of the proper material to match equipment classifications, per SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

**PART 3 - EXECUTION**

**3.01 - CHANNELS**

A. Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas, NEMA 4 or 4X areas, and on below grade, outside building and structure walls.

B. Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed in Paragraph 3.02.A of this Section.

C. Install fiberglass channel in chemical areas with NEMA 4X enclosures.

**3.02 - PHYSICAL CHECKOUT AND TESTING**

A. Provide field and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

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**SECTION 16920**

**600-VOLT MOTOR CONTROL CENTER**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16920, 600-VOLT MOTOR CONTROL CENTER is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16920, 600-VOLT MOTOR CONTROL CENTER requires the Subcontractor to perform all Work specified under this section.

**1.01 - SCOPE**

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide 600-Volt Motor Control Centers as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

**1.02 - MEASUREMENT AND PAYMENT**

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Submit in accordance with SECTION 16050, ELECTRICAL WORK – GENERAL and SECTION 01300, SUBMITTALS and as specified herein.

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

B. Variable frequency drives (VFDs):

1. For VFDs installed integral to motor control centers submit a written statement signed by the VFD manufacturer that the VFD manufacturer has received the required information from each driven equipment manufacturer that the VFD is compatible with the driven equipment and is rated for the specified application. Statement shall certify that that the VFDs, motors and associated process equipment have been review and coordinated with the equipment selections.
2. Provide VFDs in accordance with SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES.
3. See Harmonic Analysis requirements per SECTION 16260 - LOW VOLTAGE VARIABLE FREQUENCY DRIVES.

C. Submit a Bill of Materials including manufacturer name, model number and quantities for all submitted components to be furnished.

D. Submit manufacturer's descriptive and technical literature, catalog cuts, installation instructions. Clearly annotate catalog cut sheets as to what options are being submitted.

E. Shop drawings shall contain wiring and unique and schematic diagrams for each compartment furnished, equipment layout, power cable termination material and size data, and any other details required to demonstrate that system has been coordinated and will function as a unit.

F. Shop drawings shall use equipment tags as provided on the Contract electrical, mechanical and instrumentation drawings.

G. Submit to-scale equipment elevations clearly indicated all device locations.

H. Submit catalog cut sheets and time versus current curves for each size of circuit breaker furnished.

I. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated on structural drawings.

J. Spare Parts Data: Provide a list of recommended spare parts.

K. Operating and Maintenance Instruction Manuals.

L. Performance Test Reports.

**1.05 - PRODUCT HANDLING**

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

**1.06 - DESIGN CRITERIA**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

**1.07 - QUALITY ASSURANCE**

A. Provide quality assurance in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 01400, QUALITY ASSURANCE.

**1.08 - REFERENCES**

A. Underwriters' Laboratories, Inc. (UL):

1. U.L. - 845: Standards for Motor Control Centers

2. U.L. - 1008: Standard for Automatic Transfer Switches

B. National Electrical Manufacturers Association (NEMA):

1. ICS: Industrial Controls and Systems

2. ABI: Molded Case Breakers

3. KSI: Enclosed Switches

C. American National Standards Institute (ANSI):

1. C39.1: Electrical Analog Indicating Instruments
2. C57.13: Standard Requirements for Instrument Transformers

D. Federal Specifications (FS):

1. W-P-115-B, Panel, Power Distribution.
2. W-C-375, Molded Case Circuit Breakers.
3. QQ-S-365B, Silver Plating, Electro-Deposited.

E. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code (NEC).

F. International Electrical Testing Association, Inc. (NETA):

1. Acceptance Testing Specifications.

G. Massachusetts Electrical Code.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

**1.09 - DESCRIPTION**

A. Motor control center manufacturer shall be the same manufacturer of the VFD supplied under Specification 16260.

B. Provide industrial grade motor control center, totally enclosed, free-standing, cabinet-type structure with main circuit breaker, motor starters, feeder circuit breakers, variable frequency drives (up to 25 HP), contactors, key interlocks, power monitoring, surge protection devices, and other equipment, as indicated and specified. Motor control center to distribute power at 480-volt, 3-phase, 3-wire, 60-Hertz.

C. The manufacturer of the motor control center shall be the same manufacturer of the variable frequency drives provided under SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES and the switchboard provided under SECTION 16366 – LOW VOLTAGE SWITCHBOARDS.

D. Motor control center to be designed, assembled, wired, and tested at the point of manufacture in accordance with the latest NEMA, UL, and ANSI standards. Use manufacturer's standard components when data is not specified. Provide motor control centers with UL listed/recognized components.

E. Provide Surge Protection Devices SPD as indicated and as specified in SECTION 16400, SURGE PROTECTION DEVICES.

F. Provide Variable Frequency Drive (VFD) units as indicated and specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

**1.10 - SEISMIC REQUIREMENTS**

A. Conform to the requirements as indicated on Structural Drawing 00 S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS and herein.

**PART 2 – PRODUCTS**

**2.01 - ACCEPTABLE MANUFACTURERS**

A. Square D

B. Eaton

C. Or equal.

**2.02 - CONSTRUCTION**

A. Motor control center construction shall be 600V class, and comply with UL Standard 845, of dead front construction, and incorporate horizontal and vertical power bus.

B. The MCC shall consist of one or more vertical sections bolted together to form a rigid, free standing assembly and shall permit future additions of vertical sections and interchanging of units by the user.

C. Starters shall comply with the requirements of NEMA ICS 2-322.

D. All instruments shall comply with ANSI C39.1.

E. The overall short circuit withstand and interrupt rating of the equipment and devices shall be as indicated on the contract drawings. Main and feeder circuit protective devices shall be rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the indicated short circuit current in combination with the motor branch circuit protective device.

F. Enclosures:

1. Enclosures for motor control centers shall be provided in accordance with the Area Classification schedule as indicated on the Contract drawings.

2. Provide motor control centers with NEMA Class II-S, Type B wiring.

3. Provide equipment not exceeding the outline dimensions of the motor control centers with arrangement of equipment and devices as indicated.

4. Vertical sections shall be rigid, free standing structures.

5. Each vertical section shall be divided into six (6) space factors. The structure depth shall be 20 in.

6. Removable end plates shall be used to cover the horizontal power bus and horizontal wireway openings on each end of the MCC.

7. Each section shall be equipped with removable one piece top plate.

8. All enclosure metal Work will have rounded edges and be tightly fitted with no visible air gaps.

9. Horizontal wireways of standard sections, both top and bottom, shall extend the full depth of the control center. Each wireway shall provide 90 square inches of unobstructed wiring space. The horizontal wireway shall be 6-in. high and shall extend the length of the control center with a square inch opening between sections. The wireways shall be isolated from all bus by barriers. Horizontal wireways of back-to-back sections shall allow access from the front section through to the back section. Horizontal wireways shall have removable covers held closed by captive screws.

10. A full height vertical wireway shall be provided in each standard vertical section and shall be isolated from the horizontal and vertical bus. Vertical wireways shall be an integral part of each section and shall be independent of plug-in units.

11. A removable hinged door with latches shall cover the vertical wireway, and provide access to wiring without disturbing energized control units. In each section the vertical and horizontal wireways shall open to the front to allow wires to be laid in place.

G. Incoming Section:

1. Provide molded case, service entrance rated main circuit breakers with electronic trip units including full range of instantaneous, short time, and longtime trip settings.

2. Provide main sections as main lugs only (MLO) when indicated on Contract drawings.

a. Main lugs shall be sized for the bus size provided to handle cable size indicted on contract Drawings.

H. Bus Tie Sections:

1. Where indicated Bus Tie Breakers shall be molded case circuit breakers, manually operated, and provided with electronic trip units.

I. Buses:

1. The power bus system shall be tinned copper, supported, braced and isolated from front and back by a bus support molded of a high strength, non-tracking glass polyester material. Horizontal and vertical buses shall be fastened together with a bus clamp assembly. Bus bracing shall be 65,000A RMS symmetrical.

2. The horizontal bus shall be mounted in isolated, recessed channels of the bus support molding. The horizontal bus shall be continuously braced within each section and shall be continuous in each shipping section.

3. The horizontal power bus shall be tin plated copper with ratings as indicated on the drawings.

4. The splicing of the horizontal buses shall be accomplished using a splice kit of the same ampere rating as the horizontal power bus. Double stud bus clamp assemblies comprised of flat washers and pre-assembled nuts with conical washers shall be used. The splice connections shall be front accessible for servicing with a torque wrench. The location of all splices shall be indicated by a label located on the inside of the vertical wireway door.

5. The vertical bus shall be continuously braced and sandwiched in a high strength, non-tracking glass polyester molding with a polycarbonate molded cover. It shall be isolated from the other phases and the horizontal power bus.

6. The vertical power bus shall be tinned copper and rated at 300A. Provide 600A rated vertical bus on back-to-back control centers.

7. The horizontal ground bus shall be tinned copper and located in the bottom horizontal wireway along the entire length of the MCC.

8. The horizontal ground bus shall be 1/4" x 2" with a full and continuous rating.

9. Quantity two - two hole compression type ground lugs shall be mounted on the ground bus for field ground cables.

10. Main and vertical buses shall be 98 percent conductivity copper bars.

11. Contact surfaces of bar-to-bar connections and lug-to-bar connections shall be silver plated.

12. Phase rotation of vertical buses shall be same when viewed from front or from either side of motor control center.

13. Bolts and other hardware shall be hot-dip galvanized or stainless steel with locking washers.

J. Motor Control Center Units:

1. Vertical sections shall have hardware for a plug-in units. Each unit shall consist of an equipment assembly, unit support pan and unit door assembly.

2. Each plug-in unit shall be supported and guided by a removable unit support pan, so that different unit arrangements are accomplished. The rearrangement of a unit support pan from one location to another shall be accomplished without the use of tools.

3. After insertion, each plug-in unit shall be held in place by latches, located at the front of the unit.

4. Unit plug-in power stab assemblies, shall be electrolytically tin plated copper for a low resistance connection and be able to tighten during heavy current surges.

5. The stabs shall be backed by spring steel clips to provide and maintain a high pressure, two point connection to the vertical bus. They shall be free floating and self aligning during plug-in. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed at the rear of the unit. The power cable termination at the plug-in stab shall be a maintenance free crimp type and shall be mounted in a two piece support assembly. This support shall provide a separate isolated pathway for each phase minimizing the probability of a unit fault condition reaching the power bus system.

6. Size 1 through 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 starters shall utilize a stab assembly rated at 100A. Size 4 starters shall utilize a stab assembly rated at 240A. Size 5 starters shall utilize dual stab assemblies rated 240A each.

7. An industrial, heavy duty, flange mounted handle mechanism shall be supplied for the control of each disconnect switch or circuit breaker. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of unit door position.

8. The operator handles shall pivot up-down, with the down position as OFF. The ON-OFF condition of the disconnecting means shall be indicated by the handle position. It shall be possible to lock the handle in the OFF position.

9. Trip indication on circuit breaker handles (circuit breakers rated through 400A) shall be included.

10. The operator handle of all units shall be interlocked with the unit door so that the disconnect means cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating this interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the OFF position. An externally operated defeater requiring the use of a tool, shall provide access to the unit without interrupting service.

11. The operator handle shall be interlocked with the unit, so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.

12. Each unit shall be provided so that when its starter has been removed, its door may be closed to cover the opening.

13. Each unit shall be provided with a removable door mounted on removable pin type hinges which allow the door to swing open 110 deg. Doors shall be removable from any location in the center without disturbing any other doors. The unit doors shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with latches that resist forces during fault conditions. Each starter door shall be provided with an external overload reset button.

14. Each unit shall have a unit wiring diagram affixed to the rear, inside surface of the cubicle door.

K. Motor Control Center Starter Units:

1. Provide combination starter, consisting of a circuit breaker, motor circuit protector and magnetic starter, as indicated.

2. Part winding, autotransformer, and full voltage contactor units shall be provided with thermal magnetic type breakers.

3. The starter unit withstand rating at 480V through Size 5 starters shall be 65,000A RMS symmetrical.

4. The unit withstand rating at 480V when the high interrupting capacity thermal magnetic circuit breakers are used in conjunction with starters will be up to 65,000A RMS symmetrical.

5. Motor circuit protectors shall be enclosed molded case devices with current sensing coil in each of 3 poles with adjustable magnetic trip via a single knob on front. Motor circuit protector shall be manually operable. Protector shall meet NEC requirement for motor full load and locked-rotor current ratings.

6. Momentary and interrupting ratings of circuit breakers, and fused disconnect switches shall match main bus bracing rating.

7. Type of starters, i.e., full voltage, reduced voltage, reversing, nonreversing, two-speed, are as indicated.

8. Furnish magnetic starters with thermal solid state overload protection on each phase with external manual reset nonambient-compensated and overload relays. Overload heaters for each motor shall be based on nameplate data and operating conditions of motor installed. Provide overload with auxiliary contact for remote indication of overload status.

9. Size 1 shall be minimum starter capacity.

10. Verify type (single- or 2-winding) of two-speed motor being installed. Furnish type of motor starter for control of motor. Furnish decelerating, time-delay relay for each two-speed starter.

11. Furnish starter operating coils for operation on 120V, single-phase, 60-Hertz.

12. Furnish normally open and/or normally closed auxiliary contacts for indicating lights, interlocking and other requirements as required by wiring diagrams on Contract Drawings.

13. Furnish within each starter compartment a control transformer with fuses. Secondary voltage 120 Vac, unless otherwise indicated.

14. Starters shall supply 120VAC device power for motor heaters as indicated on Contract single line diagrams. Heaters shall operate when motor is not running.

15. Starters shall supply 120VAC device power for relays and equipment protection devices as indicated on Contract wiring schematics.

16. Units shall be furnished with red-green LED cluster type pilot lights and heavy-duty control switches or push buttons in a door mounted control station. The control station shall be removable for the purpose of mounting and wiring the pilot devices and shall be held in place with captive mounting screws. Space permitting, contact blocks of the pilot devices shall be mounted in a recessed control station housing to reduce the hazard of accidental contact when the unit door is open. Dual function units may use flush mounted pilot devices.

L. Mechanical Key Interlocks:

1. Provide kirk-key interlocks between switchboard feeder breakers and motor control centers as indicated on the Contract drawings.

M. Circuit Breakers:

1. Unless otherwise indicated, furnish manually operable circuit breakers and provide thermal-magnetic, inverse-time-limit overload, and instantaneous, short-circuit protection.

2. U.L. listed circuit breakers conforming to NEMA Std. ABI.

3. Provide molded case type breakers, rated 480 volts, 3 pole and having 100-ampere or larger frames. Interrupting rating equal to bus bracing shall be required.

4. Furnish overload protection on all poles with trip settings as indicated.

5. Provide all circuit breakers 200A and larger with adjustable long-time, short-time and instantaneous protective relaying with adjustable rating plugs.

6. Where indicated, furnish circuit breakers with shunt trip.

7. Furnish time vs. current curves, ratings and cable lug data for each size of breaker furnished.

N. Contactors:

1. Provide contactors for electric heating, lighting and other non-motor loads with ratings similar to motor starters. NEMA size shall be as indicated, with 30 amperes rating for use on a tungsten lamp load.

2. Contactors for lighting loads shall be mechanically held.

O. Control Devices:

1. Control relays shall be heavy-duty, industrial or machine tool type with two normally open and two normally closed contacts. Coils shall be rated 120 volts, 60 Hertz. Plug-in-style relays with sockets shall not be used.

2. Relay contacts shall be rated 10 amperes, alternating current.

3. Provide time-delay relays adjustable, solid state, operated on 120 volts, 60 Hertz, with two normally open and two normally closed timed contacts.

4. Pushbuttons and selector switches shall be heavy-duty, oiltight units rated 10 amperes continuous current at 120 volts.

5. Indicating lights shall be LED cluster type, heavy-duty, oil-tight units.

   a. RUN – Red

   b. OFF – Green

   c. FAULT – Amber

6. Local/Off/Remote hand selector switches as indicated.

7. Control and selector switches shall be rotary type with enclosed contacts. Equip each switch with rectangular escutcheon and pistol-grip handle, except handles for instrument phase selector switches equipped with round knurled or slotted handles. Switch contacts shall be rated 10 amperes continuous, at 600 volts.

P. Nameplates: Furnish each motor control center and each unit of motor control center with engraved nameplate. Provide nameplates with nomenclature labels as indicated on Contract Drawings. Provide nameplates of laminated sheet plastic, 1/16-in. thick, engraved to provide white letters on black background. Fasten nameplates in place with corrosion-resistant screws.

Q. Variable Frequency Drives (VFD):

1. VFD units rated up to 25 HP shall be provided integral to the motor control centers.

2. VFD units provided within the MCC shall be 6 pulse type.

3. VFD units up to 25 HP shall be provided with 3% line reactors.

4. VFD units with the MCC shall be provided with output filters when indicated on Contract electrical single line diagrams.

5. VFD units shall be rated for constant torque applications when indicated on the Contract electrical single lines and per driven equipment motor data.

6. Starters shall supply 120VAC device power for motor heaters as indicated on Contract single line diagrams. Heaters shall operate when motor is not running.

7. Starters shall supply 120VAC device power for relays and equipment protection devices as indicated on Contract wiring schematics.

8. Refer to Specification SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT for variable frequency drives requirements.

R. Finish:

1. All structural metal parts shall undergo a multi-step cleaning, rinsing, and painting process resulting in complete coverage of uniform thickness.

2. Shop applied rust resistant primer undercoat on all surfaces. All unpainted parts used in the assembly shall be plated for corrosion resistance.

3. All interior and exterior surfaces except back plates of unit inserts shall be shop painted ANSI 61 gray. The back plates of the unit inserts shall be shop painted high visibility gloss white.

**2.03 - WIRING**

A. Provide a project specific wiring diagram for each starter cubicle. Coordinate control requirements with Subcontractor.

B. Conductors shall be copper; size as required by load, except that no control wire is smaller than No. 14 AWG. Use 90 deg. C rated insulation that is flame retardant, and moisture and heat resistant.

C. Cables and conductors shall be bundled and tie wrapped in wireways furnished.

D. Identify internal wiring at terminations by plastic permanently marked wire markers.

E. All spare starter auxiliary contacts to be wired to terminal blocks.

F. Terminal Blocks:

1. Provide pull-apart terminal blocks for control wiring terminations.

2. Provide rated 600 volt for power with current rating as required by loads.

3. Terminal blocks shall be mounted within the unit insert in a horizontal plane up front for accessibility. Control terminal blocks shall be pull-apart on plug-in units and fixed on non plug-in factory mounted units.

**2.04 - SPARE PARTS**

A. Provide recommended spare parts list.

**2.05 - FACTORY TESTS**

A. Provide MCC assembled, wired, adjusted and tested at the factory. Submit detailed test procedure and test results for review.

B. Provide operational, dielectric, and other standard tests performed on the assembled MCC in accordance with applicable ANSI standards.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

A. Provide all material, equipment, and labor to install motor control center units as indicated and as specified.

B. Install items in accordance with manufacturers' printed instructions. Provide all conduit, wiring, and grounding interconnections.

C. Set motor circuit protectors and circuit breakers based on load installed.

**3.02 - FIELD TESTS**

A. Perform following field tests in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 16998**

**FIELD INSPECTION AND ACCEPTANCE TESTS**

**(Filed Sub-Bid Required)**

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## PART 1 – GENERAL

### 1.00 - SUBBID REQUIREMENTS

A. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS is a part of DIVISION 16, ELECTRICAL which requires a single filed sub-bid in accordance with M.G.L. c.149, s.44A through 44H, inclusive, as amended. See SECTION 16050, ELECTRICAL WORK - GENERAL.

B. The Work of SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS requires the Subcontractor to perform all Work specified under this section.

### 1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Field Inspection and Acceptance Tests as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

### 1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

**1.03 - DEFINITIONS**

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.

2. Submit data sheets for the insulation resistance testing of conductors and motors prior to performing operating testing. List all cables and motors to be tested.

3. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.

4. After completion of the testing, submit all test results with observed notes and recommendations.

**1.05 - PRODUCT HANDLING – Not Used**

**1.06 - DESIGN CRITERIA – Not Used**

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated 1.08 - REFERENCES

B. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.

1. National Electrical Manufacturer’s Association – NEMA

2. American Society for Testing and Materials – ASTM

3. Institute of Electrical and Electronics Engineers – IEEE

4. InterNational Electrical Testing Association – NETA – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD).

5. American National Standards Institute – ANSI:
    a. ANSI C2: National Electrical Safety Code
    b. ANSI Z244-1: American National Standard for Personnel Protection
6. State and Local Codes and Ordinances
7. Insulated Cable Engineers Association – ICEA
8. Association of Edison Illuminating Companies – AEIC
9. Occupational Safety and Health Administration:
    a. OSHA Part 1910; Subpart S, 1910.308
    b. OSHA Part 1926; Subpart V, 1926.950 through 1926.960
10. National Fire Protection Association – NFPA:
    a. ANSI/NFPA 70B: Electrical Equipment Maintenance
    b. NFPA 70E: Electrical Safety Requirements for Employer Workplaces
    c. ANSI/NFPA 70: National Electrical Code
    d. ANSI/NFPA 780: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

C. All inspections and tests shall utilize the following references:
1. Project Design Specifications
2. Project Design Drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus

**1.09 - DESCRIPTION**

A. Provide field inspections and acceptance testing as specified herein.

B. After electrical installation is complete, (a) adjust and set all protective devices (in accordance) with results of electrical studies, (b) perform tests to demonstrate that the entire system is in working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Test shall be performed per InterNational Electrical Testing Association (NETA): Acceptance Testing Specification for Electrical Power Distribution System and Equipment (STD). Tests are in addition to, and not a substitution for, tests of individual items at the manufacturer's facilities. Perform insulation and ground resistance tests before operating tests. Determine proper rotation of motors before permanent connections are made.

C. Tests are also intended to accomplish the following:
1. Provide initial acceptance tests and recorded data.
2. Ensure a successful start-up with a minimum of last minute interruptions and problems.
3. Determine the suitability of the equipment and systems for energizing and placing into operating service.
4. Ensure that each system component is installed satisfactorily, will perform and will continue to reliably perform its function.

D. Provide all necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation.

E. Engage the services of a nationally recognized Independent Electrical Tester to perform the required field inspections, test, and adjustments specified. The Independent Electrical Tester shall meet the following qualifications:

1. The testing firm is not to be a subsidiary, division, or department of the Contractor performing the work of Division 16.
2. The testing firm is not to be subsidiary, division, or department of the manufacturer of the equipment, materials or systems being inspected or tested.
3. The testing firm shall perform all testing in accordance with International Electrical Testing Association, Inc. (NETA), standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by a Registered Professional Electrical Engineer. Test results shall indicate recommended action for sub-par test results. Results shall list recommended test values that should be obtained for a new installation.
4. Testing and checkout work shall be performed with personnel skilled and trained in the particular tests being conducted.
5. Evidence of the proposed testing firm's qualifications, accreditation, and experience shall be submitted for evaluation. Testing firm shall be member of NETAwith minimum of five years of testing industrial electrical systems to NETA requirements and procedures.

F. The Independent Electrical Testing Contractor shall provide supervision, labor, materials, tools, test instruments, or other equipment, and services, required to adjust, set, calibrate, and test operate the components of the various electrical systems and circuits throughout the installation, the construction package, and as specified herein.

G. Perform these tests after the electrical installation is complete. These tests shall demonstrate that the entire electrical system is in proper working order and in accordance with: applicable codes; and the supplier's instructions, drawings, and specifications.

H. Testing by the Independent Electrical Tester in no way changes the requirements to perform the specified tests, checkouts, and inspections required under the equipment specification sections.

I. The listings and descriptions of the tests, and checks described herein is not to be considered as complete and all inclusive.

J. Retests required by defects and failures of equipment to meet specifications shall be conducted at no additional cost.

1. Replace wiring and equipment found to be defective, or failing to meet specified requirements, at no additional cost.
2. Supply electric current necessary for tests.

K. Where specified in other Division 16 sections, perform work under the supervision of factory trained technicians, representing the equipment being tested or inspected.

**1.10 - SCHEDULING**

A. The Contractor is responsible for the preparation of proposed procedures, testing and inspection forms, and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work to be coordinated and to be compatible with the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and NETA approved check out forms for the review. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks.

B. Prior to check out and testing for start-up, verify that all equipment and wiring is permanently identified with nameplates and tags. Check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions. Make routine checks and tests as the job progresses to verify that all wiring and equipment are properly installed.

C. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act
2. Accident Prevention Manual for Industrial Operations, National Safety Council

3. Applicable state and local safety operating procedures
4. Owner's safety practices
5. National Fire Protection Association
6. American National Standards for Personnel Protection

D. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

E. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

F. Ensure that all testing and checkout work is conducted in a safe manner. Special safety precautions such as the following to be utilized where appropriate:

1. Locking and tagging procedures
2. Barricades
3. De-energization and/or isolation of equipment prior to testing
4. Review of procedures with site personnel
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

G. Report all inspections, tests, and calibration in writing on NETA approved report forms. The recorded data from shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall serve as the test and inspection checklist for inspection requirements. Submit all test and check out data in accordance with SECTION 01300, SUBMITTALS prior to adjustments, repairs, drying out, or similar work prior to final testing and acceptance. "As-found" and "as-left" test data to be recorded and reported in writing.

H. Sequence tests and checks such that the equipment can be energized immediately after the completion of the applicable tests.

**PART 2 - PRODUCTS**

**2.01 - TESTING EQUIPMENT**

A. Calibration:

1. All calibration and setting checks by the Independent Electrical Test shall be performed with the laboratory's calibrated test instruments. This test equipment to have calibrations traceable to the National Bureau of Standards. The Independent Electrical Tester dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. All testing instruments shall be checked to verify satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.
2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

**2.02 - TESTING**

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are ensure that systems are energized when required, loads applied, and other requirements are carried out on timely, coordinated basis.

2. Conduct tests in presence of the Owner's representative. Provide ten calendar days or more advance notification of when any test is to be performed.

3. Conduct testing such that warranties or guarantees are not voided. Coordinate all testing with manufacturer's factory trained technicians, where applicable. Where specified tests are not compatible with the manufacturer's recommendations, obtain the manufacturer's review prior to testing. Permit witnessing by the manufacturer's representative if so requested.

B. Preparation:

1. Make up no low voltage connections at service entrance, transformers, motors, switchboard and motor control centers, permanently until correct phase rotation of all equipment is determined. Install and insulate these connections temporarily, if necessary, while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

**PART 3 – EXECUTION**

**3.01 - INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS**

A. Independent Electrical Testing:

1. The Independent Electrical Tester shall perform all inspections and testing as specified herein.

B. List each circuit and measured resistance as test data.

C. Maintain records of all insulation resistance values. Identify conductor, or equipment, date that value was taken, and resistance value. Submit the information in neat tabular forms.

**3.02 - SPECIFIC TESTS AND INSPECTIONS**

A. General:

1. The following specific items or work shall be performed by the Independent Electrical Tester. The equipment and cable shall be de-energized and isolated as necessary to perform the tests.

2. Perform tests and inspections as specified throughout Division 16. Tests and inspections required by these sections are not necessarily repeated under this section.

3. Provide assistance as requested by the Independent Electrical Tester in performing its work.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Motors:

a. Visually inspect the motor for any physical damage.

b. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.

c. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

2. Grounding Systems:

   a. All main plant building loops and major equipment grounds to be tested to remote earth or directly referenced to an extremely low resistance (3 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds to be made to determine the adequacy and integrity of the grounding. All ground testing results to be properly recorded, witnessed, and submitted.

   b. Ground tests shall be performed in accordance with NETA using a J. G. Biddle Company low resistance, Null balance type, ground testing ohmmeter, and test lead resistance compensated for. The test instrument to be the type, which compensates for potential and current rod resistances.

   c. Test entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 3 Ohms.

3. Outdoor Pad Mounted Transformer:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

4. Low voltage Switchboard:

   a. At the time of equipment receipt, visually inspect the equipment for any damage or defects. Coordinate inspections with factory-trained technicians.

   b. Energize heaters for prolonged storage, if required.

   c. Perform complete inspections and electrical tests in accordance with SECTION 16366, LOW VOLTAGE SWITCHBOARDS and NETA.

5. Circuit Breakers – Low Voltage:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with NETA.

6. Motor Control Centers:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS and NETA.

7. Dry-Type Transformers:

   a. All 480 volt primary, air-cooled, transformers shall be given an insulation test, by means of a megger, after connections with the primary cables are complete. The supply cable shall be meggered with the primary winding and to the open air circuit breaker. Secondary leads may be meggered with the secondary windings to the open load breakers.

   b. Check continuity and correctness of connections of all windings and ratings.

   c. Perform inspection checks, and electrical tests in accordance with NETA.

8. 600 VAC Wire and Cable:

   a. Before energizing, the continuity and insulation resistance of all wiring shall be measured with a megger from each wire to all others and to ground.

   b. All cables and wires to be checked for proper identification numbering and/or color coding.

   c. Perform inspection checks and electrical tests in accordance with NETA.

9. Overhead Conduit Systems:

   a. The overhead conduit system to be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

      (1) Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).

      (2) Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.

      (3) Conduits are routed as far away from possible fire hazards and heat sources as practical.

      (4) Conduits are supported at the required intervals.

      (5) Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.

      (6) Number of bends in the conduit does not exceed NEC requirements without a pull box installed.

      (7) Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.

      (8) Conduits are terminated in threaded hubs or bushings to prevent damage to wire.

      (9) Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.

      (10) Pull fittings are of adequate size such that cable can be installed and replaced at a later date without bending the cable less than code or manufacturer's requirements.

      (11) Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.

      (12) Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.

      (13) Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

10. Panelboard electrical checks to be as included in the Wire and Cable section of this specification. Panelboards to be checked for proper circuit identification on the door schedule.

11. Sealing of Openings: Inspect the entire job to insure that all openings and holes provided or utilized are properly sealed as specified.

12. Where referenced NETA Standards indicate optional testing, perform these tests as described.

**3.03 - CONTRACT CLOSEOUT**

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

**END OF SECTION**

**SECTION 99999**

**ATTACHMENTS**

**ATTACHMENT A**

**Rotary Drum Thickening Proposal**

**ATTACHMENT B**

**SBR and Effluent Disk Filter Proposal**

**ATTACHMENT C**
**Septage Receiving Proposal**

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**ATTACHMENT A**

**Rotary Drum Thickening Proposal**

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**SECTION 11365**

**ROTARY DRUM THICKENERS**

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## PART 1 – GENERAL

### 1.01 SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for Rotary Drum Thickeners and, where appropriate, applying or installing such materials for the various items of Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. Provide and test Rotary Drum Thickeners, valves, sludge condition devices and tanks, mixers, motors, variable frequency drives, controls and control panels and appurtenances as indicated in the RFP and specified herein.

C. All equipment shall be from a single source supplier.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section will be made in accordance with the provisions the RFP.

1. The Contract Documents will specify one Rotary Drum Thickener to be provided as part of the Base Bid.

2. The Contract Documents will specify one Rotary Drum Thickener to be provided as part of an Alternative Bid Item.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Rotary Drum Thickeners. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 SUBMITTALS**

A. Submit the following in accordance with the RFP and as specified herein:

1. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified. Electronic files shall conform to the following minimum requirements:
    a. Electronic Files: AutoCad 2013 or higher, drawn to scale.
    b. Submit electronic files as part of the Shop Drawing submittal.
    c. Submit electronic files on CD or DVD.
    d. Drawings shall include plan views, sectional views, Piping and Instrumentation diagrams, title block, Tag Numbers, serial numbers, Parts List (identifying each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.
    e. Drawings shall be in conformance with all other requirements as specified in this specification.
2. Data regarding thickener characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically equipment, showing they meet indicated and specified requirements capacity, performance and horsepower.
    b. Results of shop performance tests as specified.
    c. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-in. by 11-in. sheets, one curve per sheet.
3. Control Panels
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components.
    c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.
    d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.
4. Data for accessory items.
5. Certified setting plans, with tolerances, for anchor bolts.
6. Manufacturer's literature as needed to supplement certified data.
7. Operating and maintenance instructions and parts lists.
8. Listing of reference installations as specified with contact names and telephone numbers.
9. Bearing temperature operating range for the service conditions specified.
10. List of recommended spare parts other than those specified.
11. Shop and field inspection reports.
12. Bearing Life: Certified by the equipment manufacturer. Include design data.
13. Shop test results.
14. Qualifications of field service technician.
15. Recommendations for short and long-term storage.

16. Shop and field testing procedures and equipment to be used.
17. Special tools.
18. Number of service person-days provided and per diem field service rate.
19. Schematic control and power wiring diagrams.
20. Manufacturer's product data and specifications for painting.
21. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
22. The latest ISO 9001 series certification or Quality Control Plan.
23. Provide a scaled drawing showing the entire thickener assembly, hoists and bridge cranes including equipment weights, lifting attachments and clearances for equipment removal and maintenance.
24. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. All changes and clarifications shall be indexed to a list detailing each change and clarification. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specifications with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

## 1.05 PRODUCT HANDLING

A. Provide as specified herein.

B. Shipping

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

## 1.06 DESIGN CRITERIA

A. The Rotary Drum Thickeners equipment is intended to thicken waste sludge generated by the WWTF to reduce off-site hauling costs for dewatering and disposal/reuse. The Rotary Drum Thickeners will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. The Control Panel for the Rotary Drum Thickeners will be located in the garage (Room 102). Odorous exhaust from the truck bay is directed to the odor control carbon filter located outside. The waste sludge storage tank and thickened sludge storage tank will be served by mixing blowers to maintain sludge conditions of the combined sludges prior to thickening and hauling respectively.

B. Each Rotary Drum Thickeners shall include:

1. Flocculation/Sludge conditioning Tank; equipped with vortex mixer and polymer injection ring, low inlet with provisions to drain the tank, and a discharge flume assembly to transfer conditioned sludge to the first stage of the rotary element. The manufacturer shall be required to provide recommended layout for the system and the final location of the in-line conditioning system. Design shall allow adjustment of the flocculation time.

2. Multiple stages that progress dewatering throughout the system:

   a. Woven wire mesh to maximize flow and easily changed for performance/O&M; and

   b. Equip each stage with roll bars, split augers, ports and/or deflectors to induce shear, water release and drainage rate.

3. Drum Drive assembly will be mounted on a rigid base with provisions for adjustment of the drive, sprocket, and roller chain interface.

4. Trunnion Wheel assemblies to be mounted to the base frame to provide positive horizontal placement of the rotary drum screen assembly.

5. Washing system; complete with self-cleaning adjustable mount washing header, spray tips and stainless steel pressure gauge and dial, and booster pumps as recommended by manufacturer.

6. Spray Water Solenoid valve.

7. Shower deflection panels shall contain spray and minimize mist, and allow easy access for visual inspection and access to the trunnion wheels for maintenance.

8. Filtrate water collection; by gravity through the 4-in tank drain.

9. Type 304L Stainless Steel Construction; including tank covers, tank supports and adjustable support legs for field leveling.

10. Closed grit discharge chute; Type 304L stainless steel.
11. Plant water strainer, brass bodied Y-type with washable Type 316 stainless steel filter insert, 20 mesh.
12. Magnetic flow meter and transmitter for recording and totalizing inlet waste sludge.
13. Electrical Devices.
    a. Main unit drive; per manufacturer, gear motor rated for severe duty, with VFD, 460 VAC, 3 phase, 60 Hz. Class 1 Division1.
    b. Conditioning Tank drive; per manufacturer, gear motor rated for severe duty, with VFD, 460 VAC, 3 phase, 60 Hz Class 1 Division1.
    c. Wash Water Booster Pump; per manufacturer, fixed speed, 460 VAC, 3 phase, 60 Hz Class 1 Division1.
    a. Control Panel as defined herein.
14. Spare parts; one set each: trunnion wheels, driven sprocket, drive sprocket, idler sprocket, drive chain.
15. Any other equipment and controls required by the PROPOSER to meet the Rotary Drum Thickener system performance requirements.

C. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.07 REFERENCES**

A. American Society for Testing and Materials (ASTM) Publications:
1. A36: Specification for Structural Steel.
2. A48: Specification for Gray Iron Castings.
3. A322: Specification for Carbon and Alloy Steel Bars.
4. A536: Specification for Ductile Iron Castings.
5. A743: Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, and Nickel-Base Corrosion-Resistant for General Application.
6. B584: Specification for Copper Alloy Sand Castings for General Applications.

B. American National Standards Institute (ANSI):
1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. American Bearing Manufacturers Association (ABMA):
1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.

D. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings

**1.08 QUALITY ASSURANCE**

A. Provide as specified herein.

B. Equipment shall be the product of one manufacturer.

C. Equipment shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the thickeners, mixers, tanks, inline condition devices, solenoid valves, motors, gear reducers, controls, control panels and variable frequency drives, from a single manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system in accordance with the RFP.

G. Services of Manufacturer's Representative as stated in the RFP and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection: 1 person-day.

4. Field Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 3 person-days.

5. Acceptance Testing: Conduct acceptance testing as specified herein. 3 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1 person-day.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

8. Any additional time required.

**1.09 SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

A. Parkson Corporation

B. Huber Technology, Inc.

C. BDP Industries

D. Or Equal

**2.02 GENERAL**

A. Provide fully automatic, fully enclosed, internally fed, continuous operating, and self-cleaning sludge thickening units.

B. Thickeners to include cylindrical wedge section thickener with internal shafted screw, 190-degree rotation spray bar system with nozzles, sludge discharge chute, flocculation reactor and mixer, drives and controls.

C. Thickeners must be totally enclosed. Thickeners with open ended discharges are not acceptable.

**2.03 SCHEDULE**

A. General: Condition and thicken sludge feed to produce thickened sludge that is discharged from thickening unit, automatically, without clogging.

1. Design requirements as follows:

a. Feed Sludge Characteristics:

b. Type of Sludge

(1) Waste activated sludge from an SBR process and processed septage.

(2) Solids Concentration (Mixed WAS and Septage at 50/50 Ratio): Range: 0.3 to 0.5 percent.

2. Thickening Equipment Requirements:

a. Number of thickeners: 1 plus 1 as bid alternate.

b. Design Solids loading capacity: 400 lbs. dry solids/hour at 0.5 percent solids. Design operating hydraulic rate: (excluding polymer): 100 gpm at 0.3 to 0.5 percent solids with a range of 80 to 150 gpm

c. Magnetic flow meter to measure feed sludge to thickener.

d. Maximum polymer consumption: 10 lbs/ton dry solids.

e. Minimum solids capture: 95 percent.

f. Solids output: 5 percent (dry weight basis).

g. Maximum total connected power: 4.5 horsepower (including 2 hp thickener drive, 0.25 hp sludge conditioning tank drive, and 0.25 hp spray wash booster pump.

h. Wash water: 38 gpm maximum at 60 psi minimum.

i. Thickener cylinder

(1) Screen Openings, inch: 0.01

(2) Diameter, inches: 27.50*

(3) Length, inches: 69*

*Varies per manufacturer

**2.04 THICKENING EQUIPMENT**

A. Provide cylindrical wedge wire with a constant bar spacing as specified installed as a filtration unit.

B. Provide a multi-stage progression of the sludge to be thickened achieved with the inclined installation of the thickener and the internal helical screw.

C. Provide brushes on the conveyor screw to clean the screen, preventing sludge from sticking at the inside of the wedge wire.

D. Provide a rotating spray bar.

E. The screw conveyor speed shall be adjusted to the individual requirements of the sludge to be thickened, from 0 to 7 rpm through a VFD. The screw conveyor shall be the only rotating part of the sludge thickening unit.

F. The entire unit shall be totally closed; units not totally enclosed are not acceptable.

G. Provide a turbulence-free inlet for each unit.

H. Provide an inspection hatch in the reactor to inspect, the filtrate outlet in the wedge wire, the wedge wire, operation of the spray nozzles and the quality of the thickened sludge.

I. Provide an integrated spray wash systems constructed of Type 304L stainless steel piping and Type 304L stainless steel spray nozzles covering the entire area of the wedge wire screen, and shall rotate 190 degree around the basket in each direction, to provide a total automatic spray system, cleaning the wedge wire. Provide solenoid valves for flow control for each part of the system.

J. Provide a 4-inch flanged connection on the high point of the drum for connection to an odor control duct as indicated.

**2.05 SLUDGE CONDITIONING**

A. Sludge Condition Tanks

1. Vertical enclosed type, sized to provide optimum mixing and flocculation of sludge and conditioning chemicals. Provide a hinged and gasketed cover.

2. Type 316L stainless steel construction, furnished with the following:

a. One (1) 4-inch 150 lb. flanged sludge inlet connection

b. One (1) 3-inch (minimum) flanged drain connection with 3-inch stainless steel ball valve.

c. Provide gravity flow through one (1) 8-inch line from conditioning tank to the thickener.

3. Provide a system with all parts accessible for cleaning, maintenance or operational adjustment with no seals or bearings in contact with liquid.

4. Mixing Devices

a. Provide the vertical tank fitted with a Type 304L stainless steel vertical mixer and internal baffles. Provide mixer with an integral motor mounted variable frequency drive. Provide Type 316L stainless steel discharge lines at top of tank to provide conditioned sludge feed to the rotary drum thickener.

b. Speed Range: 0 to 12 rpm

B. In-Line Sludge Conditioning

1. Type 316L stainless steel solids handling mixing valves sized to provide optimum mixing and flocculation of sludge and conditioning chemicals.

2. Pressure drop through mixing device not to exceed 12 psi at a flow range of 125 to 185 gpm.

3. Provide one (1) in-line mixer per thickener, provide each mixer with a weighted adjustable mixing device. Provide ends flanged and drilled to 150 lb. ANSI B16.1 Standard.

4. Provide each mixing device with a polymer injection ring with four tangentially mounted polymer injectors as indicated.

5. Elbows, bends or special pipe sections are not acceptable.

6. The equipment supplier to be responsible for the final location and layout of the in-line conditioning system.

**2.06 DISCHARGE CHUTES**

A. Provide a Type 304 stainless steel enclosed discharge chute to direct thickened sludge flow to the Thickened Sludge Storage Tank below. Provide configuration as indicated.

**2.07 CONTROLS**

A. Automatic controls for operation of the Rotary Drum Thickeners (RDTs) and associated appurtenances shall be provided in Programmable Logic Controller (PLC)-based control panels. Provide control panel per RDT. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.

2. Provide NEMA 4 Type 316L Stainless Steel enclosure. The Control Panel for the Rotary Drum Thickeners will be located in the garage (Room 102).

3. Panel shall be labeled UL 508A.
4. Provide motor starters, and variable frequency drives (VFDs) internal to the control panel as required. Provide VFD's in accordance with Specification 16260, Low Voltage Variable Frequency Drives.
5. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
6. Heaters or AC units required for control panels shall obtain power from the control panel.
7. Provide the following control panel enclosure with the following:
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Control buttons as defined below.
    c. LED type indicating lights.
8. Provide an emergency stop (ESTOP) maintained pushbutton on the face of the panel.
9. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide the control panel with an integral surge protection device (SPD):
    a. 120VAC, 10 kAIC rated.
    b. Visual indication of plug status.
    c. UL listed.
11. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
12. Provide RAM memory protected by backup battery.
13. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
14. Provide fully documented ladder logic on a CD-Rom.
15. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide 10 inch Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.
16. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
17. Provide control a monitoring of the system as shown on the contract drawings.
18. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
19. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
20. Provide sufficient number of spare contacts for interlocking. Provide at least 8 spare un-powered auxiliary contacts.
21. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
22. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.

23. The RDT vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
24. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.

B. Minimum Control Requirements

1. Thickener Drive and Sludge Conditioning Tank Drive Speed Control.
    a. Provide separate speed controls to control speed of thickener drive and conditioning tank drive. Speed controls calibrated from 0 to 100 percent of unit speed.
    b. Provide START/STOP pushbuttons mounted on front of control panel for each drive. In STOP position, motors de-energized. In START position, motor runs, with speed controlled through speed controls.
2. Wash Water Solenoid Valves: Panel mounted OPEN/CLOSE/AUTOMATIC.
3. Normal RUN/OFF/AUTOMATIC of thickener.
4. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
    a. Thickener Drive.
    b. Sludge Conditioning Tank Drive.
    c. Wash Water Spray Bar Motor.
5. A FAULT light (LED), panel alarm and acknowledge button with suitable contacts, to actuate light and alarm in event of following:
    a. Thickener drive failure.
    b. Sludge conditioning tank drive failure.
    c. Spray system motor failure.
    d. High and low liquid levels in sludge conditioning tank.

C. In addition to the Main Control Panel, furnish a NEMA 4X Type 316L stainless steel remote control cabinet for each Rotary Drum Thickener for mounting locally at the equipment. The remote Control Panel will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. Each remote control cabinet shall house the following components:

1. Emergency Stop Push Button
2. H-O-A Control Switch
3. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
    a. Thickener Drive.
    b. Sludge Conditioning Tank Drive.
    c. Wash Water Spray Bar Motor.
4. A common FAULT light (LED), panel alarm and acknowledge button with suitable contacts.

**2.08 MOTORS**

A. Provide in accordance with Section 16220, Electric Motors and as specified herein.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of equipment under any condition of operation specified and indicated without operating in the motor service factor.

C. Motors: Class 1 Division 1.

D. Provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

E. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

F. Operate without overheating at the speeds specified and indicated.

G. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with VFD's.

H. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

I. Rating: 460V, 3 PH, 60 Hz.

J. Insulation: Class F with Class B temperature rise, 40 deg. C ambient.

K. Site Altitude: 60 feet above sea level.

**2.09 GAUGES**

A. Provide gauges assemblies for wash water piping.

**2.10 SHOP TESTING**

A. Provide motor shop testing.

B. Provide a mechanical operating test of the thickener and the control panel at the thickener manufacturer's facility.

C. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.

D. Repeat tests until specified results are obtained.

E. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

F. Provide Certified Test Results to the Engineerign prior to shipment of the units.

**2.11 SHOP PAINTING**

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces two part epoxy paint in accordance with the following.

1. Solids by Volume: Minimum 57 percent (percent $\pm$2).
2. Type: Polyamide epoxy, self-priming.
3. Dry Film Thickness: 4 to 6 mils per coat.
4. No. of Coats required: Three.
5. V.O.C Requirement: 3.06 lbs/gallon, Conform to AWWA D102 Inside systems No.1 and No.2.
6. Use thinners that are acceptable to ANSI NSF Std 61.
7. Color: As specified for piping system of same service or as selected by the Engineer.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

**2.12 SPARE PARTS**

A. Provide spare parts that are identical to and interchangeable with similar parts installed. for each set of thickeners of the same size and performance.

1. One set of all special tools required.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Install items in accordance with manufacturer's printed instructions and as specified.

B. Install units on a concrete pad and align thereon. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation.

### 3.02 FIELD TESTING

A. Test piping connections to prove that any nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with nozzles.

B. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer’s field service technician, conduct running test for each thickener in presence of the Engineer to determine its ability to operate at the service conditions specified and indicated and within the temperature limits specified. During field tests, observe and record capacity, motor inputs, bearing housing temperature, noise and vibration. Immediately correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner. Contractor to provide all labor, piping, equipment, calibrated gauges and flow meters.

1. Bearing and Motor Temperature:

    a. Run each unit for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

    b. Bearing temperature not to exceed 180 degrees F.

2. Test Duration: Determined by the Engineer, but not less than four hours of continuous operation at each condition specified and indicated.

C. Make all adjustments necessary to place equipment in specified working order at time of above tests.

D. Test on product only. If product is not available, test with water. Water for testing furnished by Contractor.

E. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

### 3.03 PROCESS PERFORMANCE GUARANTEE

A. The Rotary Drum Thickeners will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. In order to protect the OWNER’s interests, the SELECTED PROPOSER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

1. Name Manufacturers - SELECTED PROPOSER shall be responsible for the process performance of the Rotary Drum Thickeners and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. Or Equal Manufacturers – SELECTED PROPOSER shall be responsible for the process performance of the Rotary Drum Thickeners and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a an irrevocable Letter of Credit in the amount of 100 percent of the purchase order price for the equipment. The irrevocable Letter of Credit shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. The SELECTED PROPOSER agrees to furnish the irrevocable Letter of Credit in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a financial company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such irrevocable letter of credit shall be paid by the SELECTED PROPOSER.

B. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 WARRANTY**

A. The SELECTED PROPOSER shall be provide an warranty of the Rotary Drum Thickeners warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of this RFP. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

C. It is the SELECTED PROPOSER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 ACCEPTANCE TESTING**

A. After the field functional testing is complete, Contractor will conduct an Independent Acceptance Test. During the Acceptance Test, the feed Septage/WAS and thickened sludge shall be monitored for flow and total solids concentration and the thickener filtrate shall be monitored for TSS concentration. The design/testing criteria to be a 50/50 percent split of Septage/WAS blend at 0.3 to 0.5 percent upstream solids concentration and 5.0 percent minimum downstream concentration.

B. Polymer Selection: For start-up, the thickening equipment vendor shall recommend and provide one (1) month supply of polymer based upon similar applications

C. Rotary Drum Thickeners Acceptance Testing - The Rotary Drum Thickeners will be operated in an "acceptance testing" mode for a minimum of a continuous 4-hour period. Solids content grab samples representing the entire Septage/WAS flow will be collected both upstream and downstream of the Rotary Drum Thickeners. At least one (1) Upstream and two (2) downstream (one sample of the thickened Septage/WAS and one sample of the filtrate/centrate) solids content grab sample shall be collected at 30-minute intervals of the 4-hour continuous operation testing period. Samples shall be analyzed at an independent testing facility to be verified. The length of the testing period may be adjusted based on the volume of feed sludge available as agreed by the Owner and/or Engineer.

Rotary Drum Thickeners Acceptance Testing Criteria

1. The Rotary Drum Thickeners shall produce thickened sludge with a minimum of 5 percent solids when:
   - The process influent percent solids are in the range of 0.3 to 0.5 percent; and
   - Polymer addition at up to 10 lbs/Ton.

   and

   - Either flow to a single Rotary Drum Thickener is at least equal to the upper limit of the normal operating hydraulic loading rate defined by the final approved design; or
   - The solids load sent to a single Rotary Drum Thickener is at least equal to the maximum day solids loading capacity defined by the final approved design (whichever is more limiting when the solids content is 0.5 percent).
2. Each thickening unit shall capture a minimum of 95 percent of solids during the test period.

D. Contractor shall have responsibility for performing formal Acceptance Testing with support from manufacturer's representative. Representative shall include technical and operational advice, response to questions, and other assistance as necessary for successfully completing the Acceptance Tests. On-site support from the on-site Representative during Acceptance Testing shall be as specified herein.

**3.06 FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

END OF SECTION

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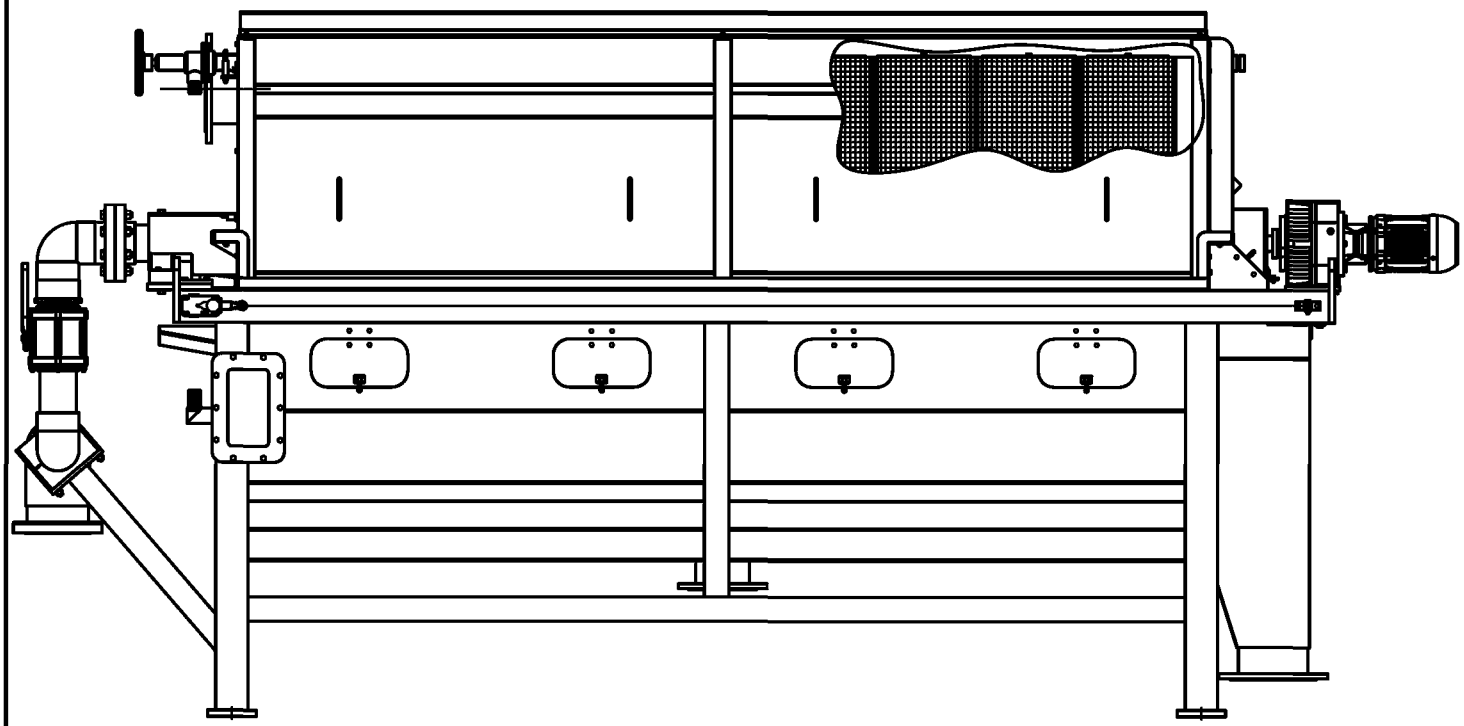
INDUSTRIES, INC.

# Submittal Package

**Orleans, Massachusets**

**Rotary Drum Thickening Equipment**



BDP Industries, Incorporated

Dual ø4' x 10' Rotary Drum Thickener

BDP Job No. 1529

DESIGNED AND MANUFACTURED IN THE USA

BDP INDUSTRIES

www.bdpindustries.com

# Rotary Drum Thickener

Industry Leader in Design and Manufacture of Filtration and Composting Systems

# Rotary Drum Thickener

**BDP Industries' RDT** design is unique in the industry providing lower capital and operating cost and superior performance:

- Lower cost screen construction
- Larger effective filtration area

Each Rotary Drum Element is composed of between five and ten stainless steel discs supported off a center shaft. Polyester fabric or stainless steel is then wrapped around these discs and held in place with stainless steel bands. Filtrate is collected in a stainless steel drip pan below the rotary drum.

Thickened slurry flows out the open end of the Rotary Drum and down a chute deflecting it away from the filtrate pan. A shaft mounted gear reducer motor and torque arm drives the rotary drum. A Variable Frequency Controller controls rotating speed of the drum. Because the openings in the consecutive discs are offset, the speed at which the drum rotates determines the slurry depth and the amount of filter area exposed to the slurry. This feature provides for more effective filtration area.

An adjustable angle, self-cleaning shower cleans the filter cloth during each revolution.

Rotary Drum Elements are made in 3' and 4' diameters and lengths up to 10'.

If higher through put is required two drums can be operated in parallel with a common feed and discharge.

Stainless Steel Drum Media

Filtrate Through Drum Media

Drum Construction

The centershaft / disc assembly is supported by a **cam shaft bearing assembly** on one end, and **the gearbox drive assembly** on the other.

This arrangement keeps the bearing from being exposed to the process as is the case with trolley bearing assemblies made by other vendors.

P.O. Box 118, 354 State Route 29
Greenwich, NY 12834
T: 518-695-6851 F: 518-695-5417

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All the information contained herein is subject to change with-out notice. Directions for use and safety will be given separately.

BDP INDUSTRIES

www.bdpindustries.com

BDP INDUSTRIES INC.
354 State Route 29 • P.O. Box 118 • Greenwich, NY 12834 • Tel. (518) 695-6851 • Fax: (518) 695-5417

# PERFORMANCE AFFIDAVIT

## ORLEANS, MA
## Dual 4x10 RDT

BDP Industries, Inc. has examined the Contract Documents and verified that the 4x10 RDT will meet in every way the performance requirements specified and design specifications set forth in the Contract Documents.

1. The sludge shall be SBR and Septage Blend.

2. Each 4x10 RDT shall be capable of meeting the following.

| PARAMETER | PERFORMANCE |
|---|---|
| Sludge Flow Rate (gpm) | 150 |
| Solids Throughput (dry lb/hr) | 400 |
| Polymer Dosage (act. lb/dry ton) | 10 |
| Discharge Cake Solids (%wt) | 5 |
| Capture | 95 |

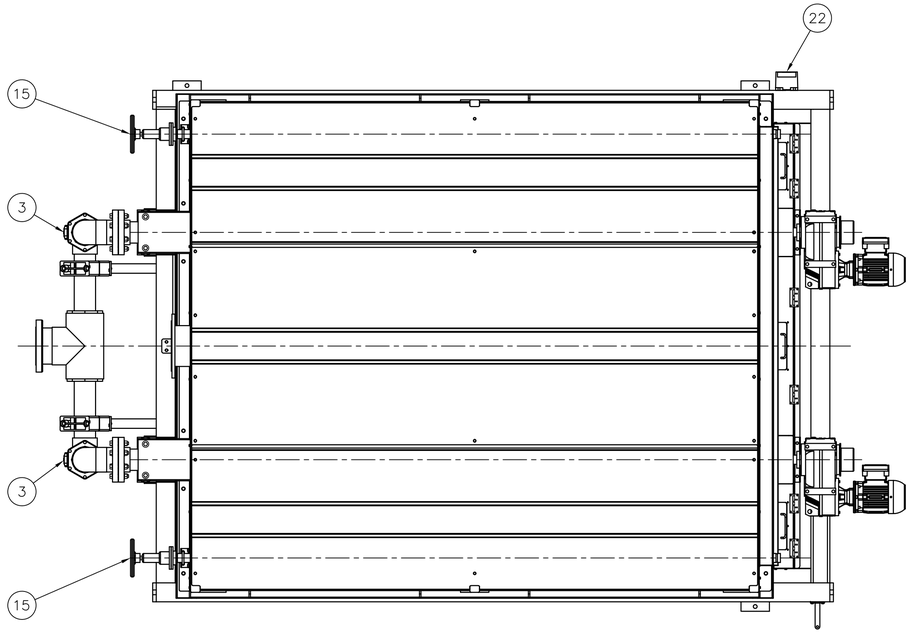
A.J. Schmidt
President

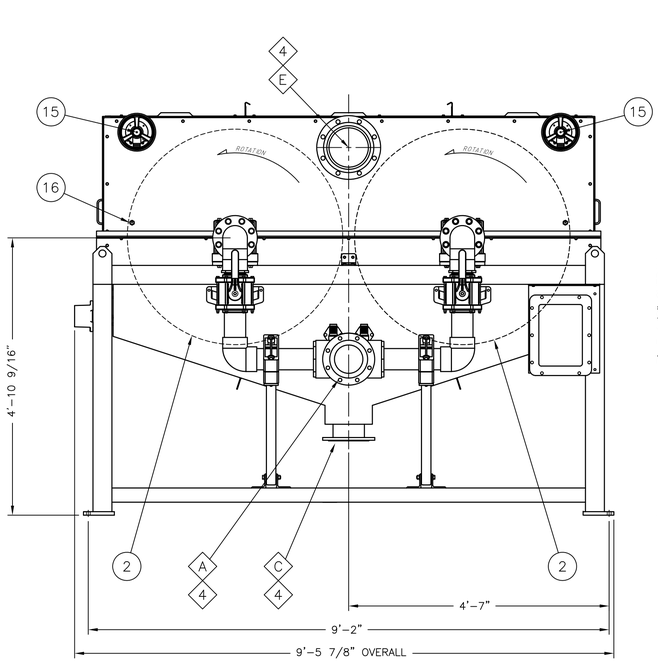
# ROTARY DRUM THICKENER

| RDT SECTION | COMPONENTS | SPECIFICATIONS |
|---|---|---|
| DRAINAGE DRUM ENCLOSURE FRAME | FRAME | 4"x4" TUBE (ASTM A554-MT316L) |
| | TOP COVER | 14 GA. (316L SS) |
| | END PLATE | 14 GA. (316L SS) |
| | BEARING MOUNT | ½" PLATE (316L SS) |
| DRAINAGE DRUM | CENTER SHAFT | 4" PIPE, A276-316 STUB SHAFT TURNED DOWN TO 1-15/16" FOR SHAFT MOUNT GEAR REDUCER |
| | COMPARTMENT HEADS | 12 GA. 316L SS |
| | END HEADS | 12 GA. 316L SS |
| | SUPPORTS LONGITUDINAL | 3/16" PLATE 316L SS |
| | FILTER SCREEN | INDUSTRIAL MONOFILAMENT WEAVE STAINLESS STEEL WIRE MESH |
| | SCREEN CLAMPS | 3/16" THICK BAR 316L SS |
| | SCREEN BANDS | MAK-A-CLAMP TYPE (316 SS) |
| SLUDGE MANIFOLD | FEED CONNECTION | 6" ANSI FLANGE |
| | DELIVERY CHAMBER | 6" SCH 40 PIPE PERFORATED ENTERING FIRST CHAMBER |
| DRUM SIDE SHIELDS | SHOWER & NON-SHOWER SIDE | 14 GA. 316SS WITH 316SS HANDLES, (6) ACCESS PORTS WITH RUBBER SKIRTING TO DEFLECT WATER INTO PAN |
| DRAINAGE DRUM | CAM FOLLOWERS | CARTER **SC 64 SB** |
| DRIVE | REDUCER / MOTOR | SHAFT MOUNT, TORQ-LOC 198.31:1, EX PROOF 1 HP.460/3/60 |
| SHOWERS | PIPE | (2) APPLETON SELF CLEANING; ADJUSTABLE ANGLE; 1-1/2" SCH. 10; 316 SS<br>WATER USAGE = 40 GPM @ 100 PSI |
| | NOZZLE | FLAT FAN TYPE; 0.079" ORIFICE; ADJUSTABLE ANGLE, RATED 1.1 GPM @ 100 PSI |

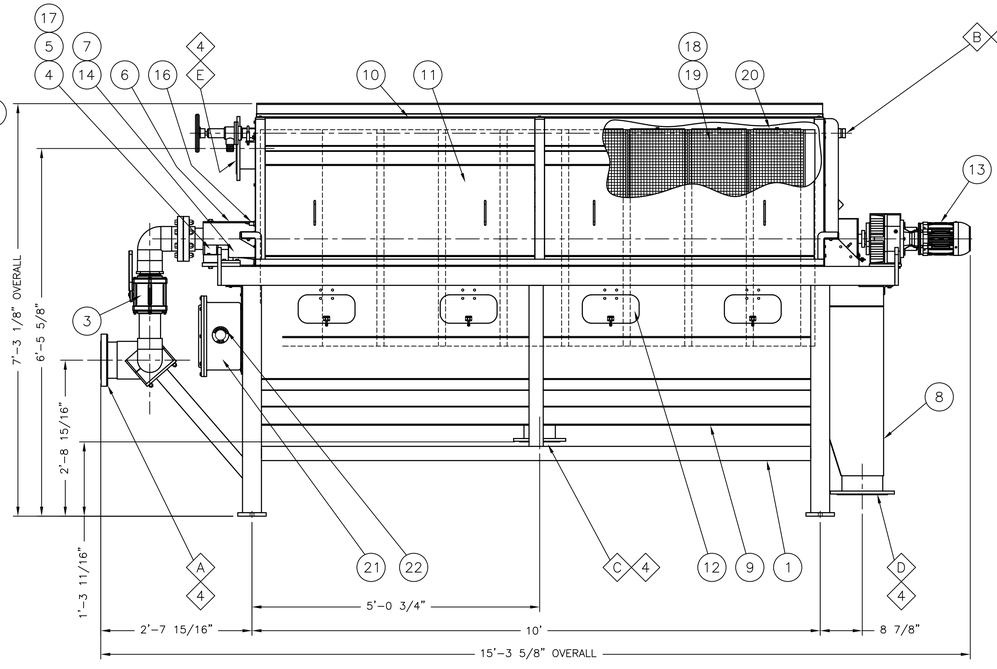
# ROTARY DRUM THICKENER

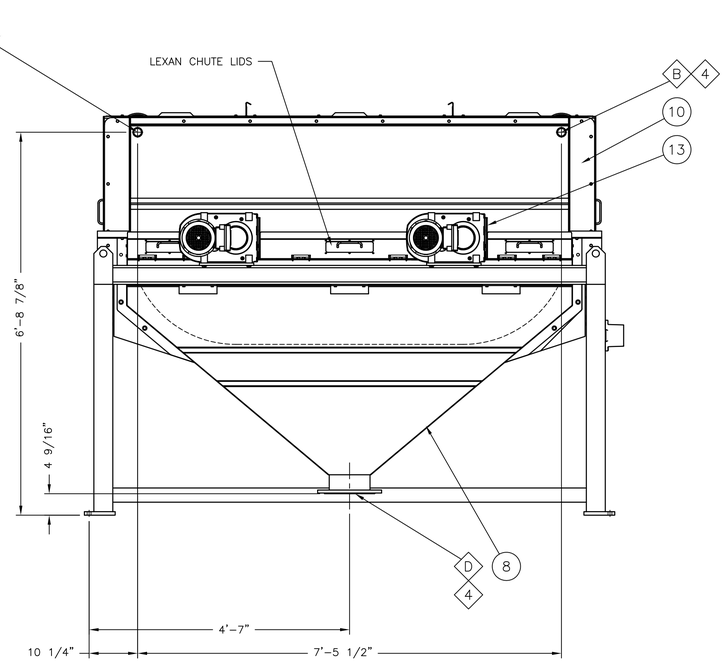
| | |
|---|---|
| NOTES: | A) ALL WETTED PARTS OF DEWATERING DRUM WILL BE 304L STAINLESS STEEL AND THE FILTRATE COLLECTION PAN WILL BE 316L STAINLESS STEEL.<br><br>B) NO BEARINGS WILL BE IN CONTACT WITH SLUDGE OR FILTRATE.<br><br>C) THE ROTARY DEWATERING DRUM WILL HAVE A VARIABLE SPEED DRIVE UNIT CAPABLE OF VARYING THE DRUMS SPEED. |




INLET END VIEW



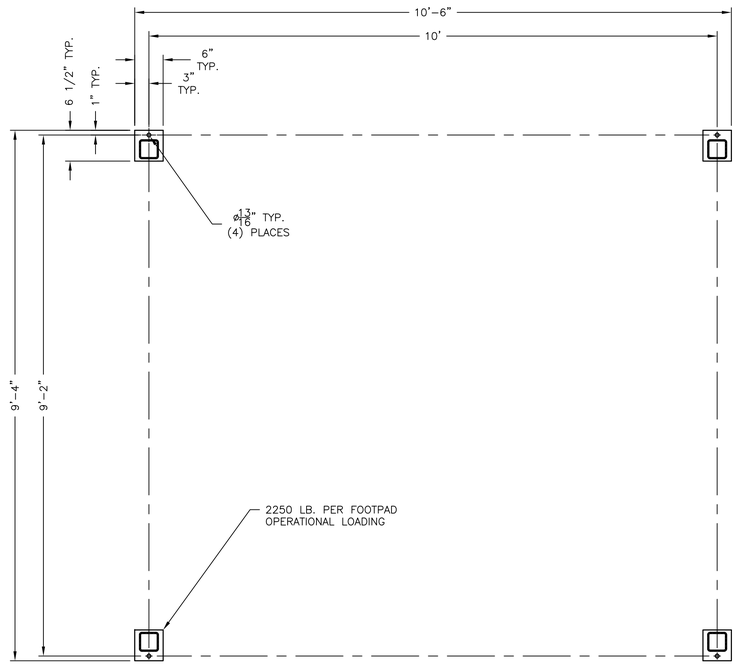




DISCHARGE END VIEW

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4' x 10' RDT | DWG TITLE: DUAL ø4' x 10' RDT GENERAL ARRANGEMENT | |
| BDP JOB NO. 1529 | DWN BY: SKD | DATE: 8/27/19 | |
| APP'D BY: | SCALE: | SHT. 1 OF 2 | REV. 1 |
| | | DWG NO. 1-1529-1 | |




## FOOTPAD LAYOUT

NOTES:

1. FRAME IS STAINLESS STEEL A554–MT316.
2. ALL STAINLESS STEEL SHEET AND PLATE IS TYPE 316 SS. ALL FASTENERS AND MISCELLANEOUS HARDWARE IS TYPE 316 SS.
3. ESTIMATED WEIGHT: DRY: 8000 LB. OPERATING: 9000 LB.
4. PIPING BEYOND THIS POINT INDEPENDENTLY SUPPORTED (NOT BY BDP INDUSTRIES).
5. FOUNDATION MATERIALS, DESIGN, ETC. NOT BY BDP (DESIGN PER LOCAL CODES, ETC. – BY OTHERS).
6. SEW–EURODRIVE REDUCER, FT77BAM143, 198.31:1, 1.9375" BORE, M5A MOUNT, NON–SYMMETRICAL TORQ–LOC, RAIL HOLES WITH EXPLOSION PROOF WEG MOTOR 00118XP3ER143TC 1HP 460V.

CONNECTION LEGEND

- A 6"–150# ANSI FEED INLET FLANGE
- B (2) 1–1/2" VIC WASH WATER INLET; 34 GPM @ 80 PSIG TOTAL
- C 6"–150# FILTRATE OUTLET
- D 8"–150# THICKENED SLUDGE OUTLET
- E 8"–150# ODOR OUTLET

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|
| 2 | E–STOP BUTTON | A.B. | 22 | 800H–FPX6A1 |
| 1 | ELECTRICAL JUNCTION BOX | NEMA 7 | 21 | |
| 96 | DRUM FABRIC KEEPER | 316 SS | 20 | |
| 2 | DRUM FILTER MEDIA; 52" x 146" | FILTER BELTS | 19 | SS20 MESH |
| 2 | DRUM FILTER MEDIA; 54" x 146" | FILTER BELTS | 18 | SS20 MESH |
| 2 | INLET PIPE SEAL | PALMETTO | 17 | 9155–0120–981P |
| 2 | ZERO SPEED SWITCH | A.B. | 16 | 871TM–DR8NE18H2 |
| 2 | DRUM SHOWER; 304 SS | APPLETON | 15 | 147999 |
| 4 | SS CAM FOLLOWER BEARING | CARTER | 14 | SC 64 SB |
| 2 | DRUM DRIVE; 1HP | | 13 | SEE NOTE 6 |
| 8 | FILTRATE PAN ACCESS DOOR | 316 SS | 12 | |
| 2 | DRUM SIDE COVER | 316 SS | 11 | |
| 1 | DRUM COVER ASSEMBLY | 316 SS | 10 | |
| 1 | FILTRATE PAN | 316 SS | 9 | |
| 1 | DISCHARGE CHUTE | 316 SS | 8 | |
| 4 | CAM FOLLOWER SPACER | 316 SS | 7 | |
| 2 | FEED SUPPORT BEARING GUARD | 316 SS | 6 | |
| 2 | INLET PIPE CLAMP | STAUFF | 5 | |
| 2 | FEED END SUPPORT | | 4 | |
| 2 | 4" BALL VALVE | PVC | 3 | |
| 2 | DEWATERING DRUM | 316 SS | 2 | |
| 1 | DRUM SUPPORT FRAME | 316 SS | 1 | |

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4' x 10' RDT | DWG TITLE: DUAL ø4' x 10' RDT GENERAL ARRANGEMENT | |
| BDP JOB NO. 1529 | DWN BY: SKD | DATE: 8/27/19 | |
| APP'D BY: | SCALE: | SHT. 2 OF 2 | REV. 1 |
| | | DWG NO. 1–1529–1 | |

| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/13/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| DRUM DRIVE | | | | | | |
| | 2 | SEW-EURODRIVE | **FT77BAM143** | GEAR REDUCER; 198.31:1, 1.9375" BORE, M5A MOUNT, NON-SYMMETRICAL TORQ-LOC, RAIL HOLES | | 2 |
| | 2 | WEG | 00118XP3ER143TC | MOTOR, EXPLOSION PROOF, INVERTER RATED, C-FACED, FOOTLESS, 1HP, 208-230/460V, 60Hz, 1765 RPM, 143TC FRAME, CLASS F INSULATION | | 2 |

# PRODUCTFOCUS

SEW EURODRIVE

## F-Series (theSnuggler®)
### Parallel Helical Gearmotors

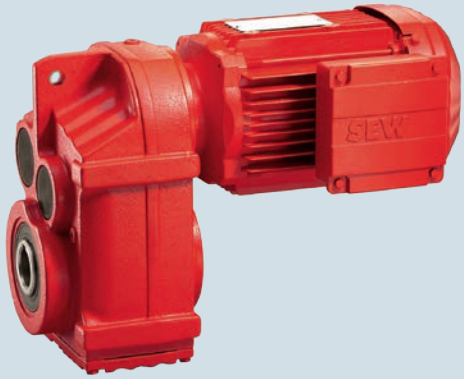
SEW-EURODRIVE's F-Series parallel helical gearmotor is the ideal drive for tight spaces. This compact drive, with its multiple mounting configurations and shaft designs, is a rugged alternative to right-angle gearmotors.

### Product Range

- Power ratings from 0.05 to 336 HP
- Ratios from 3.77 to 29,211
- Output torques to 159,300 lb-in

### Reducer

- Efficiency = 97% (2-stage) or 95.5% (3-stage)
- Gears manufactured from certified steel, heat treated to a case hardness of 58-62 Rockwell C for infinite fatigue strength
- Finished ground or shaved gear teeth to assure minimum noise, minimum heat, and maximum mechanical efficiency (approximately 1.5% loss/stage)
- Anti-friction bearings for optimum load capacity and long life
- Captured keys on input and output shafts
- F37-F157 gear housing contains high strength cast iron, SAE Class 30 or equivalent (GG20)
- F27 housing contains high strength pressure-cast aluminum
- O-ring on flange to prevent oil leakage when mounted on a surface that is not totally flat
- High cross-section modulus design, rugged monobloc design for maximum rigidity
- Center tapped holes on output shafts to aid the installation of shaft components
- Exclusive interlocking 2-piece seal design consisting of a patented bi-helix FKM inner seal and a double-lip Nitrile (Buna N) outer seal – provides three sealing surfaces against contaminants
- Metric or Inch dimension output shafts
- Removable inspection cover
- Shock capacity meets or exceeds AGMA 6009-A00




### Motor

- Inverter duty
- Connection terminals
- Low rotor inertia for high cycling and tight control
- EISA (IE3) "Premium" available
- 50Hz, 60Hz, or 50/60Hz global motor
- CE for shipment into Europe

### Mounting

- Built-in torque arm for shaft mounting
- B14 or B5 flange with centering tenon
- Tapped rail holes for foot mounting
- Can be ordered for any mounting orientation

### Optional Features

- C-Face or IEC motor adapter
- TorqLOC® taper hollow shaft
- Heavy duty taper roller bearings (FA67-FA127)
- FKM seals instead of NBR
- Corrosion and/or long term storage protection
- High cycling fail-safe brake
- Forced cooling fan for low frequency operation
- Thermostat or thermistor protection
- Plug connectors for quick motor replacement
- Two-speed motor
- Motor encoder - built-in or externally mounted
- CSA hazardous location and ATEX rated motors

# PRODUCTFOCUS

SEW EURODRIVE

9MD1203 / 0813

## About SEW-EURODRIVE

As a world leader in drive technology and a pioneer in drive-based automation, SEW-EURODRIVE has established a reputation for quickly solving the most difficult power transmission and motion control challenges. We introduced the gearmotor in 1931. In the 82 years since then, we have been bringing the best in drive technology to our customers. That commitment has led to a history of innovations - the first variable speed gearmotor, early development of electronic drives, some of the first successful efforts to decentralize control, and the first motor with energy-efficient copper rotors.

Of course none of that matters without satisfied customers. Quickly solving problems so that our customers can be more productive and profitable continues to be our priority. We offer the broadest product line in the industry - from gear- motors and heavy industrial gear units to electronic drives, software and complete drive-based automation systems. Our products are based on a unique system of modular components that can be assembled in literally millions of different configurations so every drive solution is custom built to our customer's exact specifications. Our regional assembly centers stock millions of dollars of our modular inventory for quick delivery of drive solutions and spare parts anywhere in the U.S.

At SEW-EURODRIVE our expertise doesn't stop with the sale of our products. We offer one of the most accessible customer support systems in the industry. Our trained product specialists are readily available for on-site start up assistance and applications support. In addition, our PT Pilot® drive selection quickly selects the drive for your specific needs. Our customer service personnel, engineers, product specialists, and service technicians are available to answer questions and troubleshoot problems. SEW-EURODRIVE offers on-call emergency technical support around the clock.

SEW-EURODRIVE brings together everything you need to drive performance for your systems: superior products, unsurpassed engineering, technical support, and innovative new technologies. We invite you to experience the SEW-EURODRIVE difference.

## U.S. Operations

**Midwest Region**
SEW-EURODRIVE, Inc.
2001 West Main St.
Troy, OH 45373
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F: (864) 439-7830
cslyman@seweurodrive.com

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F: (214) 330-4724
csdallas@seweurodrive.com

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F: (510) 487-6433
cshayward@seweurodrive.com

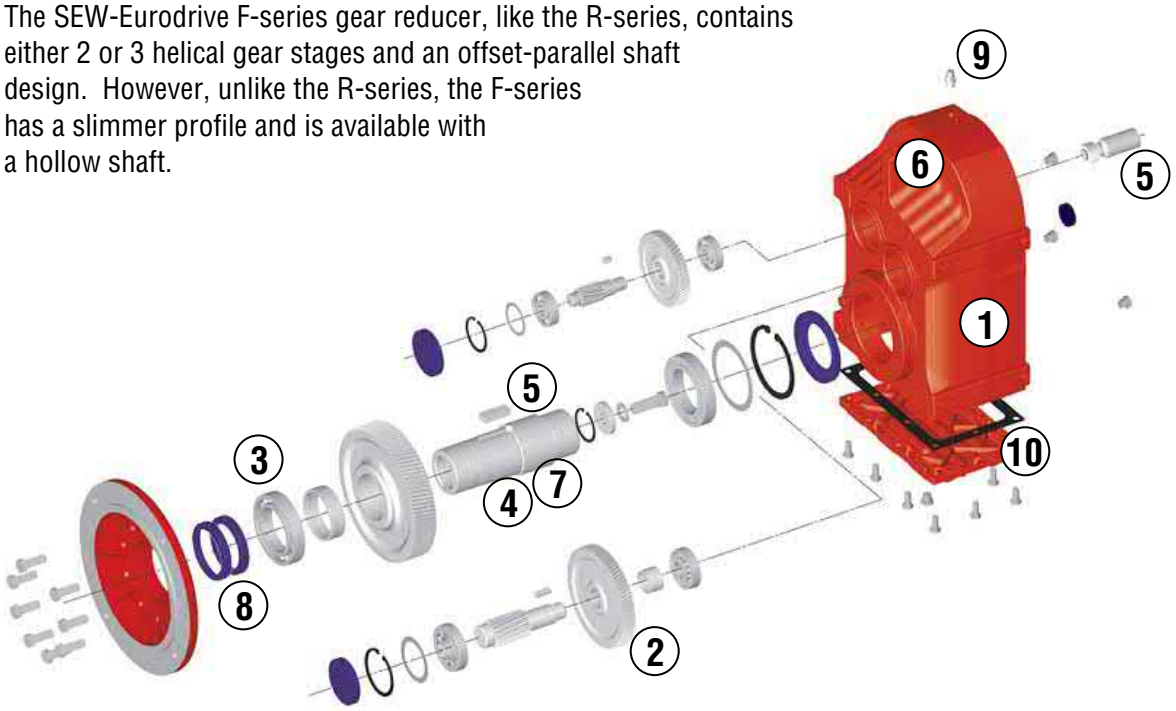
# Technical Note

## F-Series Gear Reducer - theSnuggler®

F-Series

### Features

The SEW-Eurodrive F-series gear reducer, like the R-series, contains either 2 or 3 helical gear stages and an offset-parallel shaft design. However, unlike the R-series, the F-series has a slimmer profile and is available with a hollow shaft.




1. SAE Class 30 or equivalent (GG20) gray cast iron housing and flanges on sizes F37-F157. No bolt-on bearing covers
2. Finish ground or shaved steel gears heat treated and hardened to 58-62 Rockwell C
3. ABEC-1 bearing tolerances
4. SAE 1045 steel shafts
5. Captured keys on input and output shafts
6. Corrugated surface improves heat dissipation and reduces vibration
7. Input and output shafts available in either inch or metric sizes. Solid shafts contain a center-tapped hole to ease the mounting of components onto the shaft.
8. Exclusive **interlocking** 2-piece seal design consisting of a patented bi-helix Viton® inner seal and a double-lip Nitrile (Buna N) outer seal to provide three sealing surfaces against contaminants (not available on F27/F37)
9. Oil level and breather plugs strategically placed according to the customer's mounting position
10. Removable inspection cover

## *Additional Features:*

- **Style**: Parallel shaft orientation (motor shaft is parallel to output shaft) in either 2 or 3 gear stages
- **Flange**: Contains O-ring to minimize oil leakage that may result from mounting to a "flat" surface that exceeds acceptable tolerances. Also contains a centering tenon (pilot) and is available with either through holes (B5) or tapped holes (B14).
- **Input Types**: Available with adapters to accommodate NEMA or IEC motor frames, solid input shafts, backstops, adjustable motor mounting platforms, and scoops. Also accepts an R-series reducer as the input (ex: FAF67R37) to attain higher ratios and lower output speeds
- **Output Shaft – Keyed**: Metric or inch shaft available in hollow or solid designs. Keyed hollow shaft supplied with special mounting paste and a retaining kit. Paste protects against corrosion as is available in regular or food grade. Retaining kit secures customer's solid shaft and contains bolt, washer, and protective cap.
- **Output Shaft – Keyless**: Available as a metric shrink disc, an inch tapered bushing (TorqLOC™), or a DIN 5480 spline
- **Mounting**: Available as foot (rail), flange, or shaft mount
- **Torque Ratings**: Based upon mechanical capacity under continuous duty operation
- **Torque Capacity**: From 930 lb-in to 159,300 lb-in
- **Shaft Rotation**: Unrestricted - clockwise or counterclockwise
- **Efficiency**: 97% (2-stage), 95.5% (3-stage) - 1.5% efficiency loss per gear stage
- **Ratio Range – Single**: 3.77 to 281.71
- **Ratio Range – Compound**: 134 to 29,211
- **Fatigue Strength**: Shafts and gears designed for infinite fatigue strength
- **Shock Capacity**: Meets or exceeds AGMA 6009-A00, which states that reducer must be capable of withstanding 4 shock loads within an 8-hour period – each shock equal to 200% of the maximum rated torque for 2 seconds.

## Housing Material

Except for the F27, all SEW F-series gear reducers are manufactured from SAE 30 or equivalent (GG20) gray cast iron due to the following benefits:

- Cast iron flows well, allowing it to be used on intricate castings.
- Cast iron machines well.
- Cast iron serves as an excellent damping material to minimize vibration, contributing to longer bearing life and longer gear life.

Ductile iron (or nodular iron), a type of cast iron containing magnesium, is 2 to 4 times stiffer than gray cast iron. It is often used in applications involving heavy shock loads at low temperatures – when gray iron housings lose much of their shock absorbing strength.

Ductile iron housings are not available on F-series reducers.

## Optional Bearings

Some F-series reducers are available with optional heavy-duty bearings as listed below. Heavy-duty bearings increase the axial and overhung load capacity and are standard on SEW Screw Conveyor Drives. For more information, contact SEW Regional Engineering.

| Unit | Output Bearings | |
|---|---|---|
| | Standard | Optional |
| **FA / FAF / FAZ 67** | Ball | Taper Roller |
| **FA / FAF / FAZ 77** | Ball | Taper Roller |
| **FA / FAF / FAZ 87** | Ball | Taper Roller |
| **FA / FAF / FAZ 97** | Ball | Taper Roller |
| **FA107** | Ball | Taper Roller |
| **FA127** | Ball | Taper Roller |

***Note***: Heavy-duty bearing option is only available with a metric hollow shaft.

# Technical Note

## *Foot Mounting*

The F-series reducer is not "foot mounted" in the traditional sense, since it does not have feet with through-holes for mounting. Instead, tapped holes are provided along two raised rails on each side of the reducer, as shown at right.

**F67**

These rail holes are standard on all F-units, except on the following four styles:

- FA (keyed hollow shaft)
- FT (TorqLOC keyless tapered bushing)
- FV (DIN spline)
- FH (metric shrink disc)

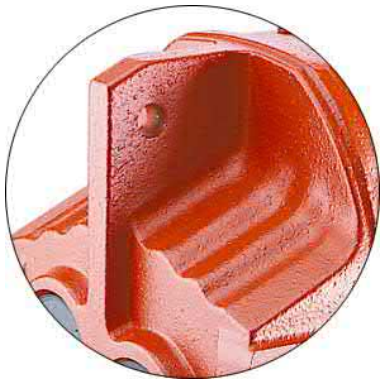
For the FA, FT, FH, or FV styles, rail holes may be ordered as an option. The letter "**B**" is added to the nomenclature and placed after the reducer size (ex: FA67B…) to designate this option, as shown at right.

**FA67**

**FA67B**

## *Shaft Mounting – Torque Arm*

The preferred method of installing a hollow shaft reducer is to hang the reducer from a solid shaft and to allow the solid shaft to support the entire weight of the reducer and motor. Since this method does not require the use of feet or a flange, the reducer has a natural tendency to spin around the shaft if not restrained. To provide a mean of restraint, the F-series reducer contains a built-in mounting lug as shown at right.

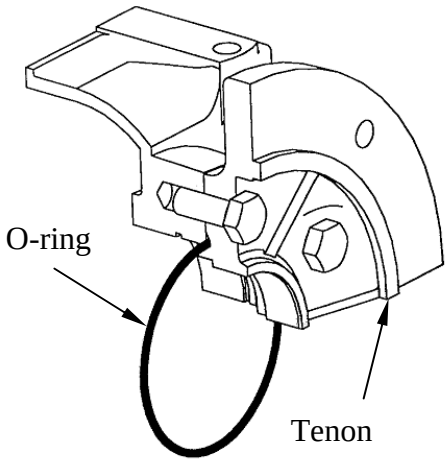


The customer must provide an adequate mounting bracket. Optional rubber grommets are available from SEW for cushioning the reducer. See **Tech Note GM-021** for information on appropriate torque arm design and installation.

# Technical Note

## *Flange Mounting*

Two flange styles are available: **B5** and **B14**. Both styles contain an O-ring and tenon (pilot) as shown at right.




The O-ring helps prevent oil leakage that could occur if the flange is mounted to a "flat" surface that exceeds the recommended flatness tolerance.

The tenon allows for easier installation as well as protects the reducer from shifting out of alignment if the mounting bolts were to loosen.

**B5 Flange ("F")**
A B5 flange bolts onto the reducer housing and contains through-holes (non-threaded) for mounting. These holes are intentionally made slightly larger than the bolts for which they are intended. The letter "**F**" is added to the nomenclature to designate this option.

**FAF67**

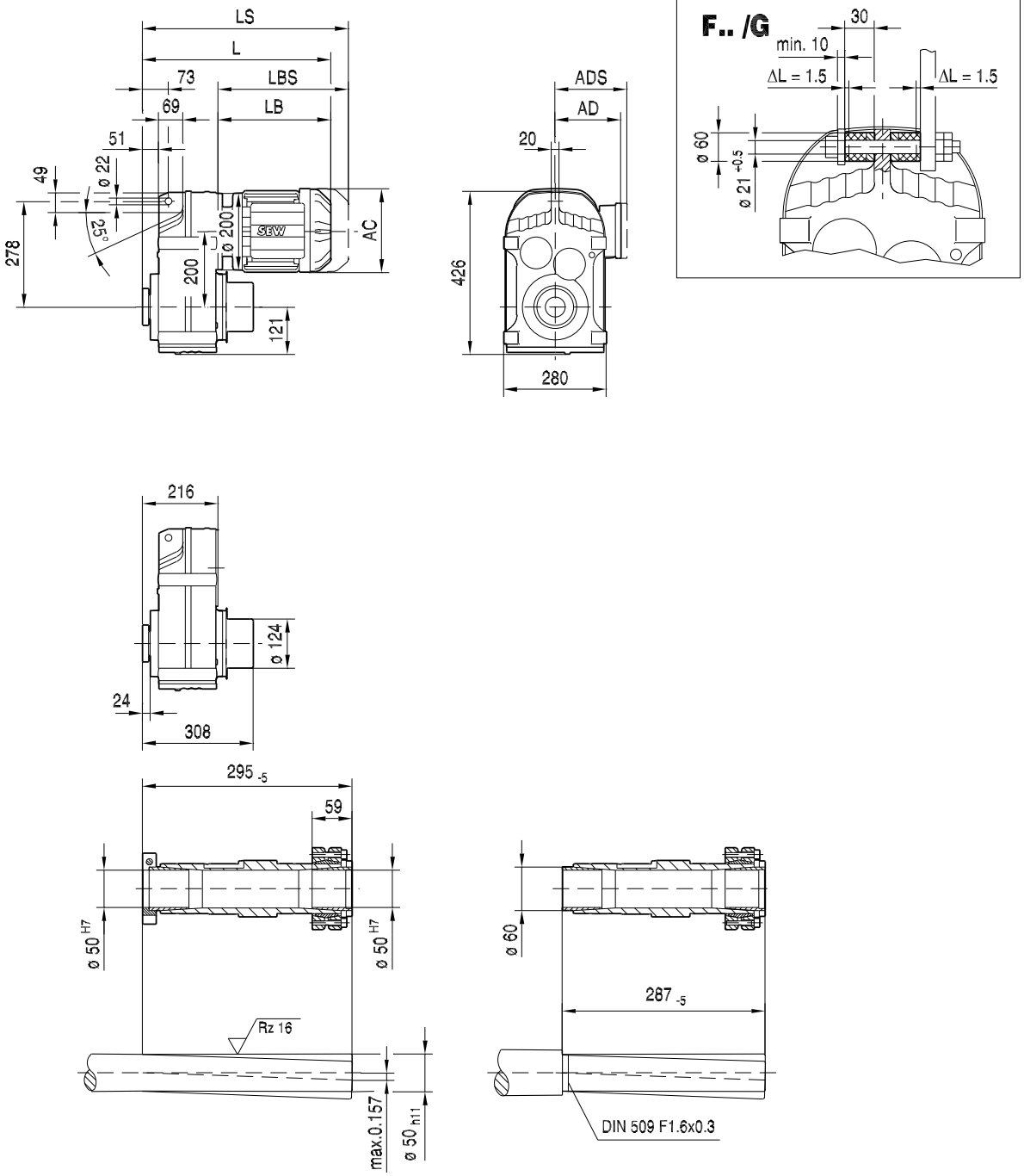
**B14 Flange ("Z")**
A B14 flange bolts onto the housing. It contains through holes to allow access to the tapped holes of the housing. The bolt circle and tenon diameters are smaller on the B14 than on the B5 flange of the same reducer. The letter "**Z**" is added to the nomenclature to designate this option.

**FAZ67**

Reference **Tech Note GM-020** for important additional information on mounting procedures for flanged units.

**FT77..**

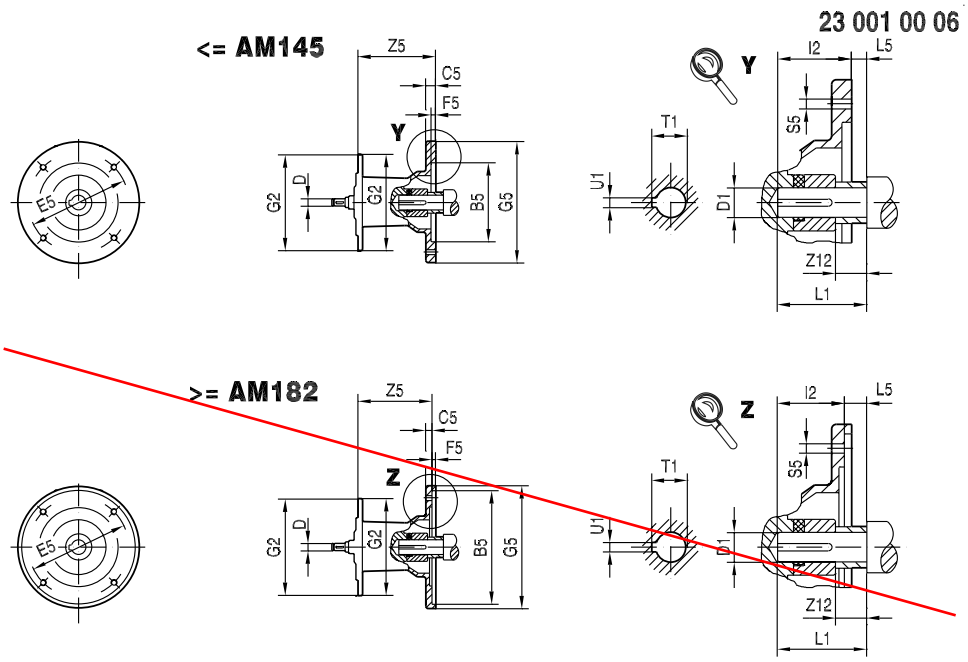
42 048 00 14




| (→ 155) | DR71S | DR71M | DRN80M | DRN90S | DRN90L | DRN100LS | DRN100L | DRN112M | DRN132S | DRN132M | DRN132L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **AC** | 139 | 139 | 156 | 179 | 179 | 197 | 197 | 221 | 221 | 261 | 261 |
| **AD** | 119 | 119 | 128 | 140 | 140 | 157 | 157 | 170 | 170 | 228 | 228 |
| **ADS** | 129 | 129 | 139 | 150 | 150 | 158 | 158 | 172 | 172 | 228 | 228 |
| **L** | 405 | 430 | 484 | 486 | 518 | 514 | 564 | 595 | 645 | 663 | 689 |
| **LS** | 473 | 498 | 565 | 579 | 611 | 608 | 658 | 707 | 757 | 801 | 826 |
| **LB** | 189 | 214 | 268 | 270 | 302 | 298 | 348 | 379 | 429 | 447 | 473 |
| **LBS** | 257 | 282 | 349 | 363 | 395 | 392 | 442 | 491 | 541 | 585 | 610 |

22301828/EN – 11/2015

## 10.7 Adapters for mounting NEMA motors




| Gear unit type | Adapter type | Dimensions in inch | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B5 | C5 | D[1] | E5 | F5 | G2 | G5 | I2 | L5 | S5 | Z5 | Z12 | D1 | L1 | T1 | U1 |
| R..27, R..37<br>F..27, F..37, F..47<br>K..37<br>S..37, S..47,<br>S..57 | AM56 | 4.50 | 0.43 | 10 | 5.87 | 0.18 | 4.72 | 6.69 | 2.07 | -0.19 | 0.41 | 3.68 | 0.65 | 0.625 | 1.85 | 0.71 | 0.1875 |
| | AM143 | | 0.47 | 12 | | | | | 2.13 | 0.12 | | 4.61 | 0.57 | 0.88 | 2.24 | 0.97 | |
| | AM145 | | | 14 | | | | | | | | | | | | | |
| R..47, R..57,<br>R..67, F..57,<br>F..67, K..47[2]<br><br>K..57, K..67<br>S..67 | AM56 | 4.50 | 0.43 | 10 | 5.87 | 0.18 | 6.30 | 6.69 | 2.07 | -0.19 | 0.41 | 3.43 | 0.65 | 0.625 | 1.85 | 0.71 | 0.1875 |
| | AM143 | | 0.47 | 12 | | | | | 2.13 | 0.12 | | 4.35 | 0.57 | 0.875 | 2.24 | 0.97 | |
| | AM145 | | | 14 | | | | | | | | | | | | | |
| | AM182 | 8.50 | 0.39 | 16 | 7.24 | 0.20 | | 8.98 | 2.63 | 0.12 | 0.59 | 5.81 | 0.65 | 1.125 | 2.72 | 1.25 | 0.25 |
| | AM184 | | | 18 | | | | | | | | | | | | | |
| | AM213/215 | | 0.43 | 22 | | | | | 3.13 | 0.25 | | 7.89 | 0.62 | 1.375 | 3.35 | 1.52 | 0.3125 |
| R..77<br>F..77<br>K..77<br>S..77 | AM56 | 4.50 | 0.43 | 10 | 5.87 | 0.18 | 7.87 | 6.69 | 2.07 | -0.19 | 0.41 | 3.19 | 0.65 | 0.625 | 1.85 | 0.71 | 0.1875 |
| | AM143 | | 0.47 | 12 | | | | | 2.13 | 0.12 | | 4.07 | 0.57 | 0.875 | 2.24 | 0.97 | |
| | AM145 | | | 14 | | | | | | | | | | | | | |
| | AM182 | 8.50 | 0.39 | 16 | 7.24 | 0.20 | | 8.98 | 2.63 | 0.12 | 0.59 | 5.49 | 0.65 | 1.125 | 2.72 | 1.25 | 0.25 |
| | AM184 | | | 18 | | | | | | | | | | | | | |
| | AM213/215 | | 0.43 | 22 | | | | | 3.13 | 0.25 | | 7.42 | 0.62 | 1.375 | 3.35 | 1.52 | 0.3125 |
| R..87<br>F..87<br>K..87<br>S..87 | AM143 | 4.50 | 0.47 | 12 | 5.87 | 0.18 | 9.84 | 6.69 | 2.13 | 0.12 | 0.41 | 3.88 | 0.57 | 0.875 | 2.24 | 0.97 | 0.1875 |
| | AM145 | | | 14 | | | | | | | | | | | | | |
| | AM182 | 8.50 | 0.39 | 16 | 7.24 | 0.20 | | 8.98 | 2.63 | 0.12 | 0.59 | 5.30 | 0.65 | 1.125 | 2.72 | 1.25 | 0.25 |
| | AM184 | | | 18 | | | | | | | | | | | | | |
| | AM213/215 | | 0.43 | 22 | | | | | 3.13 | 0.25 | | 7.22 | 0.62 | 1.375 | 3.35 | 1.52 | 0.3125 |
| | AM254/256 | | 0.47 | 28 | | | | | 3.75 | | | 9.21 | 0.35 | 1.625 | 3.98 | 1.80 | 0.375 |
| | AM284/286 | 10.50 | 0.59 | 32 | 9.00 | | | 11.26 | 4.37 | | | 9.49 | 0.62 | 1.875 | 4.61 | 2.10 | 0.5 |

1) Dimension in mm

2) Not with AM213/215

# HIGH EFFICIENCY MOTORS
# EXPLOSION PROOF - THREE PHASE
# TEFC

WEG Explosion Proof motors are suitable for applications requiring UL or CSA certification for hazardous locations.

* * Class F insulation (Impregnation Resin and Magnet wire are class H)
* F1 Mounted (Cast Iron frames are F2 convertible).
* Stainless Steel Nameplate - Laser etched with High contrast background
* All frames with regreasable ball bearings (Frames 364T and up)
* CSA Approved - File LR50962
  - Class I, Division 1, Groups C & D Temperature Code T3C
  - Class II, Division 1, Groups F & G Temperature Code T3C
* UL Approved - File E 87848
  - Class I, Division 1, Groups C & D
  - Class II, Division 1, Groups F & G
  - Frame (143T-326T) Temperature Code T4
  - Frame (364T and up) Temperature Code T3C

## Features that make a difference:

* NPT threaded terminal box
* Non-sparking fan
* Thermostats
* IP55 rated enclosure
* VFD Service 12:1 CT; 1000:1 VT (cCSAus and excludes frames 449T & 586/7)

*CSA files are NRTL cCSAus listings*

## *Inverter Rated:*
## *CSA US (Certificate 1629892)*

### *Constant Torque*
*12:1 for frames 143T to 447T) - Class I & II*
*4:1 for frame 449T - Class I only*
*12:1 for frame 504/5 - Class I & II*
*2:1 for frame 586/7 - Class I & II*

### *Variable Torque*
*1000:1 for all frames excluding 449T - Class I & II*
*1000:1 for 449T - Class I only*

## *EXPLOSION PROOF MOTORS*
## *GENERAL PURPOSE*
## *TEFC - THREE PHASE – FOOT MOUNT - HIGH EFFICIENCY*

| HP | kW | RPM | NEMA Frame | Catalog Number | List Price | Mult. Symbol | Approx. Shipping Weight (lbs) | Service Factor | FL Amps @ High | FL. Eff (%) | "C" Dimension (in) | Voltage (V) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.75 | 900 | 182T | 00109XP3E182T | 1,512 | X1 | 140 | 1.15 | 2.31 | 74.0 | 14.862 | 230/460 | 30 |
| 1.5 | 1.1 | 900 | 184T | 00159XP3E184T | 1,548 | X1 | 164 | 1.15 | 2.71 | 77.0 | 15.862 | 230/460 | 30 |
| 2 | 1.5 | 900 | 213T | 00209XP3E213T | 1,953 | X1 | 207 | 1.15 | 3.46 | 82.5 | 17.952 | 230/460 | 30 |
| 3 | 2.2 | 900 | 215T | 00309XP3E215T | 2,134 | X1 | 225 | 1.15 | 4.39 | 84.0 | 19.450 | 230/460 | 30 |
| 5 | 3.7 | 900 | 254T | 00509XP3E254T | 3,237 | X1 | 321 | 1.15 | 7.09 | 85.5 | 23.175 | 230/460 | 30 |
| 7.5 | 5.5 | 900 | 256T | 00709XP3E256T | 3,675 | X1 | 406 | 1.15 | 11.2 | 86.5 | 24.923 | 230/460 | 30 |
| 10 | 7.5 | 900 | 284T | 01009XP3E284T | 4,631 | X1 | 549 | 1.15 | 13.6 | 88.5 | 26.407 | 230/460 | 30 |
| 15 | 11 | 900 | 286T | 01509XP3E286T | 5,677 | X1 | 622 | 1.15 | 19.0 | 88.5 | 27.905 | 230/460 | 30 |
| 20 | 15 | 900 | 324T | 02009XP3E324T | 6,984 | X1 | 753 | 1.15 | 28.0 | 89.5 | 29.602 | 230/460 | 30 |
| 25 | 18.5 | 900 | 326T | 02509XP3E326T | 8,513 | X1 | 861 | 1.15 | 35.5 | 89.5 | 31.106 | 230/460 | 30 |

Refer to electrical and mechanical data sections for additional technical information. Please refer to back cover for description of "NOTES"


Data subject to change without notice.

## EXPLOSION PROOF MOTORS
## GENERAL PURPOSE
## TEFC - THREE PHASE – FOOT MOUNT - HIGH EFFICIENCY

| HP | kW | RPM | NEMA Frame | Catalog Number | List Price | Mult. Symbol | Approx. Shipping Weight (lbs) | Service Factor | FL Amps @ High | FL. Eff (%) | "C" Dimension (in) | Voltage (V) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 22 | 900 | 364/5T | 03009XP3E364T | 11,677 | X1 | 1,296 | 1.15 | 38.4 | 91.0 | 33.701 | 230/460 | 30 |
| 40 | 30 | 900 | 364/5T | 04009XP3E365T | 12,326 | X1 | 1,400 | 1.15 | 52.4 | 91.0 | 33.701 | 230/460 | 30 |
| 50 | 37 | 900 | 404/5T | 05009XP3E404T | 14,420 | X1 | 1,674 | 1.15 | 64.9 | 91.7 | 38.074 | 230/460 | 30 |
| 60 | 45 | 900 | 404/5T | 06009XP3E405T | 16,985 | X1 | 1,921 | 1.15 | 77.0 | 91.7 | 38.074 | 230/460 | 30 |
| 75 | 55 | 900 | 444/5T | 07509XP3E444T | 21,094 | X1 | 2,180 | 1.15 | 90.5 | 93.0 | 43.797 | 230/460 | 30 |
| 100 | 75 | 900 | 444/5T | 10009XP3E445T | 25,321 | X1 | 2,534 | 1.15 | 123 | 93.0 | 43.797 | 230/460 | 30 |
| | | 900 | 444/5T | 10009XP3G445T | 25,321 | X1 | 2,534 | 1.15 | 123 | 93.0 | 43.797 | 460 | 30 |
| 125 | 90 | 900 | 504/5 | 12509XP3G504 | 28,717 | X1 | 3,004 | 1.15 | 152 | 93.6 | 49.445 | 460 | 30 |
| 150 | 110 | 900 | 504/5 | 15009XP3G505 | 31,289 | X1 | 3,342 | 1.15 | 178 | 93.6 | 49.445 | 460 | 30 |
| 200 | 150 | 900 | 586/7 | 20009XP3G586/7 | 47,701 | X1 | 5,607 | 1.15 | 255 | 94.5 | 61.389 | 460 | 30 |
| 250 | 185 | 3600 | 504/5S | 25036XP3G505S | 25,936 | X1 | 2,573 | 1.15 | 267 | 95.4 | 46.875 | 460 | 30 |
| | | 1800 | 504/5 | 25018XP3G505 | 27,388 | X1 | 2,740 | 1.15 | 283 | 95.4 | 49.445 | 460 | 30 |
| | | 1200 | 586/7 | 25012XP3G586/7 | 46,557 | X1 | 4,002 | 1.15 | 305 | 95.0 | 61.389 | 460 | 30 |
| | | 900 | 586/7 | 25009XP3G586/7 | 50,701 | X1 | 6,238 | 1.15 | 313 | 95.0 | 61.389 | 460 | 30 |
| 300 | 220 | 3600 | 586/7S | 30036XP3G586/7S | 46,692 | X1 | 3,638 | 1.15 | 325 | 95.4 | 54.514 | 460 | 30 |
| | | 1800 | 586/7 | 30018XP3G586/7 | 40,772 | X1 | 4,322 | 1.15 | 329 | 95.4 | 61.389 | 460 | 30 |
| | | 1200 | 586/7 | 30012XP3G586/7 | 50,565 | X1 | 4,487 | 1.15 | 355 | 95.0 | 61.389 | 460 | 30 |
| | | 900 | 586/7 | 30009XP3G586/7 | 63,030 | X1 | 6,580 | 1.15 | 368 | 95.0 | 61.389 | 460 | 30 |
| 350 | 260 | 3600 | 586/7S | 35036XP3G586/7S | 54,890 | X1 | 3,859 | 1.15 | 384 | 95.4 | 54.514 | 460 | 30 |
| | | 1800 | 586/7 | 35018XP3G586/7 | 44,351 | X1 | 4,344 | 1.15 | 398 | 95.4 | 61.389 | 460 | 30 |
| | | 1200 | 586/7 | 35012XP3G586/7 | 59,710 | X1 | 6,352 | 1.15 | 428 | 95.4 | 61.389 | 460 | 30 |
| | | 900 | 586/7 | 35009XP3G586/7 | 64,770 | X1 | 6,807 | 1.15 | 440 | 95.0 | 61.389 | 460 | 30 |
| 400 | 300 | 1800 | 586/7 | 40018XP3G586/7 | 50,913 | X1 | 4,719 | 1.15 | 459 | 95.4 | 61.389 | 460 | 30 |
| | | 1200 | 586/7 | 40012XP3G586/7 | 62,894 | X1 | 6,709 | 1.15 | 481 | 95.4 | 61.389 | 460 | 30 |
| 450 | 330 | 1800 | 586/7 | 45018XP3G586/7 | 54,334 | X1 | 5,248 | 1.15 | 505 | 95.4 | 61.389 | 460 | 19; 30 |
| | | 1200 | 586/7 | 45012XP3G586/7 | 67,577 | X1 | 7,132 | 1.15 | 543 | 95.4 | 61.389 | 460 | 30 |
| 500 | 370 | 1800 | 586/7 | 50018XP3G586/7 | 58,405 | X1 | 5,469 | 1.00 | 564 | 95.8 | 61.389 | 460 | 1;19; 30 |

Refer to electrical and mechanical data sections for additional technical information.
Please refer to back cover for description of "NOTES"
Can't find what you are looking for? Call 1-800-ASK-4WEG (275-4934)
All data subject to change without notice

## EXPLOSION PROOF MOTORS
## GENERAL PURPOSE
## TEFC - THREE PHASE – C-FLANGE - FOOTLESS - HIGH EFFICIENCY

| HP | kW | RPM | NEMA Frame | Catalog Number | List Price | Mult. Symbol | Approx. Shipping Weight (lbs) | Service Factor | FL Amps @ High | FL. Eff (%) | "C" Dimension (in) | Voltage (V) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.75 | 1800 | 143TC | 00118XP3ER143TC | 764 | X1 | 71 | 1.15 | 1.49 | 82.5 | 12.760 | 230/460 | 15;30 |
| 1.5 | 1.1 | 1800 | 145TC | 00158XP3ER145TC | 790 | X1 | 78 | 1.15 | 2.05 | 84.0 | 13.752 | 230/460 | 15;30 |
| 2 | 1.5 | 1800 | 145TC | 00218XP3ER145TC | 802 | X1 | 80 | 1.15 | 2.77 | 84.0 | 13.752 | 230/460 | 15;30 |
| 3 | 2.2 | 1800 | 182TC | 00318XP3ER182TC | 1,030 | X1 | 132 | 1.15 | 4.05 | 87.5 | 14.862 | 230/460 | 15;30 |
| 5 | 3.7 | 1800 | 184TC | 00518XP3ER184TC | 1,056 | X1 | 137 | 1.15 | 6.55 | 87.5 | 15.862 | 230/460 | 15;30 |
| 7.5 | 5.5 | 1800 | 213TC | 00718XP3ER213TC | 1,515 | X1 | 196 | 1.15 | 9.53 | 89.5 | 17.952 | 230/460 | 15;30 |
| 10 | 7.5 | 1800 | 215TC | 01018XP3ER215TC | 1,618 | X1 | 211 | 1.15 | 12.8 | 89.5 | 19.450 | 230/460 | 15;30 |
| 15 | 11 | 1800 | 254TC | 01518XP3ER254TC | 2,111 | X1 | 319 | 1.15 | 18.1 | 91.0 | 23.175 | 230/460 | 15;30 |
| 20 | 15 | 1800 | 256TC | 02018XP3ER256TC | 2,556 | X1 | 352 | 1.15 | 24.6 | 91.0 | 24.923 | 230/460 | 15;30 |
| 25 | 18.5 | 1800 | 284TC | 02518XP3ER284TC | 3,257 | X1 | 503 | 1.15 | 29.6 | 92.4 | 26.407 | 230/460 | 15;30 |
| 30 | 22 | 3600 | 286TS | 03036XP3ER286TSC | 3,472 | X1 | 472 | 1.15 | 33.8 | 91.0 | 26.531 | 230/460 | 15;30 |
| | | 1800 | 286TC | 03018XP3ER286TC | 3,692 | X1 | 547 | 1.15 | 34.7 | 92.4 | 27.905 | 230/460 | 15;30 |
| 40 | 30 | 1800 | 324TC | 04018XP3ER324TC | 4,643 | X1 | 623 | 1.15 | 47.6 | 93.0 | 29.602 | 230/460 | 15;30 |
| 50 | 37 | 1800 | 326TC | 05018XP3ER326TC | 5,425 | X1 | 720 | 1.15 | 58.7 | 93.0 | 31.106 | 230/460 | 15;30 |

Refer to electrical and mechanical data sections for additional technical information.
Please refer to back cover for description of "NOTES"
Can't find what you are looking for? Call 1-800-ASK-4WEG (275-4934)
All data subject to change without notice

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/13/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| BEARINGS | | | | | | |
| | 4 | CARTER | **SC-64-SBEU** | CAM FOLLOWER BEARING, 2", 440C SS CONSTRUCTION, STANDARD STUD, 1/8"-27 GREASE INLET IN END OF STUD | | 4 |

# Bearings Are Our Business

CARTER

*Bearings Are Our Business*

# Xtenda™

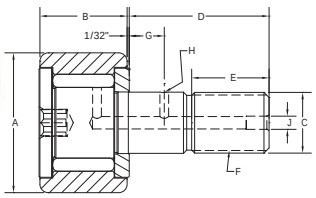
## Stainless Steel Cam Followers and Cam Yoke Rollers

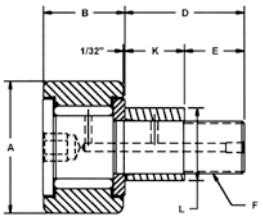
### Xtenda™

Carter's Xtenda Series stainless steel needle bearings are available in both standard and custom sizes. You can order Cam Followers from stock in sizes 1/2 thru 2 1/2 and cam yoke rollers from 3/4 thru 2 1/2, with custom designs available for virtually any special application.

All standard Xtenda Series bearings are dimensionally interchangeable with standard cam followers and cam yoke rollers offered by other major manufacturers. But Carter bearings offer many advantages over other bearings. Our Seal Tight design minimizes contamination to keep your machinery running longer. We use a food-grade lubricant in our Xtenda Series bearings to ensure compatibility with any application. Other lubricants are also available. Our high precision manufacturing produces a bearing that can minimize expensive shutdowns due to bearing failure.

# Xtenda™ Needle Bearing Cam Followers - Standard Stainless Steel






## Needle Bearing Cam Followers - Standard Stainless Steel

### Hexed & Sealed

| Part Number | | | Roller | | Stud | | | | Lubrication | | | Other Specs. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | G | H | J | | | | | |
| Size | Sealed | Crowned | Roller O.D +.000 -.001 | Roller Width +.000 -.005 | Stud Dia. +.001 -.000 | Stud Length +.010 -.010 | Min. Eff. Thread Length +.030 -.030 | Thread Class 2A | Oil Hole Center | Oil Hole Dia. | Lube Fitting Size | Min. Boss Dia. | Recom. Bore +.0005 -.0000 | **Recm. Torque Inch Pounds | Basic Dynamic Rating (lbs.) | Max. Static Capacity (lbs.) |
| 1/2 | SC-16-SB | CSC-16-SB | .500 | .375 | .190 | .625 | 1/4 | 10-32 | ~ | ~ | ~ | 19/64 | .1900 | 8 | 610 | 310 |
| 5/8 | SC-20-SB | CSC-20-SB | .625 | .438 | .250 | .750 | 39/125 | 1/4-28 | ~ | ~ | ~ | 23/64 | .2500 | 18 | 860 | 600 |
| 11/16 | SC-22-SB | CSC-22-SB | .6875 | .438 | .250 | .750 | 39/125 | 1/4-28 | ~ | ~ | ~ | 23/64 | .2500 | 18 | 860 | 600 |
| 3/4 | SC-24-SB | CSC-24-SB | .750 | .500 | .375 | .875 | 3/8 | 3/8-24 | 1/4 | 3/32 | 3/16 | 1/2 | .3750 | 48 | 1490 | 1500 |
| 7/8 | SC-28-SB | CSC-28-SB | .875 | .500 | .375 | .875 | 3/8 | 3/8-24 | 1/4 | 3/32 | 3/16 | 1/2 | .3750 | 48 | 1490 | 1500 |
| 1 | SC-32-SB | CSC-32-SB | 1.000 | .625 | .438 | 1.000 | 1/2 | 7/16-20 | 1/4 | 3/32 | 3/16 | 41/64 | .4375 | 125 | 2000 | 1800 |
| 1 1/8 | SC-36-SB | CSC-36-SB | 1.125 | .625 | .438 | 1.000 | 1/2 | 7/16-20 | 1/4 | 3/32 | 3/16 | 41/64 | .4375 | 125 | 2000 | 1800 |
| 1 1/4 | SC-40-SB | CSC-40-SB | 1.250 | .750 | .500 | 1.250 | 5/8 | 1/2-20 | 5/16 | 3/32 | 3/16 | 49/64 | .5000 | 175 | 3530 | 2300 |
| 1 3/8 | SC-44-SB | CSC-44-SB | 1.375 | .750 | .500 | 1.250 | 5/8 | 1/2-20 | 5/16 | 3/32 | 3/16 | 49/64 | .5000 | 175 | 3530 | 2300 |
| 1 1/2 | SC-48-SB | CSC-48-SB | 1.500 | .875 | .625 | 1.500 | 3/4 | 5/8-18 | 3/8 | 3/32 | 3/16 | 57/64 | .6250 | 325 | 4350 | 4000 |
| 1 5/8 | SC-52-SB | CSC-52-SB | 1.625 | .875 | .625 | 1.500 | 3/4 | 5/8-18 | 3/8 | 3/32 | 3/16 | 57/64 | .6250 | 325 | 4350 | 4000 |
| 1 3/4 | SC-56-SB | CSC-56-SB | 1.750 | 1.000 | .750 | 1.750 | 7/8 | 3/4-16 | 7/16 | 3/32 | 3/16 | 1 3/64 | .7500 | 625 | 5730 | 6000 |
| 1 7/8 | SC-60-SB | CSC-60-SB | 1.875 | 1.000 | .750 | 1.750 | 7/8 | 3/4-16 | 7/16 | 3/32 | 3/16 | 1 3/64 | .7500 | 625 | 5730 | 6000 |
| 2 | SC-64-SB | CSC-64-SB | 2.000 | 1.250 | .875 | 2.000 | 1 | 7/8-14 | 1/2 | 1/8 | 3/16 | 1 13/64 | .8750 | 750 | 7270 | 8200 |
| 2 1/4 | SC-72-SB | CSC-72-SB | 2.250 | 1.250 | .875 | 2.000 | 1 | 7/8-14 | 1/2 | 1/8 | 3/16 | 1 13/64 | .8750 | 750 | 7270 | 8200 |
| 2 1/2 | SC-80-SB | CSC-80-SB | 2.500 | 1.500 | 1.000 | 2.250 | 1 1/8 | 1-14 | 9/16 | 1/8 | 3/16 | 1 5/16 | 1.000 | 1125 | 10430 | 12335 |

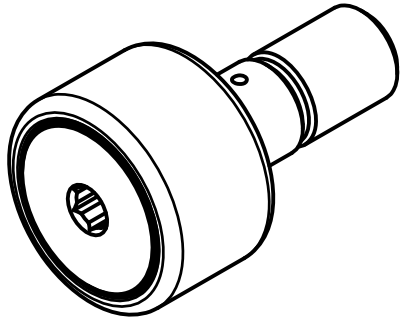
## Needle Bearing Cam Followers — Eccentric

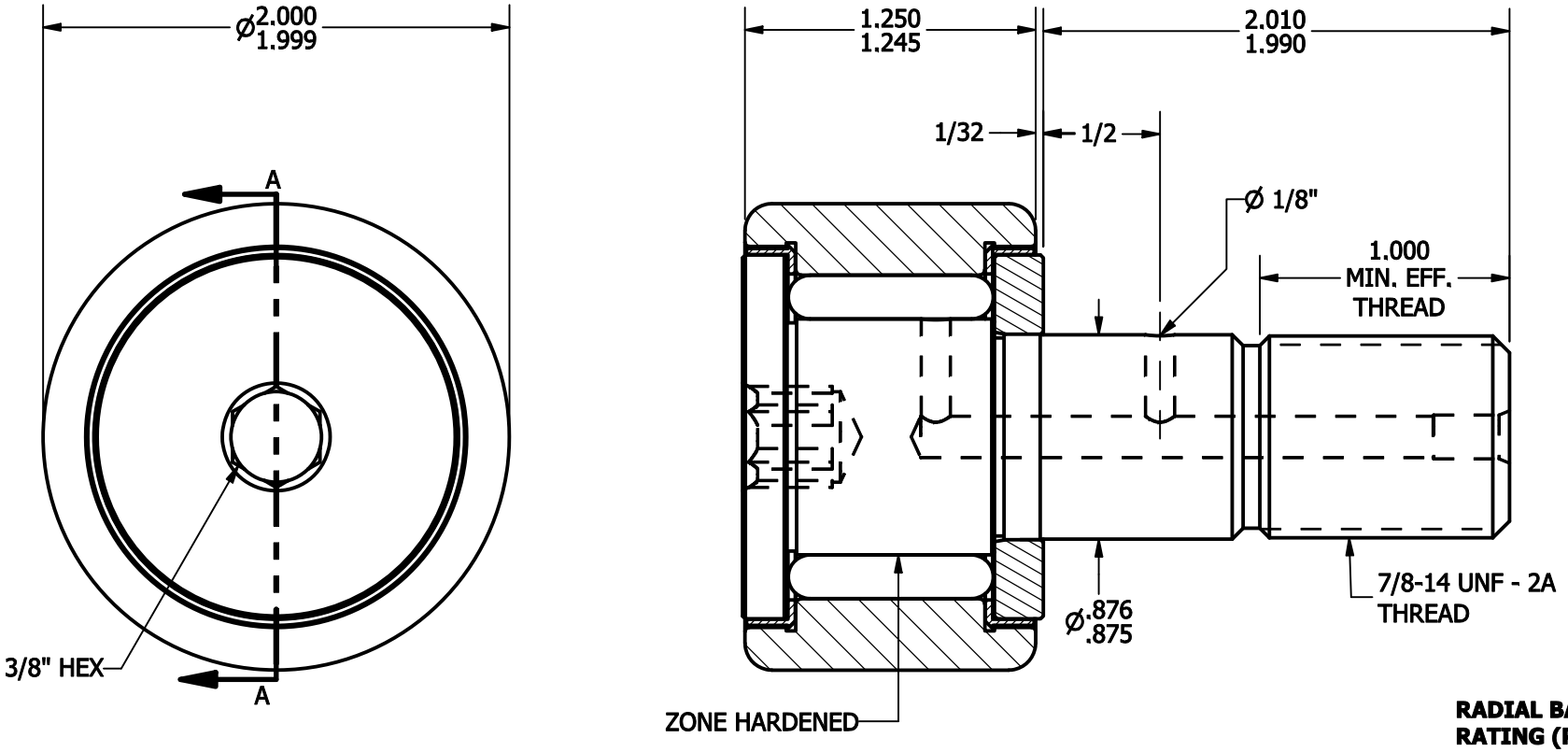
| Part Number | | | Roller | | Bushing | | Stud | | | Other Specs. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | K | L | D | E | F | | | |
| Size | Cylindrical | Crowned | Roller O.D. +.000 -.001 | Roller Width +.000 -.005 | Bushing Length +.000 -.010 | Bushing Dia. +.001 -.001 | StudLength +.010 -.010 | Min. Eff. Thread Length | Thread Class 2A | Min. Boss Dia. | **Recm. Torque Inch Pounds | Basic Dynamic Rating Pounds |
| 1/2 | SCE-16-SB | CSCE-16-SB | .500 | .375 | .375 | .250 | .625 | .250 | 10-32 | 19/64 | 15 | 680 |
| 5/8 | SCE-20-SB | CSCE-20-SB | .625 | .4375 | .437 | .375 | .750 | .312 | 1/4-28 | 23/64 | 35 | 995 |
| 11/16 | SCE-22-SB | CSCE-22-SB | .6875 | .4375 | .437 | .375 | .750 | .312 | 1/4-28 | 23/64 | 35 | 955 |
| 3/4 | SCE-24-SB | CSCE-24-SB | .750 | .500 | .500 | .500 | .875 | .375 | 3/8-24 | 1/2 | 95 | 1660 |
| 7/8 | SCE-28-SB | CSCE-28-SB | .875 | .500 | .500 | .500 | .875 | .375 | 3/8-24 | 1/2 | 95 | 1660 |
| 1 | SCE-32-SB | CSCE-32-SB | 1.000 | .625 | .500 | .625 | 1.000 | .500 | 7/16-20 | 5/8 | 250 | 2225 |
| 1 1/8 | SCE-36-SB | CSCE-36-SB | 1.125 | .625 | .500 | .625 | 1.000 | .500 | 7/16-20 | 5/8 | 250 | 2225 |
| 1 1/4 | SCE-40-SB | CSCE-40-SB | 1.250 | .750 | .625 | .687 | 1.250 | .625 | 1/2-20 | 3/4 | 350 | 3930 |
| 1 3/8 | SCE-44-SB | CSCE-44-SB | 1.375 | .750 | .625 | .687 | 1.250 | .625 | 1/2-20 | 3/4 | 350 | 3930 |
| 1 1/2 | SCE-48-SB | CSCE-48-SB | 1.500 | .875 | .750 | .875 | 1.500 | .750 | 5/8-18 | 57/64 | 650 | 4840 |
| 1 5/8 | SCE-52-SB | CSCE-52-SB | 1.625 | .875 | .750 | .875 | 1.500 | .750 | 5/8-18 | 57/64 | 650 | 4840 |
| 1 3/4 | SCE-56-SB | CSCE-56-SB | 1.750 | 1.000 | .875 | 1.000 | 1.750 | .875 | 3/4-16 | 1-3/64 | 1250 | 6385 |
| 1 7/8 | SCE-60-SB | CSCE-60-SB | 1.875 | 1.000 | .875 | 1.000 | 1.750 | .875 | 3/4-16 | 1-3/64 | 1250 | 6385 |
| 2 | SCE-64-SB | CSCE-64-SB | 2.000 | 1.250 | 1.000 | 1.187 | 2.000 | 1.000 | 7/8-14 | 1-13/64 | 1500 | 8090 |
| 2 1/4 | SCE-72-SB | CSCE-72-SB | 2.250 | 1.250 | 1.000 | 1.187 | 2.000 | 1.000 | 7/8-14 | 1-13/64 | 1500 | 8090 |
| 2 1/2 | SCE-80-SB | CSCE-80-SB | 2.500 | 1.500 | 1.125 | 1.375 | 2.250 | 1.125 | 1-14 | 1-5/16 | 2250 | 11720 |

**Clamping torque is based on lubricated threads, if threads are dry, double the value listed. Available from stock
100% 440C Stainless Construction  Food Grade Grease Standard  Other lubricants are available.

DRW. NO. **SC-64-SB**

**NOTES:**
**1. BEARING IS PACKED WITH LUBRIPLATE SFL-2 GREASE**






**RADIAL BASIC DYNAMIC RATING (POUNDS) 6,472**

**MAXIMUM STATIC CAPACITY (POUNDS) 8,456**

**MATERIAL NOTES:**

**OUTER - 440C STAINLESS, HEAT TREATED**
**STUD - 440C STAINLESS, ZONE HARDENED**
**ROLLER - 440C STAINLESS, HEAT TREATED**
**WASHER - 440C STAINLESS, HEAT TREATED**
**SEAL - SYNTHETIC**

*CUSTOMER PART#*

.XX = ± .01
.XXX = ± .005
.XXXX = ± .0005
ANGLES = ± 1˚
INCH [METRIC]

CHANGE NOTE:

CARTER MANUFACTURING IS NOT RESPONSIBLE FOR TYPOGRAPHICAL ERRORS

REVISION

| A | AUTHOR. BY | DRAWN BY | CHK'D BY | SALES | MATERIAL |
|---|---|---|---|---|---|
| | DB | GJP | MD | KPR | NOTED |
| REV. BY | DATE | DATE | DATE | DATE | DRAWING NO. |
| GJP | 2/14/2008 | 10/30/2000 | 2/14/2008 | 10/28/2000 | SC-64-SB |

**CARTER MANUFACTURING CO., INC.**
GRAND HAVEN, MICHIGAN 49417

PART NAME: **ASSEMBLY** SHEET 1 OF 2

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/13/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| DRUM FABRIC | | | | | | |
| | 2 | CLEAR EDGE | **HF7-7021** | BELT FABRIC, 52" x 146" | | 2 |
| | 2 | CLEAR EDGE | **HF7-7021** | BELT FABRIC, 54" x 146" | | 2 |
| | | | | | | |
| DRUM SHOWERS | | | | | | |
| | 2 | APPLETON | 147999 | SHOWER, 316SS, 1-1/2", 104" SW, 17 NOZ, .079", VIC | | 2 |

CLEAR EDGE
FILTER • PROCESS • PRINT

# CLEAR EDGE IS A GLOBAL, TECHNICAL LEADER IN FILTRATION, PROCESS AND SCREEN PRINT SOLUTIONS.

www.clear-edge.com

These market leading companies are members of the Clear Edge group:

**MADISON FILTER**

**VERSEIDAG TECHFAB**

**SCANDIAFELT**

**CROSIBLE**

**NATIONAL WIRE**

**INDUSTRIAL FABRICS CORP**

# CLEAR EDGE EXCELS AT TAKING OWNERSHIP OF YOUR PROCESS CHALLENGES AND PRESENTING INNOVATIVE SOLUTIONS.

CLEAR EDGE is part of Gamma Holding N.V. Comprising 110 companies in 36 countries, it employs over 9,000 people and enjoys an annual turnover of €850million.

Drawing upon a respected heritage dating back to 1829, Gamma Holding's filtration division has come together under a strong new identity: Clear Edge.

An innovative solution provider, Clear Edge is focused on three primary business sectors:

**SCREEN & FILTER**
An extensive range of wet and dry filtration and screening products to meet the needs of diverse industry sectors.

**PROCESS BELTS**
Metallic and Synthetic Wires and Fabrics are engineered to perform in process critical conveying, forming and liquid filtration applications.

**SCREEN PRINT**
VS-Monoprint mesh is the vital ingredient for colour, vibrancy and precision in screen printing applications the world over.

Vertically integrated, Clear Edge adheres to the highest quality standards, controlling both the manufacture of the roll-good material and the fabrication of the finished product.

We take ownership of your process problems and in every application endeavour to:

- Enhance product quality
- Improve productivity
- Increase profitability
- Save time and energy
- Reduce environmental impact

Clear Edge aims to be recognised as the global technical leader in the world of filter media, process and screen print solutions. This vision is realised daily, through our responsiveness, product quality, global infrastructure and local technical support.

Clear Edge offers a truly extensive range of finished products. Regardless of the application, we will have a product to match. If we don't, we'll create one.

**SCREEN & FILTER**

- Cerafil® Ceramic Elements
- Compact Filter Elements
- Dust Filter Bags
- Fluidised Bed Dryer Bags
- Filter Press Fabrics
- Tower Press Belts
- Horizontal Vacuum Belts
- Drum, Pan, Disc Covers
- Twin Wire Press Belts
- Pressure Leaf Covers
- Kelly Bags
- Candle Filter Bags
- Centrifuge Liners
- Vessel Bags
- Screening Fabrics
- Sifters & Connectors

**PROCESS PRODUCTS**

- Woven Filter Belts
- Spiral Belts
- Metal Belts & Wires
- Engineered Solutions

**SCREEN PRINT MESH**

- Screen Print Mesh

# BREADTH OF APPLICATIONS KNOWLEDGE, PLUS DEPTH OF SECTOR INSIGHT, IS A UNIQUE CLEAR EDGE ADVANTAGE.

**MINERAL PROCESSING**
Clear Edge wet and dry filter media are used on drum, disc, horizontal belt and pan filters in the mineral processing industries. Tower press belts, press cloths and Kelly bags are also supplied.

**CHEMICALS**
Our filtration and process products are used in the manufacture of pigments & dyes, acids, sulphates, chlorides, zeolites, polymers and other chemicals. Dewatering, washing and pollution control are their primary functions.

**PULP & PAPER**
Clear Edge synthetic, spiral and metal fabrics meet the washing, bleaching, fibre capture, chemical treatment and PMC dryer needs of the pulp and paper industries.

**FOOD & BEVERAGE**
Clear Edge screen, filter and process products separate and transport food stuffs including dairy products, sugars, flour, fats and starches; plus beverages such as wine, beer, juice and soft-drinks.

**WASTE WATER**
Filter press fabrics, filter belts and dewatering tables are supplied into industrial and municipal applications.

**ENVIRONMENTAL**
Clear Edge leads the field in effective pollution control solutions. Products include dust bags, Cerafil® hot gas ceramics and compact filter elements.

**HEALTH & PHARMACEUTICALS**
Our screen and filter solutions are supplied for blood transfusion, infusion, diagnostics and laboratory testing. Approved materials are also used in the manufacture of tablets, drugs and the recovery of crystalline solids.

**WOOD FIBRE & BUILDING PRODUCTS**
Clear Edge products are used at critical stages of Particle Board, Medium Density Fibreboard (MDF), Oriented Strand Board (OSB), Hardboard & Wood Veneer processes. Belting products are also supplied for the manufacture of ceiling tiles.

**NON-WOVENS**
Synthetic and metallic materials are supplied for the manufacture of Spunbond, Hydroentanglement, Air Laid Forming, Air Laid Drying, Air Transfer and Meltblown non-wovens.

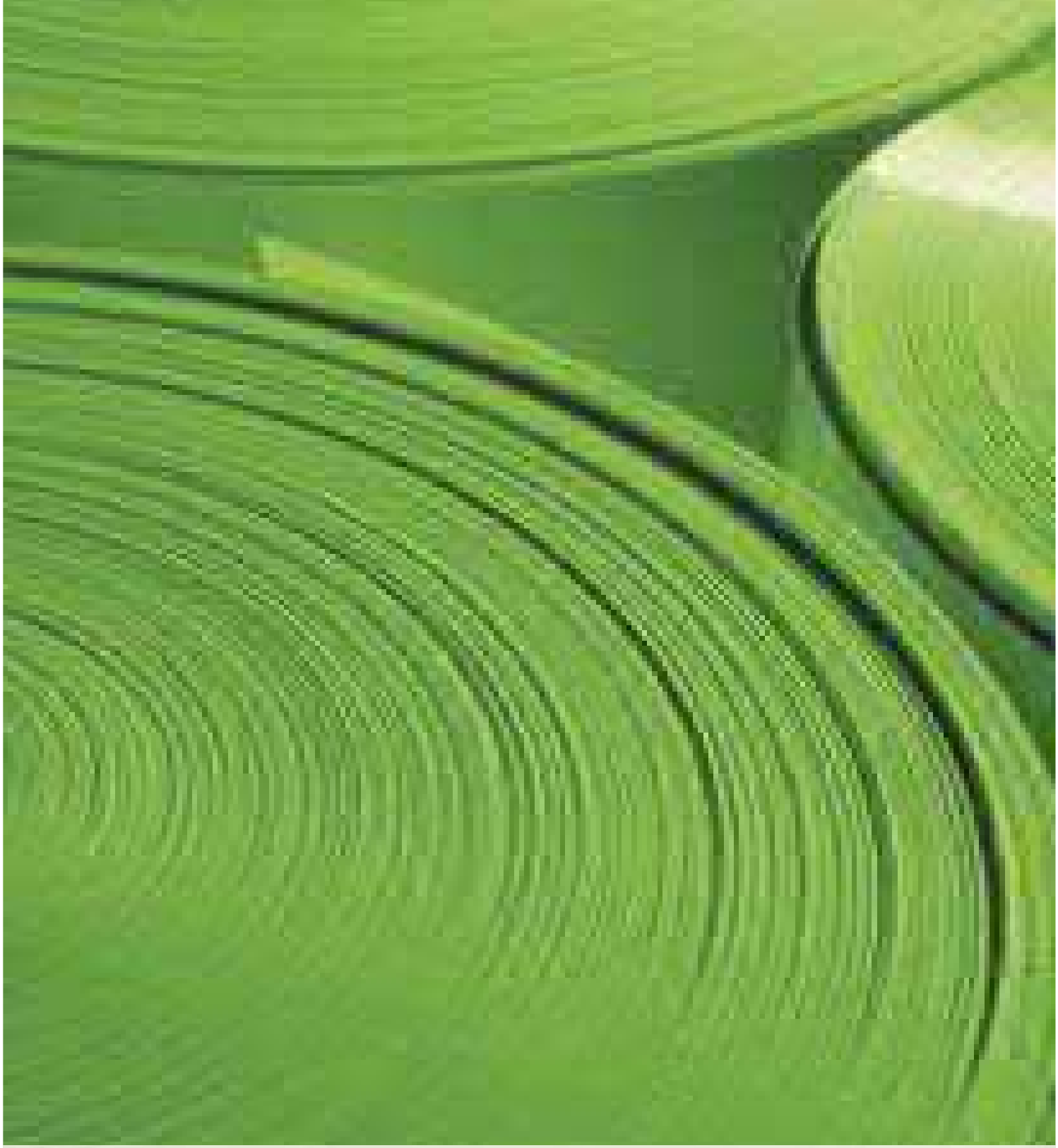
**GLASS FIBRE MATT**
Hydroformer, saturator and oven wires are supplied to meet the needs of this industry sector.

**FLUE GAS DESULPHURISATION**
OEMs and end-users rely on Clear Edge horizontal vacuum belts when dewatering gypsum.

**AUTOMOTIVE**
Precision screening fabrics, often supplied to converters in roll-good form, function as petrol, grease, oil, windshield washer and air ventilation filters.

**CORRUGATED BOXBOARD**
Needledfelt belts ensure reliable production of corrugated box boards.

**SCREEN PRINT**
VS-Monoprint precision screen printing mesh is supplied for printing on glass, ceramics, electronics, textiles, billboards and other promotional materials.



**CLEAR EDGE:**
wherever you are, we are there, too.

**EUROPE**

**ASIA PACIFIC**

**AMERICAS**

**AFRICA**

# A DYNAMIC GLOBAL STRATEGY UNDERPINNED BY STRONG LOCAL SUPPORT IS THE CORNERSTONE FOR OUR SUCCESS.

Clear Edge is committed to outstanding innovation and successful new product development.

Companies on every continent rely on our global infrastructure, which delivers a vast geographical reach, plus the best local technical service the world has to offer. Our goal is 100% total customer satisfaction. All of our actions and decisions are driven by our customer needs.

We provide technical solutions you can trust and enjoy access to an enviable, global knowledge bank. This wealth of experience is vital to our product development programme and our ability to support customers in the field, no matter where they might be.

Indeed, the multi-disciplined support from our astute technicians, plus a proven track record for responsive local resources, brings Clear Edge customers a tangible, competitive edge.

Our central (UK) research facility links to local laboratories across North America, Asia Pacific, Europe and Africa, enabling innovation to be driven globally and testing to be undertaken locally. The aim here is to partner like-minded companies and assist customers with technology transfer whilst continuing the smooth operation of their plants.

Scientists and application engineers at Clear Edge remain focused on process improvements and separating solids from liquids and particles from gasses more efficiently.

We also work in close co-operation with top scientific universities and research institutions around the world to help shape the long term future of the industry.

**CLEAR EDGE, VALUE ADDED SOLUTIONS.**

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Glasgow, G20 0SP
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F: +44 141 946 5230
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W: www.clear-edge.com

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W: www.clear-edge.com

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F: +81 333 921 22
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**Industrial Fabrics Corp**
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W: www.ifcfabrics.com

**National Wire Fabric Inc**
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W: www.nationalwirefabric.com

Issue number 0507
CLEAR EDGE is a registered trademark

# BDP Industries - 2014 Fabrics for Belt Filter Presses and Gravity Decks

| Fabric Style Designation | Fabric Weight (Oz/SqYd) | Fabric Weave (Type) | Mesh Count (Per Inch) | Mono Size (In MM) | Fabric Perm (CFM) | Tensile Strength (PLI) | |
|---|---|---|---|---|---|---|---|
| POLYESTER | | | | | | | |
| FE3366 | 25.1 | 5 X 1 FULL SATIN | 70 X 21 | .35 X .5 | 480 | 695 | |
| HF7-7021 | 26.2 | 1 X 1 PLAIN | 19 X 18 | .7 X .7 | 500 | 900 | |
| HF7-7030 | 30.4 | 6 X 2 H'BONE SATIN | 71 X 24 | .4 X .7 | 450 | 1285 | |
| HF7-7040 | 38.1 | 6 X 2 H'BONE SATIN | 64 X 24 | .5 X .8 | 375 | 1560 | |
| HF7-7043 | 37.9 | 6 X 2 H'BONE SATIN | 64 X 24 | .5 X .7 | 375 | 1560 | |
| HF7-7046 | 50.1 | 6 X 2 H'BONE SATIN | 64 X 20 | .5 X 1.0 | 330 | 1560 | |
| HF7-7051 (Blue) | 37.5 | 6 X 2 H'BONE SATIN | 65 X 23 | .5 X .8 | 385 | 1560 | |
| HF7-7052 (Green) | 37.5 | 6 X 2 H'BONE SATIN | 66 X 24 | .5 X .8 | 390 | 1560 | |
| HF7-7701 | 36.9 | 2 X 1 H'BONE TWILL | 38 X 16 | .7 X .8 | 350 | 1255 | |
| HF7-7704 | 45.4 | 3 X 2 H'BONE TWILL | 64 X 17 | .5 X 1.0 | 420 | 1370 | |
| HF7-7497 | 42.2 | 6 X 2 H'BONE SATIN | 54 X 23 | .6 X .8 | 390 | 2470 | |

**Add $1.50 / inch of belt width as a seaming charge.**

Appleton MFG. DIV.
PRODUCTIVE SOLUTIONS, INC.



## APPLETON SHOWER SYSTEMS

**"Job Proven" Showers for the paper and Belt Press Industries.**

Appleton Shower Systems are designed to provide superior service in applications using contaminated water or "white water". All systems are manufactured from stainless steel to resist corrosion, even in the harshest paper mill applications.
Appleton Showers incorporate an internal brush to permit nozzle cleaning while the shower is in service. This permits the use of unfiltered white water, eliminating the need for special water filters in most applications.

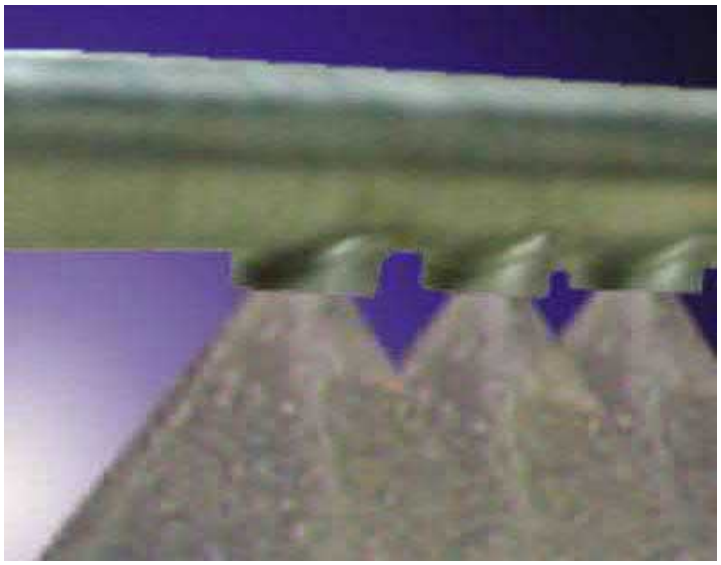
Appleton builds showers designed for specialized applications.

| Belt Press | Paper Machine | Saveall |
|---|---|---|

**All Appleton Showering Systems bring you these benefits:**

**Performance by design** The Appleton Shower System is a simple, foolproof shower system that works all the time, every time. Experience has taught us that complex nozzles and cleaning devices may work well in the lab and fall flat in the "real world" of the paper mill. The Appleton System has been proven through years of mill service.

*Full Shower*



*Shower Assembly*

Our design formula is straight-forward:

**Use quality materials**

The shower piping is typically 304L or 316L stainless steel, though more exotic grades are used when the application requires them. Your application determines the specific grade. Care is taken during our manufacturing cycle to ensure that your showers are never contaminated by contact with other metals.

**Design for the application**

The Appleton Shower Systems are design to handle the stringent requirements of the papermaking environment. Pipe sizes are dictated by water volume and pressure, couple with the required spray pattern. Available sizes include 1-1/2, 2, 2-1/2, 3, 4, and5 inch I.D.s.
The internal brush ensures shower performance, even with white water. The stainless steel brushes wipe through the nozzle, removing even the most stubborn contaminants. The Appleton brush design cleans the entire internal diameter of the pipe.

**Operation is simple**

The operator turns a single handwheel which in turn rotates the brush and opens the discharge valve. The nozzle is wiped clean and the contaminants are discharged off-machine. The showering process is uninterrupted. The

*Shower Spray*

internal brush saves you money on filtering, downtime and maintenance labor.
Our nozzles are designed to minimize plugging, even without the brush. The nozzle tip protrudes into the pipe where the water velocity cleans it continuously.

Our engineers specify the proper nozzle from a selection that ranges from 0.040 to 0.079 for needle spray, or 0.065 to 0.315 for fan spray patterns. Custom sizes have been generated for specialized needs.

The efficient nozzle design keeps water pressure requirements to a minimum. This minimal pressure results in lower water consumption and reduced pump wear.

**Provide meaningful options**

The Appleton Showering System can be equipped with optional equipment that permits remote or timed actuation of the internal brush and discharge valve. This ensure maximum showering efficiency without regular operator intervention. Air or Electro-mechanical Oscillators can be added to provide linear or rotary motion, meeting the needs of the application. System controls can be interlocked with the process to protect forming fabrics and reduce water consumption.

Don't talk showers without talking to Appleton!

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**For Detailed Specifications and Prices Call your Customer Representative at 1-800-531-2002 or (920) 751-1555. You can also e-mail us at *salesweb@appletonmfg.com***

Appleton Manufacturing Division, Productive Solutions Inc.
**Email us** with comments, questions, or suggestions about our website.

# BELT PRESS SHOWERS

## Showers designed specifically for the needs of belt press.

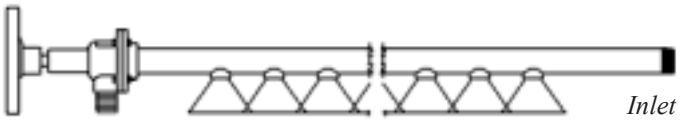
The Appleton Belt Press Shower was developed to provide an economic internal brush shower for the builders and users of belt dewatering presses. The internal brush permits the use of recycled water without the hassle of plugged nozzles. The proven Appleton design means clean belts for better press performance.

## Corrosion resistant...

The shower is fabricated of 304L or 316L stainless steel pipe and 316 stainless steel castings. The nozzles are formed from stainless steel. The Appleton Belt Press Shower is built to provide long service life.

## Designed for your press...

Our engineers use your pressure requirements and spray distance information to establish nozzle spacing that will provide uniform coverage for thorough belt cleaning, utilizing Appleton's infinitley variable spray angle technology.

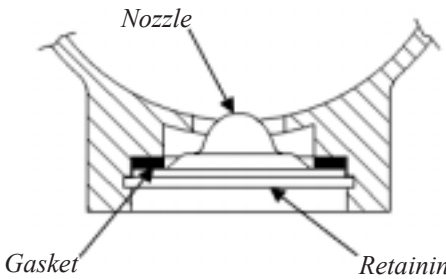



The pipe diameter is calculated to ensure proper flow and rigidity. The nozzles may be fan or needle, your requirements establish the design.

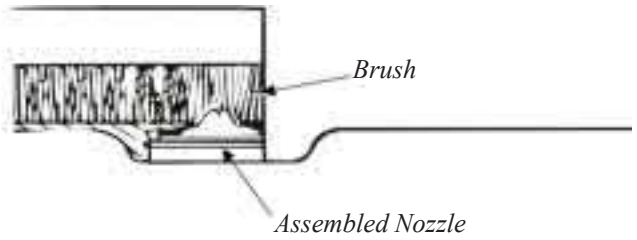
## Unstoppable...

The Appleton Belt Press Shower is designed to perform... down to the finest detail.

*Belt Cleaning Shower Nozzle Detail*



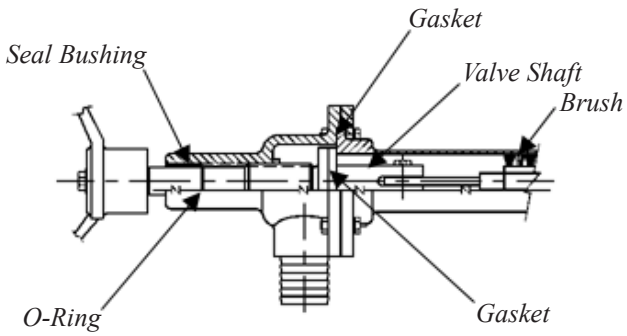

For example, the nozzle tips protrude into the pipe where they are continuously scoured by the velocity of the water passing by them.




*Thorough brush cleaning...*

The stainless steel internal brush cleans the nozzles and the interior of the pipe. This ensures that all the nozzles are operating, even with recycled water.

*1-1/2" & 2" Shower Valve Detail*



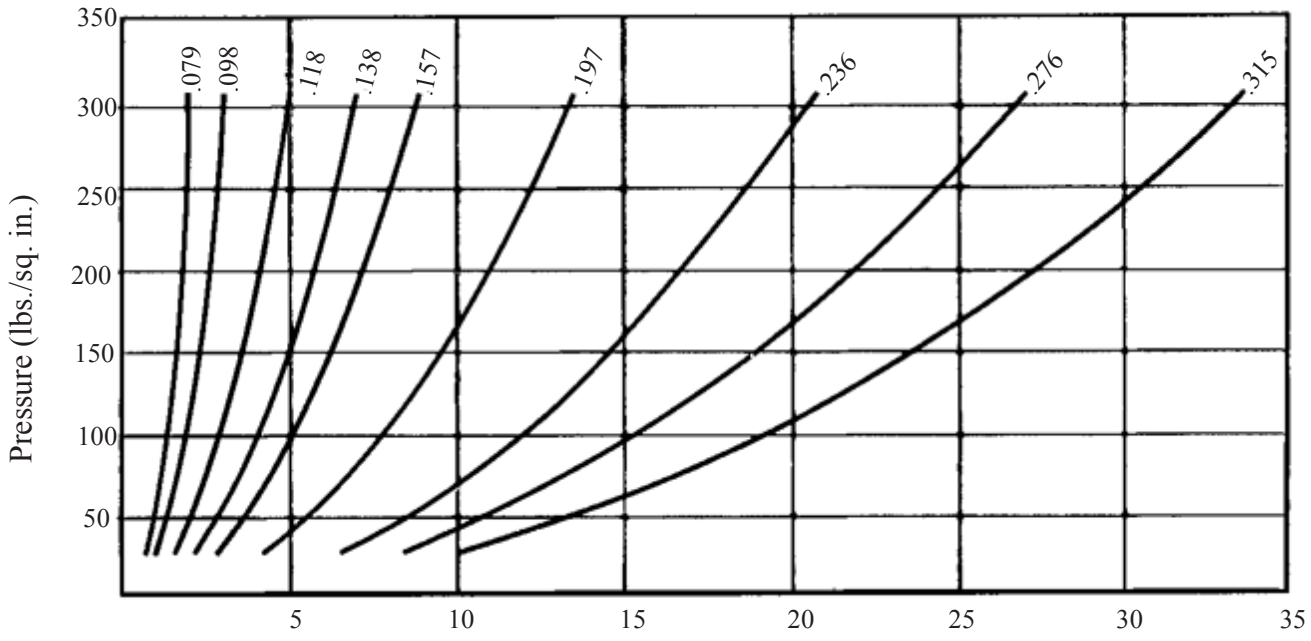

Cleaning is easy; turning the handwheel manually or via an auto-rotator, rotates the brush which cleans the nozzles. The contaminants are flushed out the discharge valve, not onto the filter belt. There is no need to interrupt the operation of the belt press to clean the nozzles.

## The bottom line...

You benefit by putting a recognized quality shower on your press, at a fair price.

Your customer realizes the benefits of continuous service, low maintenance, and cleaner filter belts.

Appleton MFG. Division P.O. Box 618 Neenah, WI. 54957-0618




FAN NOZZLE DISCHARGE

Appleton

PRODUCTIVE SOLUTIONS, INC.

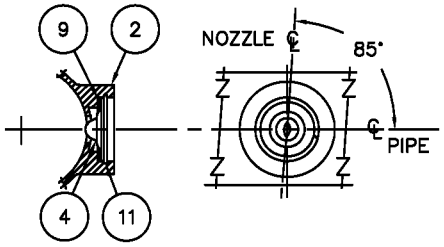
*"INGENUITY AT WORK"*



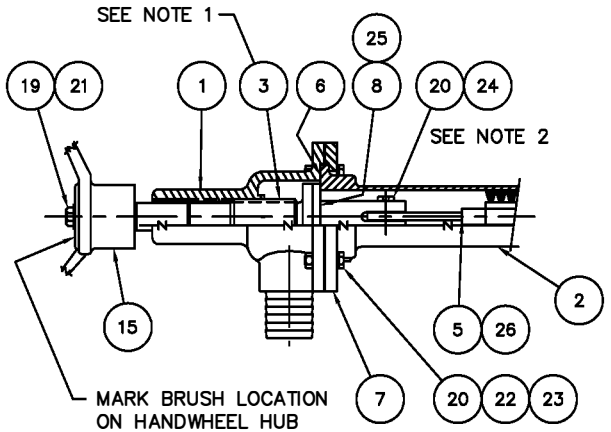
Telephone (920) 751-1555 or (800) 531-2002 Fax (920) 751-1525 www.appletonmfg.com

NOTE:

1. LUBRICATE VALVE SHAFT THREAD (ITEM 3) WITH AN ANTI-SEIZE COMPOUND
2. AFTER ATTACHING VALVE SHAFT (ITEM 3) TO BRUSH (ITEM 5), STAKE (2 PLACES) END OF CAP SCREW (ITEM 20) TO NUT (ITEM 24)
3. DISCHARGE HOSE ADAPTER MUST BE LOCATED VERTICALLY DOWNWARD TO DRAIN VALVE




NOZZLE DETAIL
.079 ORIFICE

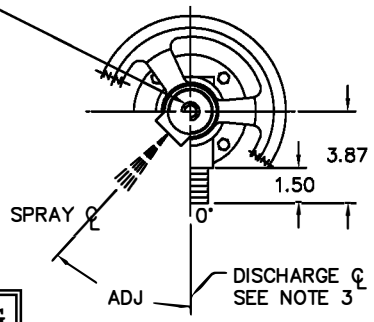



DISCHARGE VALVE DETAIL

| ITEM | PART/DWG | LOC | DESCRIPTION | QTY |
|---|---|---|---|---|
| 1 | 119407 | C | BODY,VALVE,316,1-1/2 & 2 ADJ SHR | 1 |
| 2 | 148000 | B | WELDT,PIPE,304L,1-1/2,126.58PL,ADJSA,17N | 1 |
| 3 | 104754 | B | SHAFT,VALVE,316,1-1/2 SHR | 1 |
| 4 | 100944 | B | NOZ,FAN,SM,.079 | 17 |
| 5 * | 148001 | B | ASSY,BRUSH,304,1-1/2,108.0 BL,124.6 OL | 1 |
| 6 | 119745 | A | GASKET,PIPE,1-1/2 & 2 ADJ SHR | 3 |
| 7 | 119403 | B | RING,LOCK,316,1-1/2 OR 2 SHR | 1 |
| 8 | 102397 | A | GASKET,VALVE,1-1/2 & 2 SHR | 1 |
| 9 | 104756 | A | GASKET,NOZ,NEOP,1-1/2 GROOVED SADDLE | 17 |
| 10 | | | | |
| 11 | 105229 | | RING,RETAINING,316,INT,1-1/16 | 17 |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | 105034 | | HANDWHEEL,8,5/8 B,1/4 x 1/8 KW | 1 |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | 105253 | | SCR,HEX HD CAP,316,5/16-18 x 3/4 | 1 |
| 20 | 104481 | | SCR,HEX HD MACH,316,1/4-20 x 1-1/4 | 5 |
| 21 | 105180 | | WASHER,FLAT,316,5/16 | 1 |
| 22 | 111050 | | WASHER,LOCK,316,1/4 | 4 |
| 23 | 107655 | | NUT,HEX,316,1/4 | 4 |
| 24 | 104484 | | NUT,HEX JAM,316,1/4-20 | 1 |
| 25 * | 119843 | B | KIT,VALVE REPAIR,1-1/2 & 2 ADJ SHR | AS REQD |
| 26** | 119840 | B | KIT,BRUSH REPLACE,1-1/2 & 2 ADJ SHR | AS REQD |
| 27 | 119844 | B | INSTRUCTION,SHR SET UP,1-1/2 & 2 ADJ SHR | AS REQD |

* DENOTES RECOMMENDED SPARE / REPLACEMENT PARTS
** ORDER THIS KIT WHEN ORDERING REPLACEMENT BRUSH (ITEM 5)
INCLUDE SHOWER DWG NO. 147999 WHEN ORDERING KITS

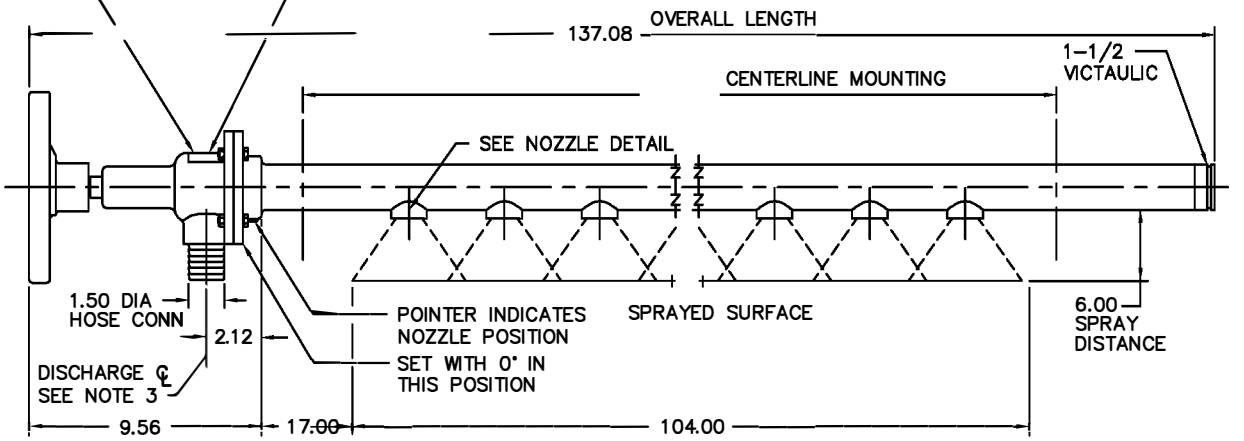
USE TORQUE WRENCH TO ROTATE BRUSH, TORQUE NOT TO EXCEED 150#




SET SPRAY ANGLE PER INSTRUCTIONS (ITEM 27)

USING 1/4 HIGH LETTERS STAMP NO. 147999 IN THIS LOCATION

SEE DISCHARGE VALVE DETAIL




**APPROVAL DRAWING**

- ☐ APPROVED
- ☐ APPROVED AS NOTED
- ☐ NOT APPROVED

NAME _____
DATE _____

| APPLICATION: BELT CLEANING | | |
|---|---|---|
| POSITION: | | |
| OPERATING PRESSURE: | 120 | P.S.I. |
| OPERATING FLOW RATE: | 23.6 | G.P.M. |

| REV. | CHANGE | DATE | BY | CHK |
|---|---|---|---|---|
| | | | | |

SHOWER,316 ,1-1/2,104.0SW,ADJSA,17NZ,VI
C CUSTOMER BELT DEWATERING
GREENWICH, NY

Appleton MFG. DIV.
PRODUCTIVE SOLUTIONS, INC.

| DATE | DWN | CHK | PART NO. | PLOT SCALE | DWG NO. |
|---|---|---|---|---|---|
| 09/06/12 | MR | NB | 147999 | | 147999 |

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/13/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| SHOWER ACCESSORIES | | | | | | |
| | 1 | GOULDS | 22BF1H7T0 (5-5/8") | MODEL 3656, 40 GPM, BOOST FROM 50-100 PSI, SIZE 1x2-7, 5-5/8" IMPELLER, BRONZE FITTED, CLOSE-COUPLED, STANDARD MECHANICAL SEAL, 3 HP XP MOTOR, 3500RPM, TEFC, 3/60/230/460V | | 1 |
| | 1 | INDELAC | FLT15DM80/SS/TFE/NPT/INSF7/115B/F07-14 | BONAMI SS BALL VALVE ASSEMBLED TO INDELAC NEMA 7 ELECTRIC ACTUATOR, 115VAC | | 1 |
| | 1 | BETA | W9-P506H-S1N-P1-K1 | PRESSURE SWITCH, EXPLOSION PROOF | | 1 |
| STOCK | 1 | TRERICE | D82LFB2502LA130 | SS 2-1/2" DIAL, LIQUID FILLED, 1/4" LOWER MOUNT WITH 316SS ISOLATION GUARD, **RANGE 0 TO 200 PSI** | | 1 |

ITT

Commercial Water

# Goulds Pumps

## 3656/3756 S-Group

Cast Iron, Bronze Fitted Centrifugal Pumps

*Bombas centrífugas en hierro fundido con accesorios de bronce*

GOULDS PUMPS

Goulds Pumps is a brand of ITT Residential and Commercial Water.

*Goulds Pumps es una marca de fábrica de ITT Agua Residencial y Comercial.*

www.goulds.com

*Engineered for life*

# A Full Range of Product Features

The 3656 and 3756 S-Group pumps from Goulds have been designed with technical benefits to meet the needs of users in a variety of water supply, recirculation, and cooling applications.

- The model 3656 offers close coupled design for space saving and simplified maintenance.
- The model 3756 offers a bearing frame mounted design for flexibility of installation and drive arrangements.
- Back pull-out to reduce maintenance down time.
- Standard Type 21 mechanical seal for both reliability and availability. Carbon/ceramic/BUNA standard, with other faces and elastomers available.
- 3656/3756 available in all iron, bronze fitted or all bronze construction for application versatility.
- Replaceable wearing components include stainless steel shaft sleeve and casing and hub wear rings to maintain peak efficiency.
- Packed box sealing is also available as an option.
- Enclosed impeller design, dynamic balancing and renewable wear rings reduce losses affecting performance and pump life.
- Suction and discharge pipe connections are NPT threaded, except 3 x 4 – 7 which has 125 lb. ANSI flat faced flanges.
- Rigid cast iron motor adapter provides support and registered fits maintain positive unit alignment.
- Standard NEMA motor frame, JM or JP shaft extension, C-face mounting, single phase or three phase, 3500 or 1750 RPM. Open drip proof and totally enclosed fan cooled.
- Optional explosion proof or high efficiency motors available.
- Optional rigid carbon steel bedplate, sheet metal coupling guard and T. B. Woods spacer coupling for 3756 models.

# *Una amplia gama de variadas características*

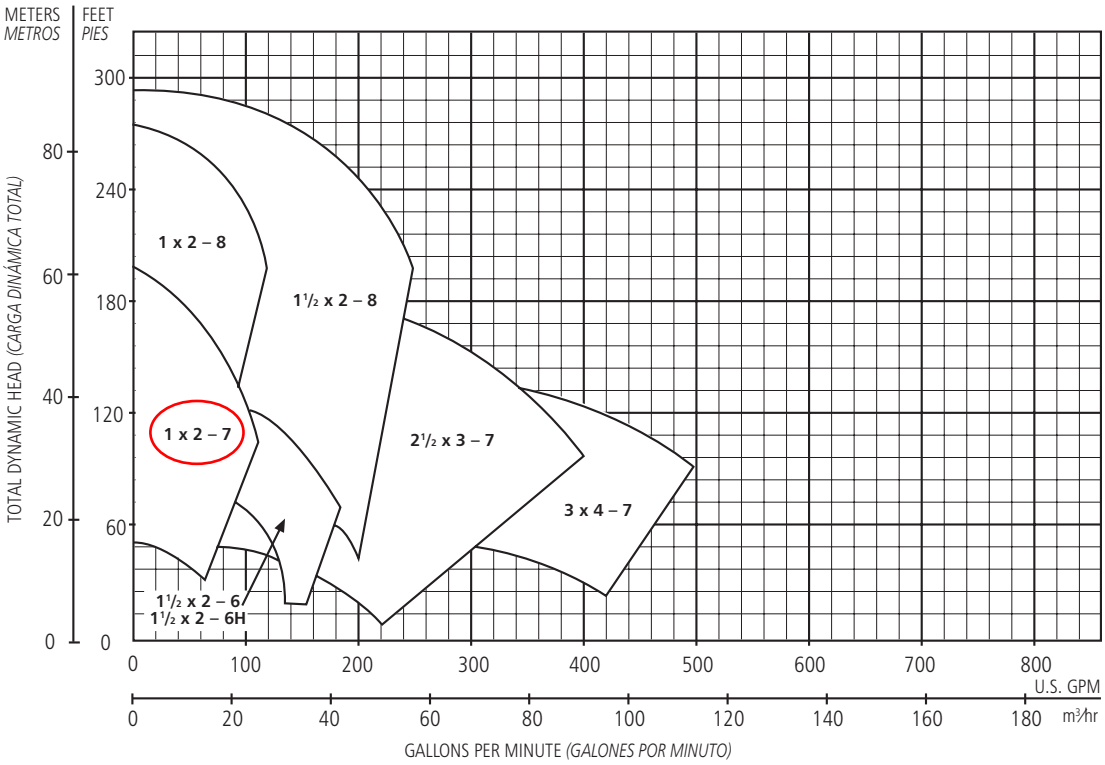
*Las bombas 3656 y 3756 del Grupo S de Goulds han sido diseñadas con beneficios técnicos para satisfacer las necesidades de los usuarios en variadas aplicaciones de suministro y recirculación de agua y aplicaciones de refrigeración.*

- *El modelo 3656 cuenta con diseño de acoplamiento corto para ahorrar espacio y simplificar el mantenimiento.*
- *El modelo 3756 cuenta con diseño de montaje sobre bastidor que ofrece gran flexibilidad en los arreglos de instalación y accionamiento.*
- *Desmontaje posterior que reduce el tiempo de inactividad por mantenimiento.*
- *Sello mecánico estándar Tipo 21, brinda gran confiabilidad y asegura la disponibilidad. Estándar de carbono/cerámica/BUNA, también se encuentran disponibles con otras caras y elastómeros.*
- *Los modelos 3656 y 3756 se fabrican en todo hierro, con accesorios de bronce o en todo bronce, para una mayor versatilidad de aplicación.*
- *Los componentes de desgaste reemplazables incluyen los anillos de desgaste de la carcasa y del rodete y la camisa del eje, de acero inoxidable, para mantener la eficiencia pico.*
- *El diseño de impulsor encerrado, balanceo dinámico y anillos de desgaste reemplazables reducen las pérdidas que afectan el desempeño y la vida de la bomba.*
- *Las conexiones de succión y descarga son roscadas NPT, con excepción de la bomba de 3 x 4 – 7, que cuenta con bridas de cara lisa ANSI de 125 lbs.*
- *El adaptador rígido del motor, de hierro fundido, ofrece soporte y los montajes registrados mantienen el alineamiento positivo de la unidad.*
- *Motor con bastidor NEMA estándar, extensión de eje JM, montaje en cara C, monofásico o trifásico, 3500 ó 1750 RPM. Abierto a prueba de filtraciones o totalmente encerrado enfriado por ventilador.*
- *Motores a prueba de explosiones y de alta eficiencia disponibles como opción.*
- *Placa de asiento rígida de acero al carbono, protector de acoplamiento de chapa metálica y acoplamiento espaciador T. B. Woods disponibles como opción en los modelos 3756.*

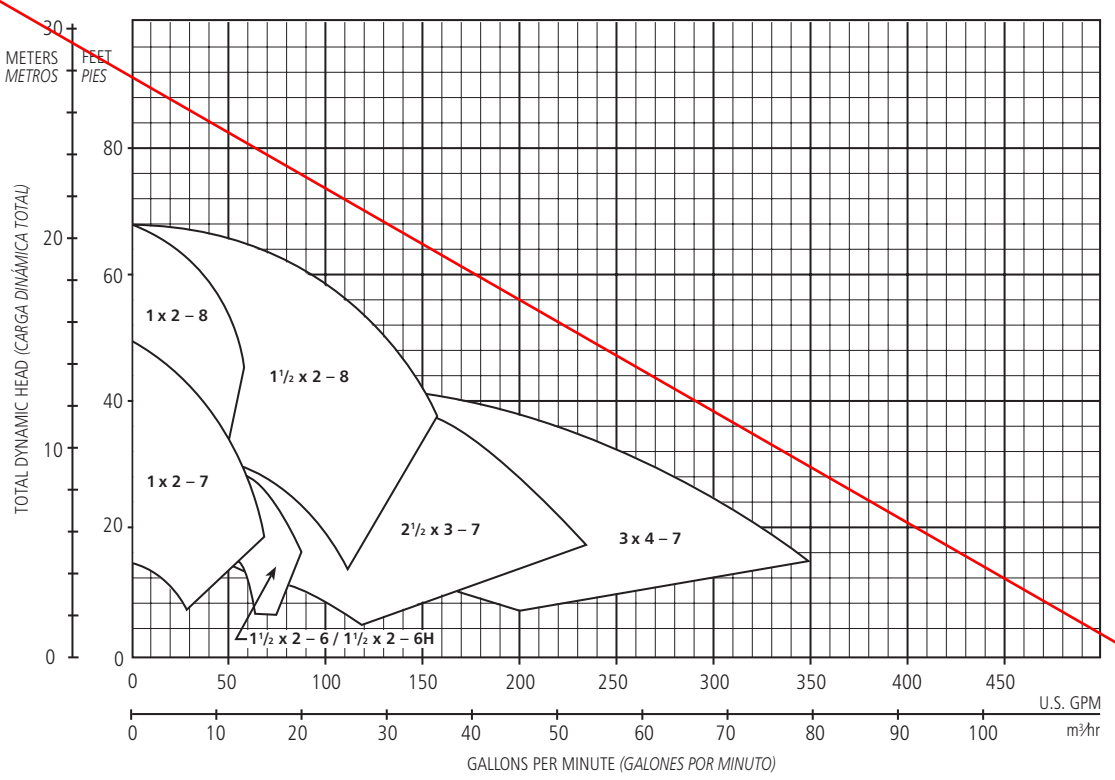
**Goulds Pumps is ISO 9001 Registered.**

## Performance Coverage
## *Curvas de desempeño*

### 3500 Coverage Curve, *Curva de alcance 3500*




### 1750 Coverage Curve, *Curva de alcance 1750*



## 3656/3756 S-Group Numbering System For All Units Built After June 1, 1998

## *Sistema de numeración del Grupo S, modelos 3656/3756, para todas las unidades fabricadas luego del 1° de junio de 1998*

The various versions of the 3656 and 3756 S-Group are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown below.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with Goulds on non-cataloged numbers.

Not recommended for operation beyond printed H-Q curve. For critical application conditions consult factory.

*Las diferentes versiones de los modelos 3656 y 3756 del Grupo S se identifican con un número de código de producto en la etiqueta de la bomba. Este número es también el número de catálogo de la bomba. A continuación se ilustra el significado de cada dígito en el código del producto.*

*No todas las combinaciones de motor, impulsor y sellos están disponibles para cada modelo. Consulte a Goulds sobre números que no aparecen en el catálogo.*

*No se recomienda la operación más allá de la curva impresa de H-Q (carga-capacidad). Para aplicaciones bajo condiciones críticas, consulte con la fábrica.*

**Example Product Code, *Ejemplo del código de producto***

9 BF 1 H 2 G 0 H

**High Head Impeller (1½ x 2 – 6H Only), *Impulsor de carga alta (1½ x 2 – 6H únicamente)***

**Mechanical Seal and O-ring, *Sello mecánico y anillo en O***

| Type 21 Mechanical Seal, *Tipo 21 sello mecánico* | | | | | |
|---|---|---|---|---|---|
| **Seal Code, *Código del Sello*** | **Rotary, *Rotativo*** | **Stationary, *Estacionario*** | **Elastomers, *Elastómeros*** | **Metal Parts, *Partes Metálicas*** | **Part No., *Pieza Número*** |
| 0 | Carbon, *Carbón* | Ceramic, *Cerámica* | BUNA-N | 316 SS, *316 Acero inoxidable* | 10K13 |
| 1 | | Sil-Carbide, *Carburo de silicona* | EPR | | 10K19 |
| 3 | | | Viton | | 10K27 |
| 5 | Sil-Carbide | | | | 10K64 |
| 9 | Packed Box Design with BUNA O-Ring, *Diseño de prensaestopas empacado con anillo en O de BUNA* | | | | 15K16 |

**Note:** 10K27 replaces obsolete 10K25, ***Nota:** La 10K27 reemplace la obsoleta 10K25.*

**Impeller Option Code, *Código de opción de impulsor***

| Impeller Code, *Código del impulsor* | 22BF | 9BF | 3BF | | 5BF | 4BF | 6BF |
|---|---|---|---|---|---|---|---|
| | 1 x 2 – 7 | 1 x 2 – 8 | 1½ x 2 – 6 | 1½ x 2 – 6H | 1½ x 2 – 8 | 2½ x 3 – 7 | 3 x 4 – 7 |
| | Dia. | Dia. | Dia. | Dia. | Dia. | Dia. | Dia. |
| A | 6¾" | 8 1/16" | 5 15/16" | 5 15/16" | 8 1/16" | 7 1/16" | 7 1/16" |
| B | 6 7/16 | 7 5/8 | 5 5/8 | 5 5/8 | 7 5/8 | 6 7/8 | 6 3/8 |
| C | 6 | 7 5/16 | 5 1/8 | | 6¾ | 6 9/16 | 5½ |
| D | 5¾ | 7 | 4¾ | | 5¾ | 6 | 4 11/16 |
| E | 5½ | 6½ | | | 7¾ | 5 11/16 | 5 1/8 |
| F | 5 1/16 | 6 3/16 | | | 7 | 5 7/16 | 6 |
| G | 4 13/16 | 5 3/8 | | | 6¼ | 5 3/16 | |
| H | 4 9/16 | 5 1/8 | | | 6 1/8 | 4¾ | |
| J | 4 3/8 | | | | | 4½ | |
| K | 4 1/16 | | | | | 4 1/16 | |
| L | 3 13/16 | | | | | | |

**Driver, *Elemento motor***

1 = 1 PH, *fase*, ODP
2 = 3 PH, *fases*, ODP
3 = 575 V, ODP
4 = 1PH, *fase*, TEFC
5 = 3 PH, TEFC
6 = 575 V, TEFC
7 = 3 PH, *fases*, XP
8 = 575 V, XP
9 = 3 PH, *fases*, TEFC, PREFF
0 = 1 PH, *fase*, XP

*1 PH, fase = Monofásico; 3 PH, fases = Trifásico*

**HP Rating, *Potencia nominal, HP***

C = ½ HP
D = ¾ HP
E = 1 HP
F = 1½ HP
G = 2 HP
H = 3 HP
J = 5 HP
K = 7½ HP
L = 10 HP
M = 15 HP
N = 20 HP

**Driver: Hertz/Pole/RPM, *Elemento motor: Hertz/Polos/RPM***

1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

For frame mounted version, substitute the letters "FRM" in these positions.

*Para las versiones de montaje en bastidor, reemplazar las letras en esta ubicación con "FRM".*

**Material, *Material***

BF = Bronze fitted, *Accesorios de bronce*
AI = All iron, *Todo hierro*
AB = All bronze, *Todo bronce*

**Pump Size, *Tamaño de bomba***

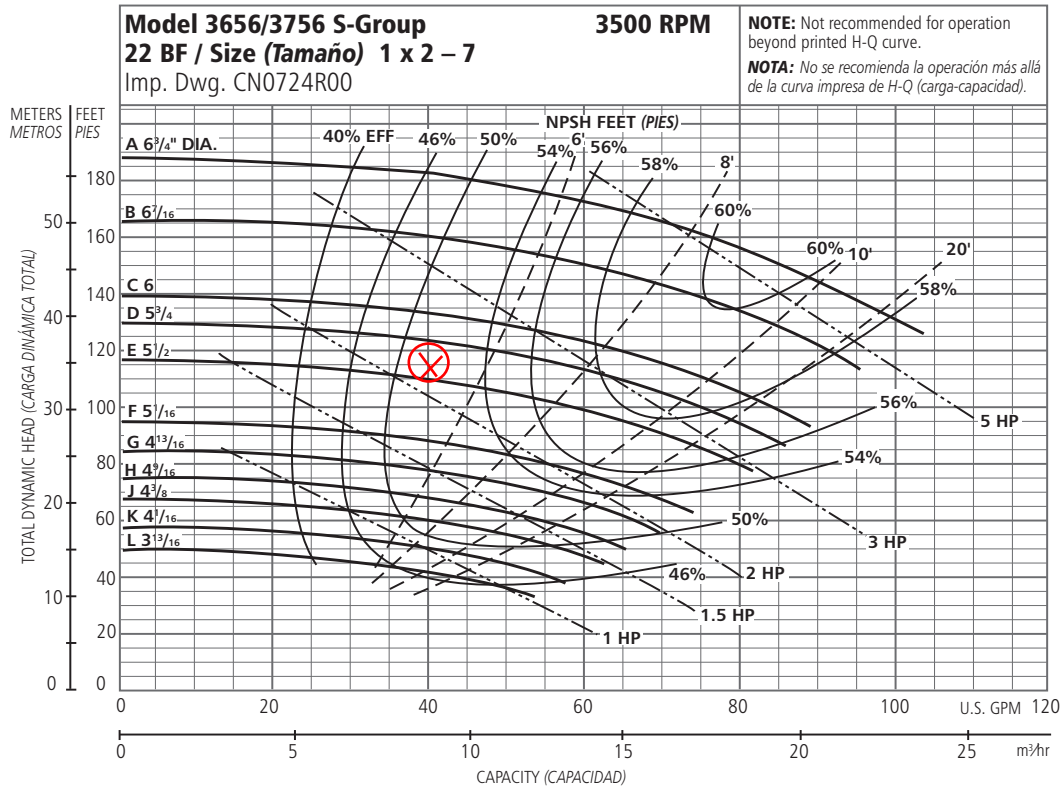
3 = 1½ x 2 – 6(H)
4 = 2½ x 3 – 7
5 = 1½ x 2 – 8
6 = 3 x 4 – 7
9 = 1 x 2 – 8
22 = 1 x 2 – 7

The 1 x 2 – 8 and 1 x 2 – 7 are only available in Bronze Fitted.
*Los tamaños 1 x 2 – 8 y 1 x 2 – 7 están disponibles con accesorios de bronce únicamente.*

## Performance Curves – 60 Hz, 3500 RPM
## *Curvas de desempeño – 60 Hz, 3500 RPM*

These curves show the performance of the 3656 and 3756 at 3500 RPM and 1750 RPM, 60 Hz, and at 2900 RPM and 1450 RPM, 50 Hz. Standard impeller trims are shown.

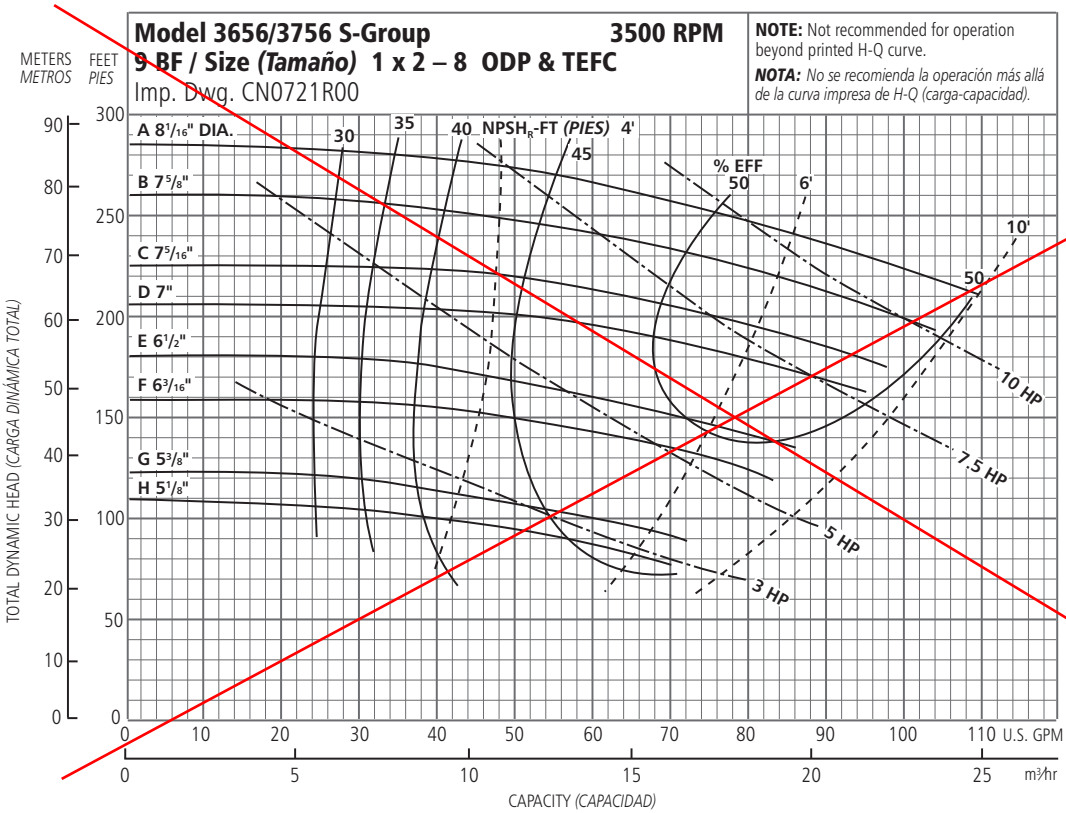
*Estas curvas ilustran el desempeño de los modelos 3656 y 3756 operando a 3500 RPM y 1750 RPM en 60 Hz, y a 2900 RPM y 1450 RPM en 50 Hz. Se muestran los diámetros de impulsor estándar.*




| Optional Impeller *Impulsor optativo* | |
|---|---|
| **Ordering Code** ***Código de pedido*** | **Dia.** ***Diá.*** |
| A | 6¾" |
| B | 6⁷/₁₆ |
| C | 6 |
| D | 5¾ |
| E | 5½ |
| F | 5¹/₁₆ |
| G | 4¹³/₁₆ |
| H | 4⁹/₁₆ |
| J | 4⅜ |
| K | 4¼ |
| L | 3¹³/₁₆ |

**NOTE:** Pump will pass a sphere to ³/₁₆" diameter.

***NOTA:*** *La bomba dejará pasar una esfera de hasta ³/₁₆ de pulgada de diámetro.*

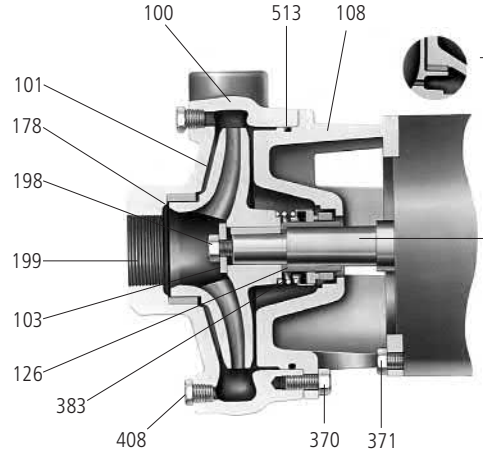



| Optional Impeller *Impulsor optativo* | |
|---|---|
| **Ordering Code** ***Código de pedido*** | **Dia.** ***Diá.*** |
| A | 8¹/₁₆" |
| B | 7⅝" |
| C | 7⁵/₁₆ |
| D | 7 |
| E | 6½ |
| F | 6³/₁₆ |
| G | 5⅜ |
| H | 5⅛ |

**NOTE:** Pump will pass a sphere to ³/₁₆" diameter.

***NOTA:*** *La bomba dejará pasar una esfera de hasta ³/₁₆ de pulgada de diámetro.*

## 3656 S-Group Materials of Construction
## *Materiales de construcción - Grupo S, modelo 3756*

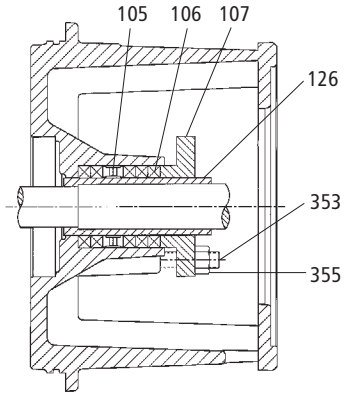



Back wearing ring on S-Group (2½ x 3 – 7) only

*Anillo de desgaste posterior en el Grupo S (2½x 3 – 7) únicamente.*

AISI 1045 steel motor shaft extension (typical)

*Extensión del eje del motor de acero AISI 1045 (típico)*




Packed Box Arrangement
*Caja prensaestopas*

| Item No. *No. Ítem* | Description *Descripción* | Materials, *Materiales* | | |
|---|---|---|---|---|
| | | All Iron *Todo hierro* | Bronze Fitted *Accesorios de bronce* | All Bronze *Todo bronce* |
| 100 | Casing, *Carcasa* | 1001 | 1001 | 1101 |
| 101 | Impeller, *Impulsor* | | 1101 | |
| 103 | Casing wear ring, *Anillo de desgaste de la carcasa* | | 1618 | 1618 |
| 108 | Adapter, *Adaptador* | | 1001 | 1001 |
| 184 | Seal housing, *Cubierta del sello* ① | One piece with adapter, *Una pieza con adaptador* | | 1101 |
| 126 | Shaft sleeve, *Camisa del eje* | AISI Type 300 series stainless steel *Acero inoxidable serie AISI tipo 300* | | |
| 198 | Impeller bolt, *Perno del impulsor* | | | |
| 199 | Impeller washer, *Arandela del impulsor* | | | |
| 178 | Impeller key, *Chaveta del impulsor* | Carbon Steel, *Acero al carbono* | | |
| 370 | Hex head cap screw (adapter to case), *Tornillo de cabeza hexagonal (del adaptador a la cubierta)* | Steel SAE 1200 Grade 5 *Acero SAE 1200 grado 5* | | |
| 371 | Hex head cap screw (adapter to motor), *Tornillo de cabeza hexagonal (del adaptador al motor)* | | | |
| 383 | Mechanical seal, *Sello mecánico* | See seal chart, *Ver tabla del sello* | | |
| 408 | Pipe plug ¼" or ⅜", *Tapón de tubos de ¼ de pulgada ó ⅜ de pulgada* | Steel, *Acero* | | Bronze, *Bronce* |
| 513 | O-ring, *Anillo en O* | BUNA-N, *BUNA-N* | | |

① For separate seal housing and adapter construction, all bronze material only, see repair parts page.

*Para la construcción separada del compartimiento del sello y el adaptador, materiales de bronce únicamente, consulte la página de piezas de repuesto.*

**NOTE:**
Pumps will be shipped with top-vertical discharge position as standard. For other orientations, remove casing bolts – rotate discharge to desired position – replace and tighten bolts to 25 ft./lbs. Note that discharge may extend below motor mounting surface in bottom-horizontal position; adequate clearance must be provided.

***NOTA:***
*Las bombas salen de la fábrica con la descarga orientada en posición vertical superior de manera estándar. Para modificar la orientación, retirar los pernos de la carcasa, hacer girar la descarga hasta la posición deseada y volver a colocar los pernos, ajustándolos a una torsión de 25 pies/libras. Se ha de notar que la descarga se puede extender por debajo de la superficie de montaje del motor en la posición horizontal inferior; por lo tanto, debe proveerse suficiente espacio.*

| Material Code, *Código de material* | Engineering Standard, *Norma de ingeniería* |
|---|---|
| 1101 | Cast iron ASTM A48 CL20, *Hierro fundido ASTM A48 CL20* |
| 1101 | Silicon bronze ASTM B584, C87500, *Siliciuro de bronce ASTM B584, C87500* |
| 1618 | Bizmuth brass, *Latón al bismuto* |

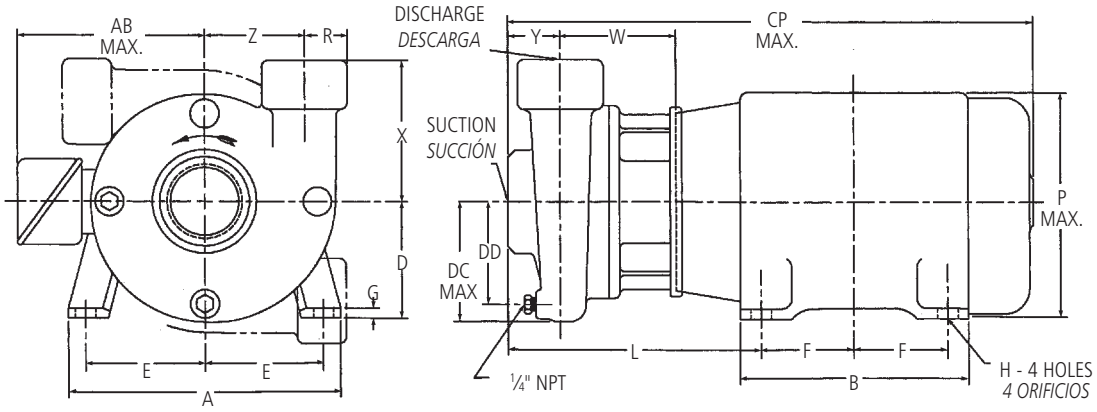
**Packed Box Arrangement, *Caja prensaestopas***

| Item No., *No. Ítem* | Description, *Descripción* | Materials, *Materiales* |
|---|---|---|
| 105 | Lantern ring, *Aro de linterna* | Teflon™ |
| 106 | Packing, 5 rings; *Empaquetadura, 5 aros* | Teflon Impregnated, *Impregnado de Teflon* |
| 107 | Gland, *Casquillo* | AISI 316SS |
| 126 | Shaft sleeve, *Camisa del eje* | AISI Type 300 Series Stainless Steel *Acero inoxidable serie AISI tipo 300* |
| 353 | Gland stud, *Perno del casquillo* | |
| 355 | Gland nut, *Tuerca del casquillo* | |

**Type 21 Mechanical Seal, *Tipo 21 sello mecánico***

| Seal Code, *Código del Sello* | Rotary, *Rotativo* | Stationary, *Estacionario* | Elastomers, *Elastómeros* | Metal Parts, *Partes Metálicas* | Part No., *Pieza Número* |
|---|---|---|---|---|---|
| 0 | Carbon, *Carbón* | Ceramic, *Cerámica* | BUNA-N | 316 SS, *316 Acero inoxidable* | 10K13 |
| 1 | | Sil-Carbide, *Carburo de silicona* | EPR | | 10K19 |
| 3 | | | Viton | | 10K27 |
| 5 | Sil-Carbide | | | | 10K64 |
| 9 | Packed Box Design with BUNA O-Ring, *Diseño de prensaestopas empacado con anillo en O de BUNA* | | | | 15K16 |

**Note:** 10K27 replaces obsolete 10K25, ***Nota: La 10K27 reemplace la obsoleta 10K25.***




**Pump Dimensions and Weights** (Dimension "L" determined by Pump and Motor)
***Peso y dimensiones de la bomba*** *(la dimensión "L" está determinada por la bomba y el motor)*

| Pump *Bomba* | Suction *Succión* | Discharge *Descarga* | CP Max. | DC Max. | DD | R | W | X | Y | Z | Wt. (lbs.) *Pesos (libras)* | Motor Frame Size, *Bastidor* L | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | 140 | 180 | 210 | 250 |
| 1 x 2 – 7 | 2 | 1 | 27 | 4¼ | 3½ | 1 1/16 | 4⅛ | 5½ | 3 | 4 | 52 | 10 | 10¾ | — | — |
| 1 x 2 – 8 | | | | | 4 | | 3 15/16 | 5¾ | 3 3/16 | 4¼ | 52 | | | — | — |
| 1½ x 2 – 6 | | 1½ | 23¾ | | 3½ | 1¼ | 4¼ | 4½ | 2⅝ | 3½ | 34 | 9⅜ | 10½ | — | — |
| 1½ x 2 – 8 | | | 27⅛ | 5⅜ | 4⅝ | | | 5 | | 4¼ | 54 | | | 11⅝ | 11⅝ |
| 2½ x 3 – 7 | 3 | 2½ | 25⅝ | 5⅛ | 4½ | 1 13/16 | | 6 | 3 | 4 | 49 | 10⅛ | 10¾ | 11¾ | — |
| 3 x 4 – 7 | 4* | 3* | 25¼ | 5¾ | 5⅛ | ¾ | 4⅜ | | 2½ | 4½ | 82 | 9¾ | 10⅜ | 11⅜ | — |

*For use with ANSI class 150 mating flange. All others are NPT connections.
** Para uso con brida de contacto ANSI clase 150. Todas las demás son conexiones NTP.*

**Motor Dimensions and Weights** (may vary with manufacturer)*
***Peso y dimensiones del motor*** *(pueden variar de acuerdo al fabricante) **

| Frame Size JM *Tamaño del bastidor JM* | A | AB (Max.) | B | D | E | F | G | H | P (Max.) | Weight (lbs.) *Pesos (libras)* |
|---|---|---|---|---|---|---|---|---|---|---|
| 143 | 6½ | 5¼ | 6 | 3½ | 2¾ | 2 | ⅛ | 11/32 | 6⅝ | 41 |
| 145 | | | | | | 2½ | | | | 57 |
| 182 | 8½ | 5⅞ | 6½ | 4½ | 3¾ | 2¼ | 3/16 | 13/32 | 7⅞ | 77 |
| 184 | | | | | | 2¾ | | | | 97 |
| 213 | 9½ | 7⅜ | 8 | 5¼ | 4¼ | 2¾ | 7/32 | 13/32 | 9⅝ | 122 |
| 215 | | | | | | 3½ | | | | 155 |
| 254 TCZ | 11¼ | 9 | 9½ | 6¼ | 5 | 4⅛ | ¼ | 17/32 | 11½ | 265 |
| 256 TCZ | | | 11¾ | | | 5 | | | | 320 |

**NOTE:**
All pumps shipped in vertical discharge position. May be rotated in 90º increments. Tighten casing bolts to 25 ft./lbs. torque.

***NOTA:***
*Todas las bombas se embarcan con la descarga en posición vertical. Esta posición puede rotarse en incrementos de 90°. Ajustar los pernos de la carcasa a una torsión de 25 pies/libras.*

**Motor Frames and Horsepower**
***Bastidores del motor y potencia en HP***

| Motor Frame *Bastidor del motor* | 3500 RPM | | | | 1750 RPM | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 Phase | | 3 Phase | | 1 Phase | | 3 Phase | |
| | ODP | TEFC | ODP | TEFC | ODP | TEFC | ODP | TEFC |
| 143 | — | ¾, 1, 1½ | ¾, 1, 1½ | ¾, 1, 1½ | — | ½, ¾ | ½, ¾, 1 | ½, ¾, 1 |
| 145 | — | 2 | 2, 3 | 2, 3 | — | 1, 1½ | 1½, 2 | 1½, 2 |
| 182 | 3 | 3 | 5 | 3 | 3 | 2, 3 | 3 | 3 |
| 184 | 5 | 3, 5 | 7½ | 5 | — | — | 5 | 5 |
| 213 | 7½ | — | 10 | 7½ | 5 | — | 7½ | 7½ |
| 215 | 10 | — | 15 | 10, 15 | — | — | — | — |
| 254TCZ | — | — | 20 | — | — | — | — | — |
| 256TCZ | — | — | 25 | 20, 25 | — | — | — | — |

All dimensions in inches and weights in lbs. Do not use for construction purposes.
*Todas las dimensiones están en pulgadas, el peso en libras. No utilizar para fines de construcción.*

ITT

## Commercial Water

### Specifications

**Capacities to:**
550 GPM (125 $m^3$/hr) at 3500 RPM
350 GPM (79 $m^3$/hr) at 1750 RPM

**Heads to:**
280 feet TDH (85 m) at 3500 RPM
67 feet TDH (20 m) at 1750 RPM

**Working pressure to:**
175 PSIG (12 bars)

**Suction pressure to:**
100 PSIG (7 bars)

**Maximum temperature to:**
212°F (100°C) with standard seal or 250°F (121°C) with optional seal.

**Motor:**
NEMA standard JM frame or JP frame for 3656 or T-frame for 3756. Open drip-proof, totally enclosed fan cooled and explosion proof enclosures available. Single phase (115/208 – 230 V), ½ to 3 HP (208 – 230 V) 5 HP and (230V only) on 7½, 10 HP. Three phase (208 – 230/460 V) standard note that 20 and 25 HP are (230/460 V).

**Direction of Rotation:**
Clockwise viewed from motor end.

### *Especificaciones*

***Capacidad hasta:***
*550 GPM (125 $m^3$/hr) a 3500 RPM*
*350 GPM (79 $m^3$/hr) a 1750 RPM*

***Cargas hasta:***
*280 pies (85 m) carga dinámica total a 3500 RPM*
*67 pies (20 m) carga dinámica total a 1750 RPM*

***Presión de operación hasta:***
*175 PSIG (12 bars)*

***Presión de succión hasta:***
*100 PSIG (7 bars)*

***Temperatura máxima:***
*212 °F (100 °C) con sello estándar o 250 °F (121 °C) con sello optativo.*

***Motor:***
*Bastidor NEMA JM estándar en el modelo 3656 y bastidor NEMA T estándar en el modelo 3756. Las cubiertas disponibles son: abierta a prueba de filtración, totalmente encerrada con enfriamiento por ventilador y a prueba de explosiones. Monofásico (115/208 – 230 V), ½ a 3 HP; (208 – 230 V) 5 HP y (230 V solamente) 7½ a 10 HP. Trifásico (208 – 230/460 V) estándar. Los motores de 20 a 25 HP son de 230/460 V.*

***Dirección de rotación:***
*Dextrorsa (sentido de las agujas del reloj) cuando se mira desde el extremo del motor.*

### Typical Applications

- Booster service
- Spraying systems
- Irrigation
- Water circulation
- Liquid transfer
- General purpose pumping

### *Aplicaciones típicas*

- *Servicio de refuerzo*
- *Sistemas de rociado*
- *Sistemas de riego*
- *Circulación de agua*
- *Transferencia de líquidos*
- *Aplicaciones de bombeo en general*

GOULDS PUMPS

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**36/3756S October *(Octubre)*, 2006**
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*Engineered for life*

# SR & SX

## 200 & 300 IN-LBS, NEMA 7

The SR & SX NEMA 7 rotary electric actuators were designed solely for applications within 200 & 300 in-lbs of torque used in hazardous locations. These heavy-duty reversing actuators are used in place of model SD, SR, SDX, and SX when the area used in requires enclosure rating of Class I Groups C & D and Class II Groups E, F, & G div. I and II.

## SPECIFICATIONS:

| | | | |
|---|---|---|---|
| TORQUE | SR | 200 In-Lb (22.6 Nm) | |
| | SX | 300 In-Lb (33.9 Nm) | |
| CYCLE TIME | 5 Sec./90 | 12Vdc, 24Vdc, 24Vac, 115Vac & 230Vac | |
| | 10 Sec./90 | 115Vac extended duty motor (75%) | |
| DUTY CYCLE | 25% standard on 115Vac and 230Vac | | |
| | 75% standard on 12Vdc, 24Vdc and 24Vac, optional on 115Vac extended duty motor | | |
| MOTOR | Permanent split capacitor (for AC) with thermal overload protection | | |

CURRENT RATINGS FL= Full Load, LR= Lock Rotor

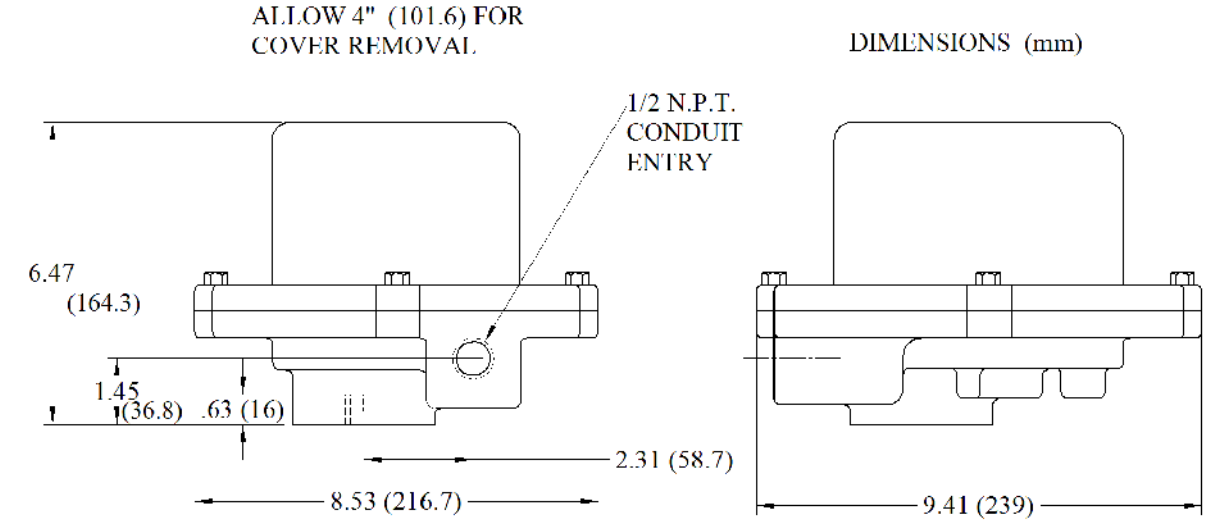
| 115 Vac (Std.) | | 115 Vac Extended Duty | | 24 Vac | | 24 Vdc | | 12 Vdc | | 208 Vac/1Ph/60Hz | | 230 Vac/1Ph/60Hz | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FL | LR | FL | LR | FL | LR | FL | LR | FL | LR | FL | LR | FL | LR |
| 0.38 | 0.75 | 0.38 | 0.75 | 0.70 | 3.20 | 0.70 | 3.20 | 1.30 | 4.20 | 0.28 | 0.35 | 0.25 | 0.35 |

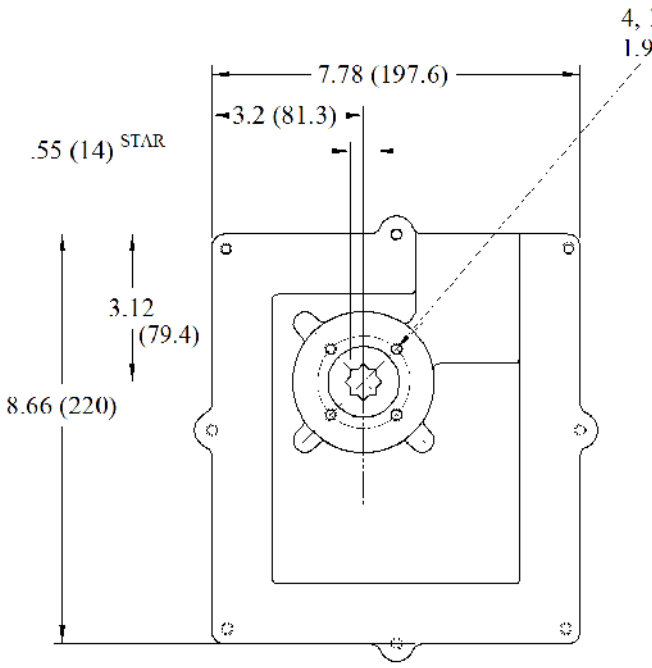
The motor's LR amps must be taken into account when sizing the input power supply and fuses. Slow blow fuses are recommended

| | | |
|---|---|---|
| CERTIFICATION | CSA | Master Contract 178618 |
| LOCATION | Hazardous - Class I, Division 1 & 2, Groups C & D; Class II Division 1 & 2, Groups E, F & G | |
| CANADIAN | CSA C322802 – Valves – Actuators – For Hazardous Locations CAN/CSA – C22.2 No. 139-1982; CAN/CSA – C22.2 No. 25-1966; CAN/CSA- C22.2 No. 30-M1986 | |
| UNITED STATES | Class C322882 - Valves – Actuators – For Hazardous Locations - Certified to US Standards. ANSI/UL 429, Seventh Ed. – 2013; ANSI/UL 1203 Third Ed. - 2000 | |
| CERTIFIED VOLTAGES | 12Vdc, 24Vdc & 115Vac | |
| APPROVED TEMP. | -4F (-20C) to 104F (40C) | |
| CERTIFIED OPTIONS | Enclosure Type 4, 7 & 9, One, Two or Three Auxiliary Switches, Push Knob Declutching Manual Override, Motor Brake for 12Vdc, 24Vdc & 115Vac, all Feedback Potentiometer options, Modulating Controls LRC, VP, VQ, VP0 & VQ0, Visual Position Indication D, DI, D3L, D3T, TX, TX0 & TQ, Additional Conduit Entry, Heater and Heater with Thermostat (For complete list of options, see option grid in catalog page 33) | |
| COATING | Thermally bonded polyester powder | |
| INDICATOR | Visual | Optional |
| | Electric | Feedback from limit switches, same as operating voltage |
| SWITCHES | Snap action | SPDT, 15A @ 250Vac |
| LUBRICATION | Grease | Permanent, little or no maintenance required |
| WEIGHT | Pound | 15 (lb) |
| | Kilogram | 4.54 (kg) |

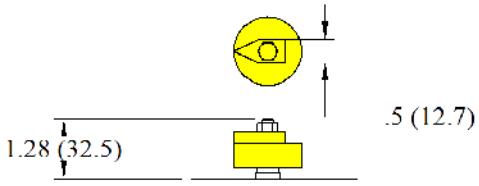
# SPECIFICATIONS (CONTINUED):

| | |
|---|---|
| MOUNTING | Universal |
| MOUNTING PAD | ISO 5211 F05 with 14mm star drive |
| TEMPERATURE | -40F (-40C) to 150F (65.6C), heater & thermostat required 0F and below<br>Optional double heater for application up to -76F (-60C) |
| OVERRIDE | Manual, non-declutching optional<br>Declutching manual override optional<br>DC voltage and 75% duty cycle motor must be declutching |

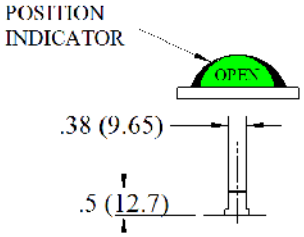



**OPTIONAL MANUAL OVERRIDE AND POSITION INDICATOR**




OPTION #1
DECLUTCHING WITH
PUSH KNOB




OPTION #2
ROTATE
THROUGH GEARS

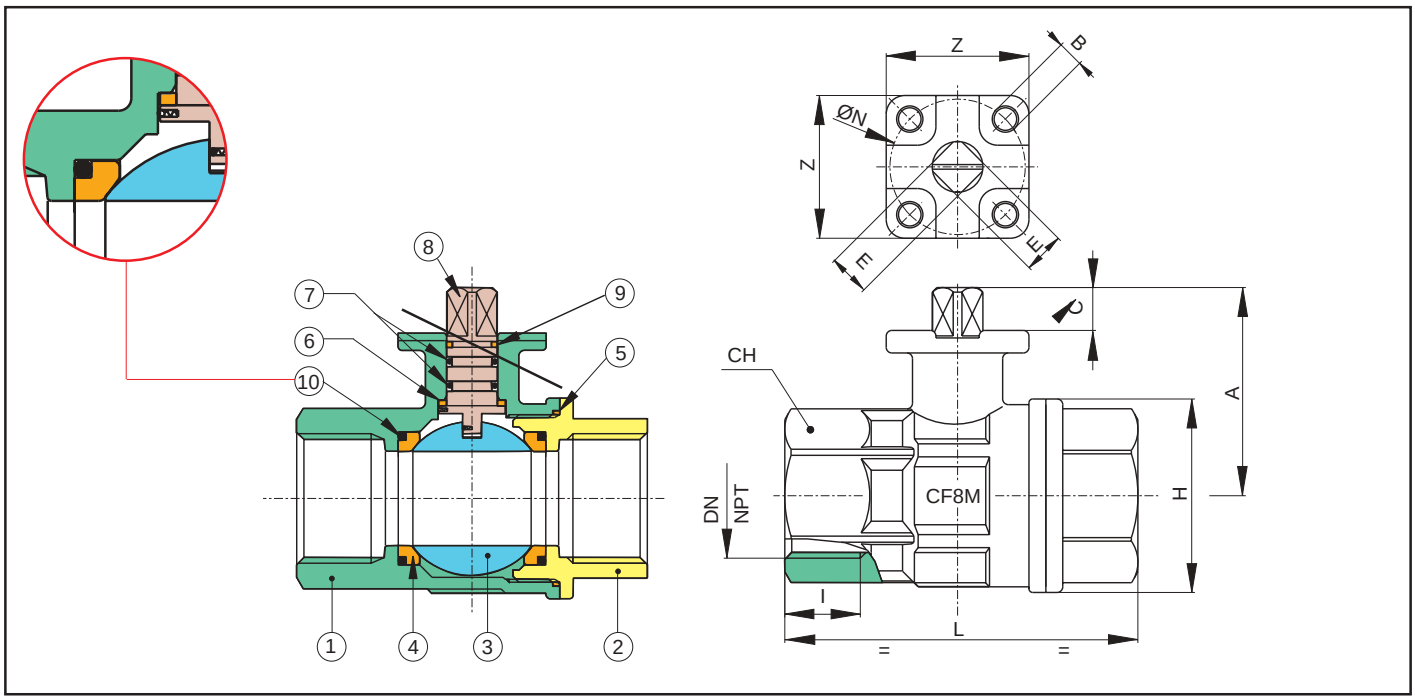
# SERIES 700076

## STAINLESS STEEL DIRECT MOUNT BALL VALVE

2 pc stainless steel ASTM A351 - CF8M ball valve, with ISO 5211 pad.

- Full port sizes 1/2" to 2".
- Pressure rating 1000 PSI WOG - 150 PSI steam.
- Temperature to 366°F.
- Blow out proof stem.
- P.T.F.E. seats with O-RING backing for low operating torque.
- P.T.F.E. seals and double O-RING stem packing.

- 100% electronically tested in the open and closed position at 80 PSI.




| N Pos | PART NAME | MATERIALS | N PCS |
|---|---|---|---|
| 1 | BODY | CF8M | 1 |
| 2 | END CONNECTION | CF8M | 1 |
| 3 | BALL | AISI 316 - CF8M | 1 |
| 4 | BALL SEAT | P.T.F.E. | 2 |
| 5 | SEAT | P.T.F.E. | 1 |
| 6 | STEM SEAL | P.T.F.E. | 1 |
| 7 | O-RING | FKM (Viton®) | 2 |
| 8 | STEM | AISI 316 | 1 |
| 9 | STEM SEAT | P.T.F.E. | 1 |
| 10 | O-RING | FKM (Viton®) | 2 |

| SIZE | | I | L | H | CH | A | C | E | N | B | Z | CV | PSI | Lbs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2” | in | 0.59 | 2.63 | 1.35 | 1.06 | 1.63 | 0.35 | 0.35 | 1.41 | 0.23 | 1.49 | 16.3 | 1000 | 0.68 |
| 3/4” | in | 0.64 | 3.07 | 1.65 | 1.25 | 1.71 | 0.35 | 0.35 | 1.41 | 0.23 | 1.49 | 29.5 | 1000 | 0.91 |
| 1” | in | 0.75 | 3.54 | 2.02 | 1.61 | 2.10 | 0.35 | 0.35 | 1.41 | 0.23 | 1.49 | 43.00 | 1000 | 1.35 |
| 1”1/4 | in | 0.84 | 3.93 | 2.53 | 1.96 | 2.24 | 0.35 | 0.35 | 1.41 | 0.23 | 1.49 | 89.00 | 1000 | 2.22 |
| 1”1/2 | in | 0.84 | 4.40 | 3.03 | 2.16 | 2.91 | 0.43 | 0.43 | 1.96 | 0.27 | 1.96 | 230.00 | 1000 | 3.69 |
| 2” | in | 1.01 | 5.31 | 3.81 | 2.75 | 3.27 | 0.43 | 0.43 | 1.96 | 0.27 | 1.96 | 265.00 | 1000 | 6.49 |

# D80 Series

## Liquid Filled • Stainless Steel Case

*D82LFB shown*

- **2", 2½", 4" Dial Sizes**
- **±1.6% Accuracy**
- **Stainless Steel Case**
- **Glycerine Fill Standard**

The Trerice **D80 Series** Utility Gauge is designed for rugged performance requirements at an economical cost. This liquid filled gauge is furnished with a stainless steel case and crimped ring. Wetted parts are either bronze tube with brass socket or stainless steel.

- Optional features and case style variations available: Please consult the Options & Accessories Section for details.
- For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.

### Specifications

| Models | | Wetted Parts |
|---|---|---|
| **D82LFB** | (liquid filled) | Bronze tube, brass socket |
| **D83LFSS** | (liquid filled) | 316 Stainless steel tube & socket |

| | |
|---|---|
| **Dial Sizes** | 2", 2½", 4" |
| **Fill** | Glycerine, other fills available<br>See Optional Features Section |
| **Movement** | **D82LFB**: Brass<br>**D83LFSS**: 316 Stainless steel |
| **Connection** | Lower male or center back male, ¼ NPT |
| **Case** | 304 stainless steel, stem-mounted flangeless |
| **Ring** | Crimped 304 stainless steel |
| **Window** | Acrylic |
| **Pointer** | Plain, black finished |
| **Dial Face** | Aluminum, white background with black graduations and markings |
| **Accuracy** | ±1.6% Full Scale |
| **Maximum Temperature** | **150°F (65°C)** |
| **Approximate Shipping Weight** | 2" Dial Size: 0.4 lbs [0.18 kg]<br>2½" Dial Size: 0.5 lbs [0.23 kg]<br>4" Dial Size: 1.0 lbs [0.45 kg] |

### HOW TO ORDER

Sample Order Number: **D82LFB 25 02 L A 110**

| Model | Dial Size | Connection Size | Connection Location | Units of Measure | Range Code |
|---|---|---|---|---|---|
| **D82LFB**<br>**D83LFSS** | **20** 2"<br>**25** 2½"<br>**40** 4½" | **02** ¼ NPT | **L** Lower<br>**B** Back | **A** psi<br>**D** psi/kPa | See Standard Ranges |



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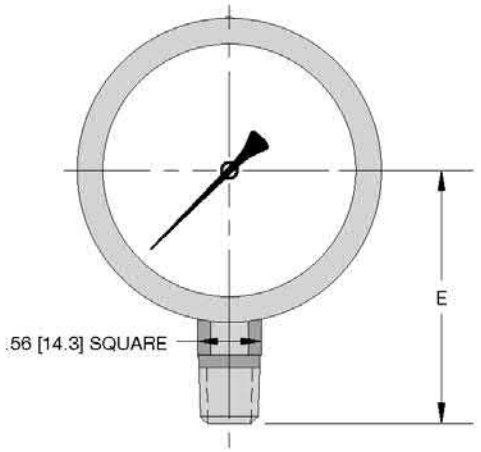
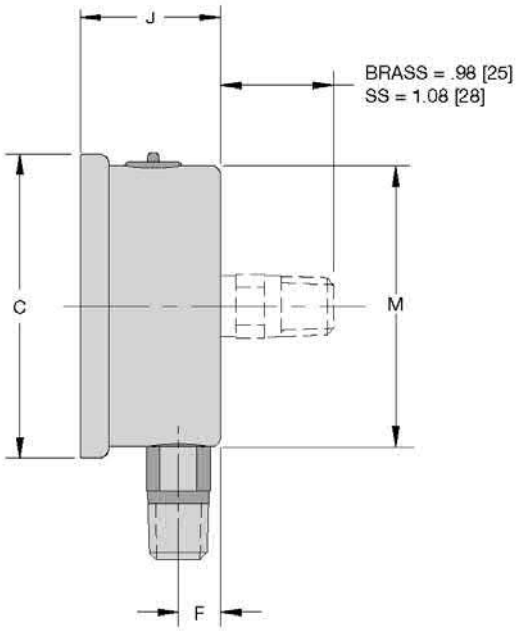
All dimensions are nominal. Dimensions in [ ] are in millimeters.






## Standard Ranges

| psi Ranges (A) | | | |
|---|---|---|---|
| **Range Code** | **Specific Range (psi)** | **Figure Intervals** | **Minor Divisions** |
| **010** | 30" Hg to 0 | 5 | 0.5 |
| **020** | 30" Hg to 15 psi | 10/5 | 1/0.5 |
| **030** | 30" Hg to 30 psi | 10/10 | 2/1 |
| **040** | 30" Hg to 60 psi | 30/20 | 2/2 |
| **050** | 30" Hg to 100 psi | 30/20 | 5/2 |
| **060** | 30" Hg to 150 psi | 30/20 | 10/5 |
| **070** | 30" Hg to 300 psi | 30/30 | 5/10 |
| **080** | 0 to 15 psi | 3 | 0.2 |
| **090** | 0 to 30 psi | 5 | 0.5 |
| **100** | 0 to 60 psi | 10 | 1 |
| **110** | 0 to 100 psi | 20 | 2 |
| **120** | 0 to 160 psi | 20 | 2 |
| **130** | 0 to 200 psi | 50 | 5 |
| **140** | 0 to 300 psi | 50 | 5 |
| **150** | 0 to 400 psi | 100 | 10 |
| **160** | 0 to 600 psi | 100 | 10 |
| **180** | 0 to 1000 psi | 200 | 20 |
| **190** | 0 to 1500 psi | 300 | 20 |
| **200** | 0 to 2000 psi | 500 | 50 |
| **210** | 0 to 3000 psi | 500 | 50 |
| **220** | 0 to 5000 psi | 1000 | 100 |
| | Ranges over 5000 psi are not available in D82LFB. | | |
| **230** | 0 to 10,000 psi | 2000 | 200 |
| **240** | 0 to 15,000 psi | 3000 | 200 |

*For dual scale ranges specify the appropriate **Units of Measure: D** (psi/kPa) followed by the corresponding **A** (psi) **Range Code**.*

| Dial Size | C | E | F | J | M |
|---|---|---|---|---|---|
| 2" | 2.09 [53.1] | 1.91 [48.5] | 0.43 [11.0] | 1.10 [28.0] | 1.94 [49.3] |
| 2½" | 2.67 [67.8] | 2.22 [56.5] | 0.37 [9.5] | 1.20 [30.5] | 2.47 [62.7] |
| 4" Brass | 4.18 [106.1] | 2.85 [72.3] | 0.48 [12.2] | 1.32 [33.5] | 3.93 [99.7] |
| 4" SS | 4.18 [106.1] | 3.07 [78] | 0.46 [11.8] | 1.31 [33.5] | 3.93 [99.7] |

SP210.J/13/06/1M-(FC)

# Pressure and Temperature Switches

## C, W and Z series switches

## The 'user-friendly generation' of BETA Pressure and Temperature Switches

### Safety:

— Safe, secure electrical hookup by clamp terminals
— Standard earth terminal
— IP 66 enclosure (NEMA 4X)
— Solid cover with gasket and captive screws

### Reliability:

— Highest overrange protection
— Spring loaded piston, excellent resistance against shock and vibration
— Flexible stainless steel mounting bracket
— No pipe strains on the instrument to cause shift of setpoint

### Approved by:

— EXIDA SIL3 Capable
— ATEX: W - Z - Series and C-Series Intrinsically Safe
— IECEx: W-Series and C-Series Intrinsically Safe
— PED: TÜV certificate CE 0035
— CSA: W-Series, C-Series and C-Series Intrinsically Safe
— FM: W-Series, C-Series Intrinsically Safe

### Quality SGS:

— SGS certified Quality Assurance according to ISO 9001 – 2008 and ISO 14001 - 2004, covers all switch manufacturing,engineering and design.

### Economy:

— A wide range of wetted process materials enable proper selection for any application.

### Service:

— The international BETA sales network backs up this high quality product with equally high quality service.

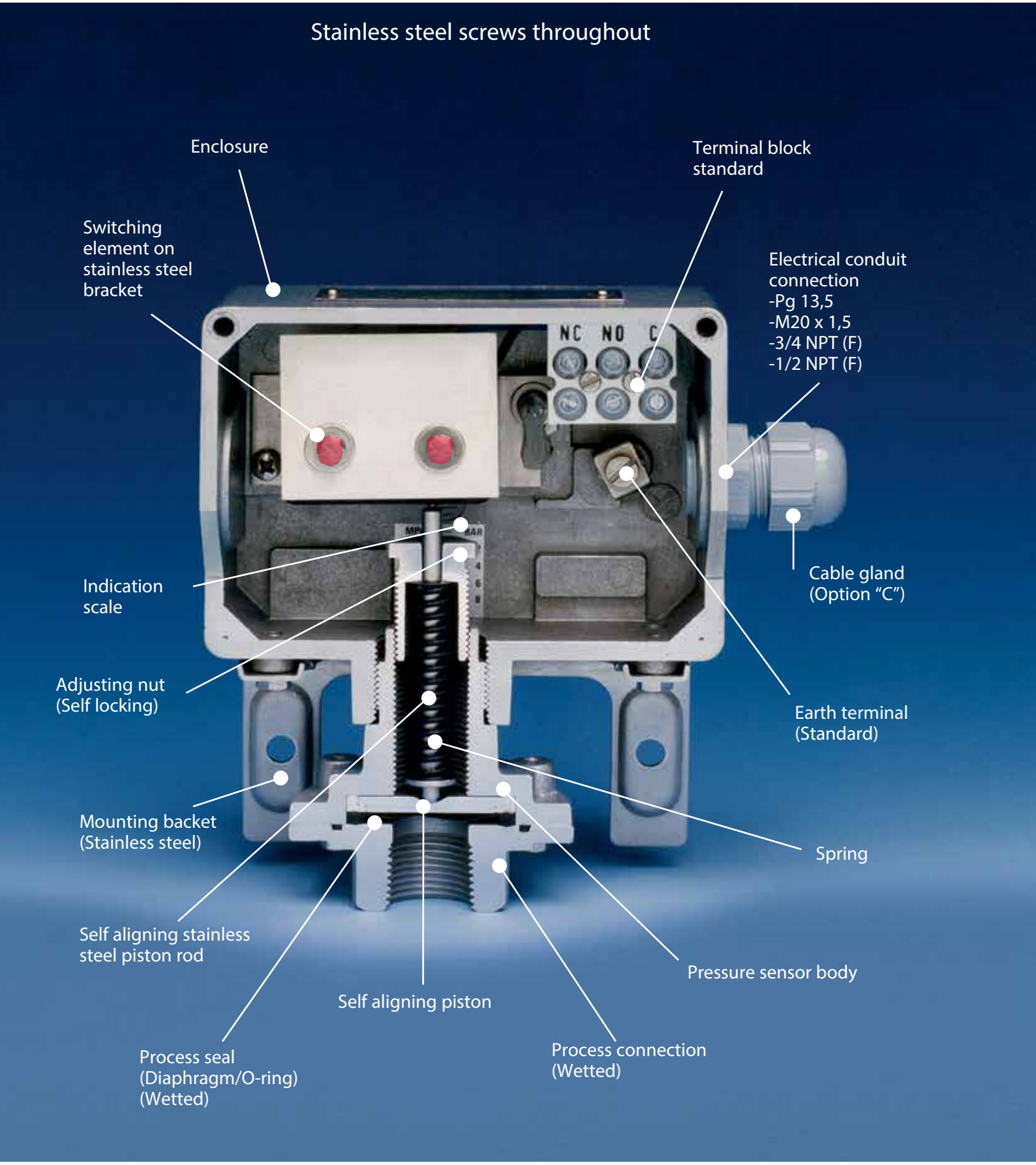
### Benefits:

— Our products are distinguished by highest reliability and are used in virtually any sector of industry. Highest quality and worldwide certification of our products for safety-critical applications ensure reliable monitoring of your plant, equipment or installation.

— BETA safety switches are assembled according to your requirements and are available in more than 10 million versions. Your special request might be a standard for us. Please contact us to discuss your requirements – we will be pleased to advise you.

exida SIL2 Capable

# BETA SWITCH PRINCIPLE



# THE “USER FRIENDLY GENERATION“

- The “User Friendly Generation” is no idle boast. BETA can – and always will – supply the best - instrumentation for the given conditions.
- Many years of close attention to our customer’s requirements have resulted in a vast experience of virtually all known switch applications.

Major users all over the world, in all areas of industry, already enjoy the benefits of BETA’s “user friendly” switches. BETA manufactures high quality instruments to meet all of your requirements.

## THE BETA PRINCIPLE

A high quality, self-aligning diaphragm/piston sensor is the heart of a BETA switch. The limited piston travel transmits pressure at the diaphragm directly to the microswitch, with no intervening linkages or mechanisms while providing full protection against high overrange pressure.

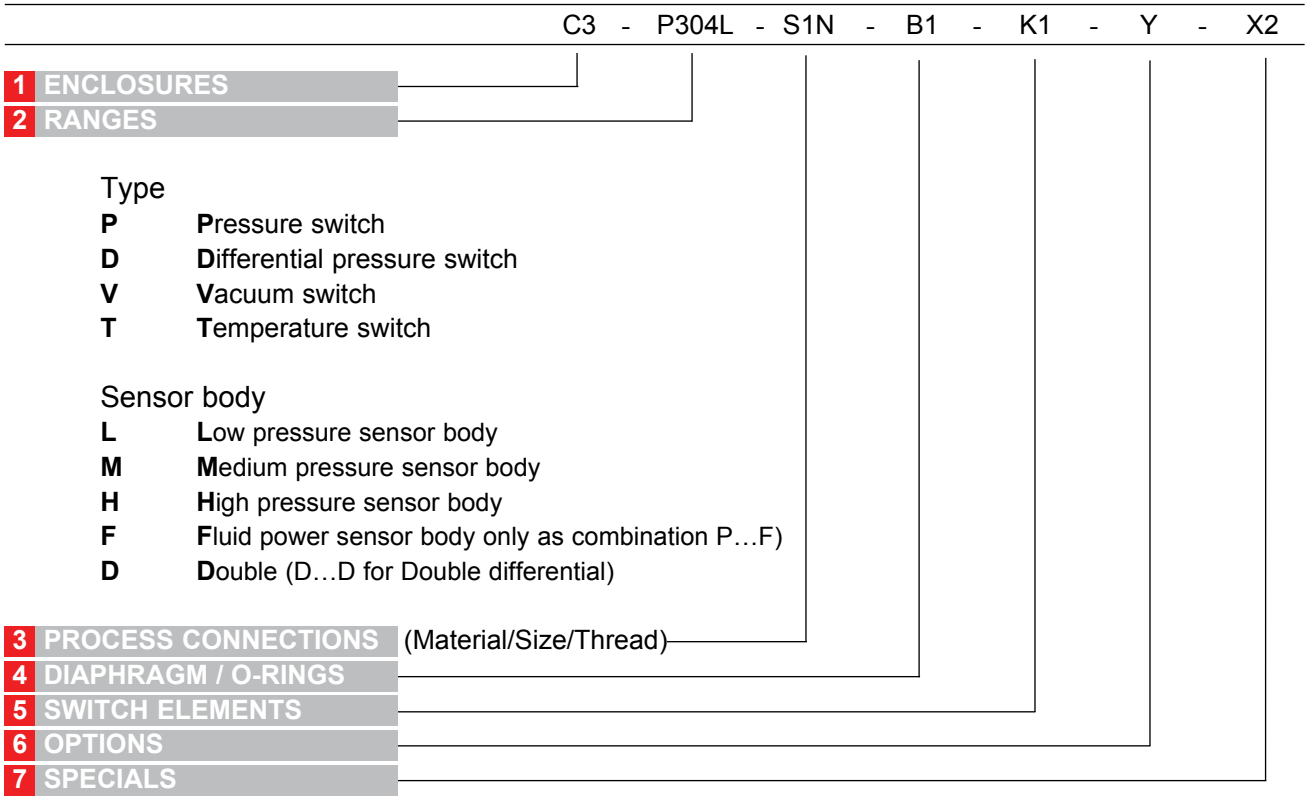
The piston sensor is isolated from the process fluid by a diaphragm and static O-Ring seal and retained by a process connection port. These (3) are the only process wetted parts and are available in an extensive range of materials.*

*) A BETA vacuum switch contains also a vacuum piston and spring (SS 316) on the wetted parts side

**THE BETA SWITCH HAS “DESIGNED-IN“ RELIABILITY.**

# GUIDE OF HOW TO SELECT YOUR BETA SWITCH

BETA uses a simple and logical model code system for easy, accurate product specification, project coordination,efficient document handling and after sales service.




# TO SELECT YOUR SWITCH

**Follow section 1 through 5**

If required: For “Optional” and “Special” accessories Follow section 6 or 7.

**Ambient temperature:**

Standard: -30 to +80°C
ATEX: -60 to +70°C : W-Series for T6
-60 to +80°C : W-Series for T5
-55 to +65°C : Z-Series for T6
Ex i: -60 to +80°C : C-Series

**Repeatability:**

± 0.2% of Full Range* (measured at 20°C ambient temperature acc. to ANSI/I.S.A.-S51.1-1979).

**Tagging/ Setting:**

BETA will free of charge, add your tag no. on the nameplate and set the pressure switches at desired setpoint if this is requested on your order.

Temperature switches can also be set at an additional charge.

**Warranty:**

36 months from ex-works date of manufacture (excl. “wetted parts”).

* For standard BETA switch (Switch with “K1” switching element and “B1” diaphragm/O-Ring).

# 1 ENCLOSURES

C3 - P304L - S1N - B1 - K1 - Y - X2

| ENCLOSURE CODE | CLASSIFICATION | ELECTRIAL COND. CONN. | MATERIAL | EARTH TERMINAL | TERM. BLOCK | TYPE OF SENSOR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | PRESS | FLUID P. | VACUUM | DIFF. | TEMP. |
| B2 [1] | Weathertight Miniature (IP65) | Hirschmann Plug conn. DIN 43650-A | Aluminium | Standard (Via plug) | Not applicable | √ | √ | √ | - | √ |
| C1 | Weathertight (IP66) Intrinsically safe (with Option "I") | PG 13,5 | Aluminium | Standard (Internal) | Standard | √ | √ | √ | √ | √ |
| C2 | | M20 x 1,5 | | | | | | | | |
| C3 | | 3/4" NPT (F) | | | | | | | | |
| C4 | | 1/2" NPT (F) | | | | | | | | |
| C8 | | M20 x 1,5 | 316 SS [2] | | | | | | | |
| C9 | | 3/4" NPT (F) | | | | | | | | |
| W3 | Explosion-proof ATEX & IECEx: Ex d II C T6...T5 Ex tD A21 T100°C IP66 | 3/4" NPT (F) | Aluminium | Standard In- & External | Standard | √ | √ | √ | √ | √ |
| W8 | | M20 x 1,5 | 316 SS [2] | | | | | | | |
| W9 | | 3/4" NPT (F) | | | | | | | | |
| Z1 | Explosion-proof Ex de IIC T6 (IP 66) 02 ATEX 2187X | PG 13,5 | Aluminium | Standard (In- & external) | Standard EEx e | √ | √ | √ | √ [3] | √ |
| Z2 | | M20 x 1,5 | | | | | | | | |
| Z3 | | 3/4" NPT (F) | | | | | | | | |
| Z4 | | 1/2" NPT (F) | | | | | | | | |
| Z8 | | M20 x 1,5 | 316 SS [2] | | | | | | | |
| Z9 | | 3/4" NPT (F) | | | | | | | | |

[1] See separate brochure BETAMINI for ranges, Process Connections etc.

[2] Includes SS 316 sensor body and adjusting nut.

[3] All differentials except D..D-type

**2" Pipe mount bracket sets available, see page 31.**

# 2 RANGES for Pressure switches

C3 - **P304L** - S1N - B1 - K1 - Y - X2

"Ranges" given here are valid for setpoints at increasing pressures (vacuum) of the high end of the range and decreasing for the low end of the range.
The "Deadband" values are the max. possible values for a standard micro & diaphragm/ O-ring and varies nearly linear with setpoint between indicated limits of range and should be multiplied by deadband multipliers as given in section 4 and 5, where appropriate. (For Fluid Power multiplier acc. to section 5 only).
Selection of other than standard micro may influence lower end of range.

| RANGE CODE | ADJUSTABLE RANGE | | MAX. DEADBAND | | MAX. OVERRANGE PRESSURE | PROOF PRESSURE |
|---|---|---|---|---|---|---|
| | | **bar** [mbar] | | **bar** [mbar] | **bar** | **bar** |
| **P 301 L** [1] | [2 - 15] | [mbar] | [1.1 - 1.9] | [mbar] | 10 | 15 |
| **P 302 L** [1] | [10 - 100] | [mbar] | [2.5 - 3.5] | [mbar] | 30 | 35 |
| **P 304 L** | [20 - 240] | [mbar] | [6 - 9] | [mbar] | | |
| **P 306 L** | [20 - 560] | [mbar] | [6 -12] | [mbar] | | |
| **P 308 L** | [25 - 1300] | [mbar] | [7 - 15] | [mbar] | | |
| **P 402 M** | [100 - 400] | [mbar] | [15 - 20] | [mbar] | 125 | 140 |
| **P 404 M** | [100 - 950] | [mbar] | [16 - 50] | [mbar] | | |
| **P 406 M** | [120 - 2300] | [mbar] | [15 - 30] | [mbar] | | |
| **P 408 M** | [150 - 5400] | [mbar] | [16 - 90] | [mbar] | | |
| **P 502 H** | 0.3 - 1.6 | **bar** | [65 - 95] | [mbar] | 200 | 600 |
| **P 504 H** | 0.4 - 3.5 | **bar** | [65 - 160] | [mbar] | | |
| **P 506 H** | 0.5 - 9.0 | **bar** | [65 - 330] | [mbar] | | |
| **P 508 H** | 0.7 - 21.5 | **bar** | [70 - 810] | [mbar] | | |
| **P 706 H** | 2.5 - 32 | **bar** | 0.3 - 1.65 | **bar** | | |
| **P 708 H** | 3.0 - 76 | **bar** | 0.3 - 3.75 | **bar** | | |
| **P 808 H** | 4.0 - 170 | **bar** | 0.8 - 9.5 | **bar** | 300 | |
| **P 908 H** | 10 - 300 | **bar** | 2.0 - 19.5 | **bar** | 400 | |
| **P 909 H** | 10 - 350 | **bar** | 2.0 - 25 | **bar** | | |

[1] Only available with L1 -microswitch element.K1 possible consult factory).

## RANGES for Fluid power switches

| RANGE CODE | ADJUSTABLE RANGE | | MAX. DEADBAND | | MAX. OVERRANGE PRESSURE | PROOF PRESSURE |
|---|---|---|---|---|---|---|
| | | **bar** | | **bar** | **bar** | **bar** |
| **P 904 F** | 12 - 55 | **bar** | 3.5 - 6.0 | **bar** | 650 | 700 |
| **P 906 F** | 16 - 130 | **bar** | 4.0 - 8.5 | **bar** | | |
| **P 908 F** | 20 - 300 | **bar** | 6 - 12 | **bar** | | |
| **P 918 F** | 30 - 540 | **bar** | 15 - 31 | **bar** | | |

Fluid Power switches are to be used on clean, lubricating fluids only.

## RANGES for Vacuum switches

| RANGE CODE | ADJUSTABLE RANGE [1] (INCR. VAC. TO PRESS.) | | MAX. DEADBAND (VAC. / PRESS.) | | MAX. VACUUM | | MAX. OVERRANGE PRESSURE | | PROOF PRESSURE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **bar** [mbar] | | **bar** [mbar] | **bar** [mbar] | | **bar** [mbar] | | **bar** [mbar] | |
| **V 301 L** | [-10 to -3] | [mbar] | [1] | [mbar] | [-500] | [mbar] | +10 | **bar** | +15 | **bar** |
| **V 304 L** | [-60/0/+150] | [mbar] | [4/4/6.5] | [mbar] | [-500] | [mbar] | +30 | **bar** | +35 | **bar** |
| **V 404 M** | [-400/0/+400] | [mbar] | [16/16/25] | [mbar] | -1 | **bar** | +125 | **bar** | +140 | **bar** |
| **V 406 M** | [-980/0/+1000] | [mbar] | [30/30/40] | [mbar] | | | | | | |
| **V 506 H** | -1/0/+6 | **bar** | [80/80/25] | [mbar] | -1 | **bar** | +200 | **bar** | +600 | **bar** |

[1] For setpoint around zero bar gauge, consult factory.

# 3 PROCESS CONNECTIONS

C3 - P304L - **S1N** - B1 - K1 - Y - X2

| | PROCESS CONNECT SIZE / CODE | AVAILABLE ON SENSOR [2] | ALUMINIUM | | SS 316 | | MONEL | | BRASS | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NPT | BSP | NPT | BSP | NPT | BSP | NPT | BSP |
| | 1/4"F | F | | | S1N | S1B | | | B1N | B1B |
| | | L<br>D...L | A1N | A1B | | | M1N | M1B | | |
| | | H / M / D...M | | | | | | | | |
| | | D...H / D | | | | | | | | |
| | 1/2"F | F | | | S2N | S2B | | | B2N | B2B |
| | | L<br>D...L | A2N | A2B | | | M2N | M2B | | |
| | | H / M / D...M | | | | | | | | |
| | 1/2"M | L, M & H<br>D...L / M | | | S7N | S7B | M7N | M7B | | |
| | 1/2" Gauge Connection | H<br>L & M | | | | S7G | | | | |
| Not for vacuum [1] | 1"F | L & D...L | | | S4N | S4B | | | | |
| Not for vacuum [1] | 2"F | L & D...L | | | S6N | S6B | | | B6N | B6B |
| Not for vacuum [1] | 1"M | M & H<br>D...M | | | S8N | S8B | | | | |

Other materials such as P.V.C., Hastelloy, 316 SS Ti, Titanium etc. and other sizes and (Teflon lined) flanged connections are available.

[1] **Vacuum switches**: Process conn. size max. 1/2". Vacuum piston & spring (both wetted) standard in 316 SS.

[2] (**Standard) process connection** for "L"ow pressure sensor body : **A1N or A1B**
"M"edium & "H"igh pressure sensor body : **S1N or S1B**
"F"luid power pressure sensor body : **B1N or B1B**
Differential switches: D…H, D…D, D...M : **S1N or S1B only**
D…L : **A1N or A1B; For Low side only**
**High side; Only "L"-sensor connection**

**NOTES:** ** Process connection according to NACE standards are available, consult your BETA Switch Representative.
** NPT connections are tapered; BSP are parallel threaded.

# 4 DIAPHRAGM / O-RINGS

C3 - P304L - S1N - **B1** - K1 - Y - X2

| DIAPHRAGM/ O-RING CODE | DIAPHRAGM [6] | O-RING | USE [1] | DEADBAND MULTIPLIER |
|---|---|---|---|---|
| **B1** | Buna-N | Buna-N [2] | Standard water / oil (-30°C to +80°C). | 1.0 |
| **E6** | EPDM | EPDM [2] | Some hydraulic fluids. | 1.0 |
| **K5** | Kalrez | Kalrez [2] | Highly corrosive fluids. | 1.5 |
| **M1** | Monel | Buna-N | Seawater. | 2.0 |
| **M2** | | Viton-A [5] | High temperature NOT below -10°C. [7] | |
| **M4** | | PTFE [4] | Corrosive acids. | |
| **M5** | | Kalrez | Highly corrosive and permeative acids. | |
| **N3** | Neoprene | Neoprene [2] | When required. | 1.0 |
| **P1** | PTFE (Polyimide coated with PTFE) | Buna-N | Oil / air / water. | 1.5 |
| **P2** | | Viton-A [5] | High temperature NOT below -10°C. [7] | |
| **P4** | | PTFE [4] | Corrosive acids. | |
| **P5** | | Kalrez | Corrosive acids. | |
| **S1** | SS 316 | Buna-N | Permeative gases. | 2.0 |
| **S2** | | Viton-A [5] | High temperature NOT below -10°C [7] | |
| **S3** | | Neoprene | Permeative refrigerant gases. | |
| **S4** | | PTFE [4] | Corrosive acids. | |
| **S5** | | Kalrez | Highly corrosive and permeative acids. | |
| **S6** | | EPDM | Steam. | |
| **T1** | Tantalum | Buna-N | Highly corrosive and permeativr gases and non-acid liquids. Select O-ring as required. | 2.0 |
| **T2** | | Viton-A [5] | | |
| **T3** | | Neoprene | | |
| **T4** | | PTFE [4] | | |
| **T5** | | Kalrez | | |
| **V2** | Viton-A | Viton-A [2] [5] | High temperature NOT below -10°C. [7] | 1.5 |
| **S0** | SS 316 Welded diaphragm | None [3] | Highly permeative gases. | 3.0 |
| **M0** | Monel Welded diaphragm | | | |

[1] Wetted parts are suggested for use on the service indicated. However they do not constitute a guarantee against corrosive or permeation since processes vary from plant to plant.
Empirical experience by users should be the final guide. The diaphragm / O-Ring combinations are for process temperatures of -30°C to +80°C, unless otherwise indicated.
For process temperatures beyond these limits please contact your BETA Switch Representative.

[2] Switches for fluid power applications are limited to these options (O-Ring only with 316 SS piston).

[3] Only for 1/4" & 1/2" process connections. Not available on vacuum switches. For other sizes and materials, consult your BETA Switch Representative.

[4] PTFE O-Ring not suitable for vacuum switches or vacuum conditions.
(Wetted internal spring of Co-Cr-Ni alloy, comparable with Elgiloy).

[5] For process temperature > 100 °C, consult your BETA Switch Representative.

[6] Other diaphragm materials like Hastelloy available, consult your BETA Switch Representative.

[7] High temperature refers to max. 140 °C at process connection.

**Note:**
Wetted parts are not guaranteed against corrosion or permeation since processes vary from plant and concentration of harmful fluids, gasses or solids vary from time to time in a given process.
Empirical experience by users should be the final guide and alternate materials based on this are generally available.

# 4 DIAPHRAGM / O-RINGS

C3 - D352H - S1N - **P1** - K1 - Y - X2

Differential Pressure Switches can use the same Diaphragm/O-ring combinations as Pressure Switches but we have to consider following:

| TYPE | STANDARD | FOLLOWING COMBINATIONS ARE POSSIBLE |
|---|---|---|
| P301L/ D...L | **B1** | All except with PTFE O-Ring and Welded diaphragm. |
| D...M | **B1** | All diaphragm and O-Ring combinations. |
| D...H | **P1** | Metal + TCP. |
| D...D | **P1** | Metal + TCP. |

**Note:** Deadband Multiplier for Diaphragm/O-Ring and microswitch element is the same as for pressure switch.

# 5 SWITCHING ELEMENTS

C3 - D352H - S1N - P1 - **K1** - Y - X2

| SWITCHING ELEMENT CODE [1] | | USE | MAX. RATINGS (RES.) | | DEADBAND MULTIPL. | |
|---|---|---|---|---|---|---|
| | | | VAC. | VDC [8] | S.P.D.T. | D.P.D.T. |
| **H1 (SL)** [5] | Herm. sealed | (Inert gas filled) Dusty, corrosive environment. | 125/ 1A | 28/ 15A | 5.0 | 6.5 |
| **K1** [4] [9] | General-service | Standard. | 480/ 15A | 28/ 0.5A** | 1.0 | 1.5 |
| **L1** [4] | | Standard for P/D301L & P/D302L ranges. | 480/ 10A | 28/ 0.5A | 1.0 | - |
| **M1** * | | M2 Standard on W-Series. | 250/ 5A | 30/ 0.1A | 1.5 | 3.5 |
| **U1** [9] | | Normal DC-service. | 480/ 15A | 125/ 0.5A | 2.5 | 4.0 |
| **G1** [4] | Low voltage circuit (Gold contacts) | For use in $H_2S$ environment and/or for (EEx)i applications. [2] | 125/ 1A | 28/ 0.5A** | 1.5 | 2.0 |
| **Y1** * | | | 125/ 0.1A | 30/ 0.1A | 3.0 | 4.5 |
| **O1** * | Gold contacts | Environmental proof (IP 67). | 250/ 0.1A | 30/ 0.1A | 1.5 | 3.0 |
| **N1** * | Silver contacts | Environmental proof (IP 67). | 250/ 2A | 30/ 2A | 1.5 | 3.0 |
| **Z1** * | For higher (amb.) temp. | Elgiloy spring. For corrosive environment. | 250/ 5A | 125/ 0.3A | 3.0 | 4.5 |
| **R1** | Ex. Proof. | ATEX approved. (Only Z-series) | 250/ 5A | 250/ 0.25A | 2.5 | 4.5 |
| **SP** | Adjustable deadband | Small adjustable deadband. | 250/ 15A | - | 1 to 3 | S.P.D.T. only |
| **SR** [3] [5] [6] [9] | | Wide adjustable deadband. | 480/ 20A | - | 2 to 6 | |
| **SE** [3] | Manual reset | Actuates automatic on increasing pressure. | 480/ 15A | 125/ 0.5A | 1.5 | |
| **SG** [3] | Manual reset | Actuates automatic on decreasing pressure. | 480/ 15A | 125/ 0.5A | 1.5 | |
| **SV** | DC-service | High DC cap. magnetic blow out. | 125/ 10A | 125/ 10A | 4.0 | |
| **SA** [3] | Pneumatic [7] | Normally closed (NC). | For use in explosive atm. Ex II 2G c T6 KEMA 04ATEX4060 | | Consult BETA Switch Rep. | Single Only |
| **SB** [3] | | Normally open (NO). | | | | |

[1] For D.P.D.T. action second code figure should be specified as “2” (Example: K1 = S.P.D.T ./ K2 = D.P.D.T.).

[2] Capacitive and / or inductive load may influence the setpoint repeatability.

[3] Not on Differential pressure switches (except for “SR”-micro in “W”-enclosure).

[4] VDE certified acc. to. DIN EN 61 058-1:1992+A1:1993.

[5] “SR”-and “H1”-micro may influence the low end of range.

[6] “SR”-micro in combination with metal diaphragm: standard with option “P”.

[7] For pneumatic element ask for our separate Air Relay documentation.

[8] For DC rating, give resistive loads.

[9] MAX. 10A in “W...” Enclosure

* Subminiature.

** DC rating not U.L. listed, although experience and third party testing confirm the DC voltage ratings. Consult your BETA Switch Representative.

# 5 SWITCHING ELEMENTS VS. ENCLOSURES

C3 - P304L - S1N - B1 - **K1** - Y - X2

| SWITCHING ELEMENT | | ENCLOSURE | | |
|---|---|---|---|---|
| | | C1, C2, C3, C4, C8, C9 | W3, W8, W9 | Z1, Z2, Z3, Z4, Z8, Z9 |
| | | Internal Earth Ground Terminal | Internal & External Earth Ground Terminal | Internal & External Earth Ground Terminal |
| S. P. D. T. (SINGLE SWTCHING ELEMENT) | SE | 3-WAY TERMINAL BLOCK | | |
| | SG | | | |
| | SP | | | |
| | SR | | SCREW.TERM.BL. | |
| | SV | | 4-WAY TERMINAL BLOCK | |
| | G1<br>H1 (SL)<br>K1<br>L1<br>U1<br>O1<br>N1 | | | |
| | R1 | | | 3-WAY TERMINAL BLOCK |
| | M1<br>Y1<br>Z1 | 3-WAY TERMINAL BLOCK | 4-WAY TERMINAL BLOCK | |
| D. P. D. T. (DOUBLE SWITCHING LEMENT) | R2 | | | 2X3-WAY TERMINAL BLOCK |
| | M2<br>Y2<br>Z2 | 2X3-WAY TERMINAL BLOCK | 7-WAY TERMINAL BLOCK | |
| | G2<br>H2<br>K2<br>U2 | 2X3-WAY TERMINAL BLOCK | | |
| | O2<br>N2 | | 7-WAY TERMINAL BLOCK | |
| | SA *<br>SB * | 1/4 NPT. (F) CONNECTIONS | | |

POSSIBLE

NOT PRACTICAL

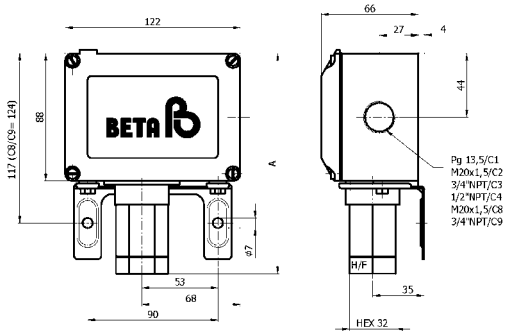
NOT POSSIBLE

* “SA” / “SB” only with C1- / C8-enclosure.

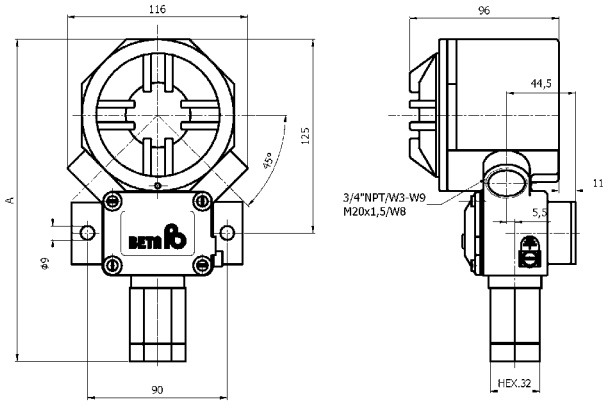
The standard switching elements are:
“K1” for C- and W- enclosures. (“L1” for P301L/P302L/D302L range).
“R1” for Z- enclosures.

# DIMENSIONS

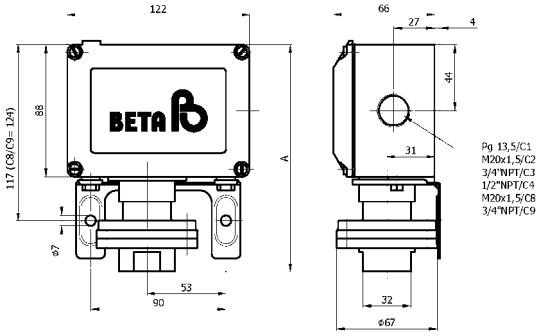
## “C - Z”-Series: Pressure & Vacuum “P...H”



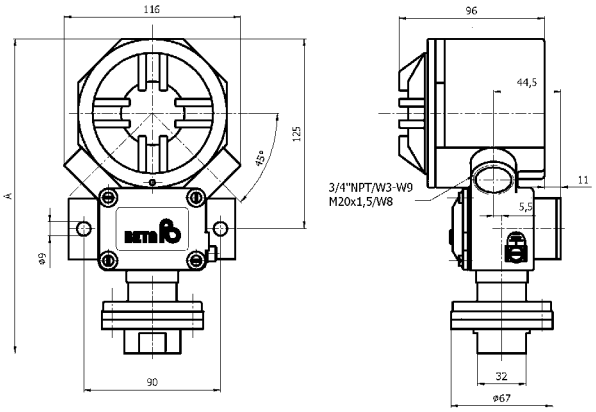

## “W.”-Series: Pressure & Vacuum “P...H”



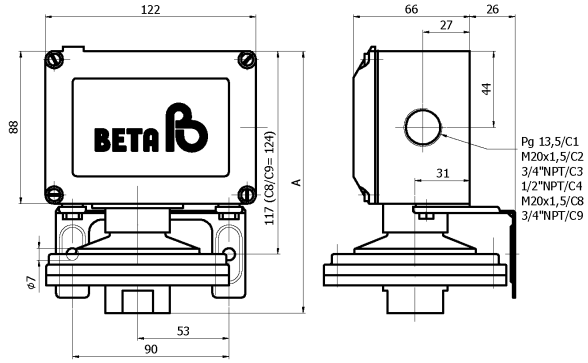

## “C - Z”-Series: Pressure & Vacuum “P...M”



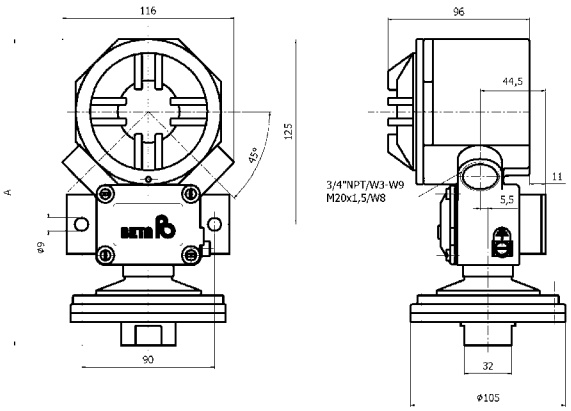

## “W.”-Series: Pressure & Vacuum “P...M”




## “C -Z”-Series: Pressure & Vacuum “P...L”




## “W.”-Series: Pressure & Vacuum “P...L”




** For specific details about the dimension “A” consult factory.

BDP INDUSTRIES INC.
354 State Route 29 • P.O. Box 118 • Greenwich, NY 12834 • Tel. (518) 695-6851 • Fax: (518) 695-5417

# *RDT CONTROLS DESCRIPTION*

*BDP Job 1529*

The rotary drum thickener will consist of one main control panel and a local control station. The control panel will have an OIT on the front door and will house all the motor VFDs, starters, control relays, PLC and transformer. The local panel will be a NEMA 7 rated enclosure housing H-O-A and speed control of components. The control schematics 1-1529-4, 1-1529-5, and 1-1529-6 show the wiring between the panel and the auxiliary equipment. The following items are controlled and/or displayed from the front of the OIT:

1. Hand-Off-Auto selector button
2. Auto Start/Stop buttons
3. Wash water Valve Open/Close buttons
4. Wash water Booster Pump Start/Stop buttons
5. Dual Drum Drive Start/Stop buttons and speed control
6. Sludge Pump Start/Stop buttons and speed control
7. Polymer System Start/Stop buttons and speed control
8. Emergency Stop mushroom head pushbutton
9. Hour Run Display
10. Test/Reset pushbutton
11. Silence pushbutton
12. Speed Displays for all variable speed drives
13. Sludge Flow Display
14. Various Alarm Displays

The following items are controlled from the front of the local control panel:

1. Local-Off-Remote selector button
2. Auto Start/Stop buttons
3. Drum Speed Potentiometer
4. Sludge Feed Pump Speed Potentiometer
5. Polymer System Speed Potentiometer
6. System Running Light
7. System Fault Light
8. Emergency Stop Button

**Hand-Off-Auto from Main OIT**

The mode of operation can be selected from the BDP control panel OIT. This selection is made from the "Overview" screen. In the OFF position, none of the components will operate. In the HAND position, the start and stop buttons will control their respective component. In the AUTO position, the AUTO START button will activate an automatic starting of the components in order, and the AUTO STOP button will then stop the components in the reverse order.

# *RDT CONTROLS DESCRIPTION*

*BDP Job 1455*

**Local-Off-Remote from Local Control Panel**

If the Local-Off-Remote switch is placed in Remote on the local control panel, the RDT main panel OIT will have full control of the equipment. When placed in OFF, none of the components can operate. When placed in Local, the operator can Auto Start or Auto Stop the equipment locally and have speed control of the drum, sludge pump and polymer system.

**Auto Mode**

Once AUTO mode has been selected and the AUTO START button is pressed, the PLC will begin to start the following components in order. First, the PLC will call for the washwater valve to open. Once the valve is fully opened, the booster pump will be called to start. Both drum drives will then be called to start and will rotate at the set speed adjustable by the speed setpoint function on the OIT. The RDT READY display will then highlight. The selected sludge pump and polymer system will then be called to start. Sludge and Polymer selection/start/stop/speed will be communicated to the plant network via Ethernet. At this point, conditioned sludge will pass through to the feed pipe, then split into each drum. The sludge will fall from the drum discharge opening into a sludge hopper attached to the machine.

**NOTE: There is no "automatic" speed control of the drives. Before starting the equipment, make sure the speed setpoints are adjusted to a desired starting set point. After components have been started, operators will have to manually set desired rates of speed.**

When operation is complete, pressing the AUTO STOP button will automatically shut down the components in the reverse order that they started. First, the sludge pump and polymer pump will be called to stop, and the WASH CYCLE display will highlight again. The post wash cycle usually lasts 20 minutes to allow all sludge to be removed from the filter belt, and allows sufficient time for operators to wash down the machine. After the wash cycle, the drum drives will stop and the wash water valve will close.

**Hand Mode**

Once the H-O-A button is placed in HAND mode, the operator is responsible for starting and stopping the components individually from the Hand Mode screen. The components are arranged on the screen so that starting will commence from the top to the bottom. The order of operation should follow the same steps as described in the AUTO MODE above.

**Sludge Pumps and Polymer System**

The pumps can be controlled from the BDP control panel via Ethernet with the plant PLC. When the START button is pressed for the pump, the PLC will send the start command to the plant PLC through communication. All speed commands/feedbacks, run signals, alarms will be communicated between the BDP PLC and the plant PLC (external to BDP panel).

# *RDT CONTROLS DESCRIPTION*

*BDP Job 1529*

**Emergency Stop Pushbutton**

The E-stop is a jumbo head red pushbutton on the panel door. When pressed, the button is maintained and can only be released by twisting the head. See ALARMS below for functionality.

**Alarms**

Any of the following alarms will cause an Emergency shutdown:

- Emergency Stop pushbutton on panel
- Emergency Stop pull cords on thickener
- Drum Zero Speed

Any of the following alarms will cause a Programmed shutdown:

- Low Wash Water Pressure
- Sludge Pump Failure
- Polymer Pump Failure

An emergency shutdown will immediately stop the drum drives, stop the polymer pump, stop the sludge pump, and close the wash water valve. The emergency shutdown interrupts all power to the equipment and activates the audible alarm horn. The SILENCE pushbutton will stop the alarm horn. Once the problem is corrected, the RESET button will clear the alarm, and the equipment can be restarted.

A programmed shutdown will act as if the AUTO STOP pushbutton was pressed. The sludge pump will stop and the polymer pump will stop and the RDT will enter a wash cycle for 20 minutes eventually shutting the remaining components down.

The specific alarm is posted across the top the OIT screen and a red pilot light will light up on the panel door. All alarms are kept in an alarm history menu until the “Clear” button is pressed.

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/28/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| RDT MOUNTED ELECTRICAL | | | | | | |
| | 2 | ALLEN BRADLEY | 800H-FPX6A1 | MUSHROOM HEAD PUSH-PULL PUSHBUTTON, RED, NEMA 7 | | 2 |
| | 2 | ALLEN BRADLEY | 871TM-DR8NE18H2 | PROXIMITY SWITCH, 18MM, INTRINSICALLY SAFE, ZERO SPEED | | 2 |
| | 1 | ADALET | XCE061105-N4 | XPROOF JUNCTION BOX, NEMA 7, 4X OPTION | | 1 |
| | 1 | ADALET | X1030303-N4 | SINGLE OPERATOR CONTROL STATION, NEMA 7, 4X OPTION | | 1 |
| | | | | | | |
| ELECTRICAL | | | | | | |
| STOCK | 1 | PANDUIT | UGB2/0-414-12 | UL LISTED GROUND BAR | | 1 |
| | 1 | HAMMOND | PH1000MQMJ | 1000VA CONTROL TRANSFORMER | | 1 |
| | 1 | EATON | 9SX700 | TOWER STYLE UPS 700VA, 120V | | 1 |
| | 1 | EATON | EHBPL1500R-PDUIU | HOT SWAP MAINTENANCE BYPASS | | 1 |
| BDP | 1 | BDP | PANEL LEGS | 24' PANEL LEGS, 1 PAIR | | 1 |
| | 2 | IDEC | RH3B-UL-120VAC | 3 POLE RELAY, 120VAC COIL | | 2 |
| | 4 | IDEC | RH2B-UL-AC110-120V | 2 POLE RELAY, 120VAC COIL | | 4 |
| | 2 | IDEC | SH3B-05 | 3 POLE RELAY BASE | | 2 |
| | 4 | IDEC | SH2B-05 | 2 POLE RELAY BASE | | 4 |
| STOCK | 1 | FEDERAL | 350-120-30 | HORN 120VAC/60HZ | | 1 |
| STOCK | 1 | FEDERAL | K8435666A | HORN MOUNTING KIT | | 1 |
| STOCK | 100 | PHOENIX | 3044102 | TERMINAL BLOCK - GRAY | | 100 |
| STOCK | 25 | PHOENIX | 3044115 | TERMINAL BLOCK - BLUE | | 25 |
| | 1 | PHOENIX | 2856702 | SURGE SUPPRESSOR | | 1 |
| | 1 | PHOENIX | 2963860 | SIMPLEX PLUG SOCKET, 120V | | 1 |
| | 1 | PHOENIX | 2902994 | 24 VOLT DC POWER SUPPLY, 90 WATT | | 1 |
| | 1 | PHOENIX | 2891929 | 8 PORT ETHERNET SWITCH | | 1 |
| | 2 | PHOENIX | 2907609 | CIRCUIT BREAKER, TMC 83C 03A, 3 POLE, 3 AMP, C CURVE | | 2 |
| | 1 | PHOENIX | 2907684 | CIRCUIT BREAKER, TMC 83D 10A, 3 POLE, 10 AMP, D CURVE | | 1 |
| | 1 | PHOENIX | 2907588 | CIRCUIT BREAKER, TMC 82D 06A, 2 POLE, 6 AMP, D CURVE | | 1 |
| | 1 | PHOENIX | 2907563 | CIRCUIT BREAKER, TMC 81C 06A, 1 POLE, 6 AMP, C CURVE | | 1 |
| | 1 | PHOENIX | 2907562 | CIRCUIT BREAKER, TMC 81C 05A, 1 POLE, 5 AMP, C CURVE | | 1 |
| | 2 | PHOENIX | 2907559 | CIRCUIT BREAKER, TMC 81C 02A, 1 POLE, 2 AMP, C CURVE | | 2 |
| | 1 | SQUARE D | LC1D12G7 | CONTACTOR, NON REV, 12A, 3-Pole, 120VAC Coil, 1 NO & 1 NC | | 1 |
| | 1 | SQUARE D | LRD10 | OVERLOAD RELAY, 4 TO 6 AMPS | | 1 |
| | 1 | SQUARE D | HJL36015 | MAIN CIRCUIT BREAKER, 3 POLE, 15 AMP | | 1 |
| STOCK | 1 | SQUARE D | 9001KN8330 | EMERGENCY STOP CIRCULAR LEGEND | | 1 |
| | 1 | SQUARE D | 9422A2 | OPERATING HANDLE, NEMA 4X | | 1 |
| | 1 | SQUARE D | 9422RQ1 | VARIABLE DEPTH OPERATING MECHANISM | | 1 |
| | 1 | SQUARE D | PDC6HD6 | POWER DISTRIBUTION LUG KIT | | 1 |
| | 1 | ALLEN BRADLEY | 800H-QRH2R | RED PILOT LIGHT, LED | | 1 |
| | 1 | ALLEN BRADLEY | 800H-BR5A2 | WHITE PUSH BUTTON | | 1 |
| | 1 | ALLEN BRADLEY | 800H-BR2A | BLACK PUSH BUTTON | | 1 |
| | 1 | ALLEN BRADLEY | 800H-FRXJT6A1 | MUSHROOM HEAD E-STOP | | 1 |
| | 2 | ALLEN BRADLEY | 25BD2P3N104 | POWERFLEX 525 AC DRIVE, 1 HP, 480V, NEMA 1 | | 2 |
| | 1 | ALLEN BRADLEY | 1769-L30ER | COMPACTLOGIX PROCESSOR | | 1 |
| | 1 | ALLEN BRADLEY | 1769-PA2 | PLC POWER SUPPLY | | 1 |
| | 1 | ALLEN BRADLEY | 1769-IA16 | 16 POINT INPUT CARD, 120VAC | | 1 |
| | 1 | ALLEN BRADLEY | 1769-OA16 | 16 POINT OUTPUT CARD, 120VAC | | 1 |
| | 1 | ALLEN BRADLEY | 1769-IF4 | ANALOG INPUT MODULE | | 1 |
| | 1 | ALLEN BRADLEY | 1769-ECR | END CAP | | 1 |
| | 1 | ALLEN BRADLEY | 2711P-T12W21D8S | PANELVIEW PLUS 7; 12" STANDARD | | 1 |
| | 2 | ALLEN BRADLEY | 937ZH-DPDP-2 | ZENER BARRIER, DC POSITIVE POLARITY, 250 OHMS | | 2 |
| | 2 | ALLEN BRADLEY | 700-SH10JZ24 | SOLID STATE RELAY | | 2 |
| | 1 | SAGINAW | SCE-48XEL3712SS6LP | NEMA 4X ENCLOSURE, 316 STAINLESS STEEL | | 1 |
| | 1 | SAGINAW | SCE-48P36 | BACK PANEL | | 1 |
| | 3 | MIECO | LEG-1 | LEGENDS PER PRINT | | 3 |
| | | | | | | |

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/28/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL QTY |
|---|---|---|---|---|---|---|
| LOCAL CONTROL PANEL | | | | | | |
| STOCK | 10 | PHOENIX | 3044102 | TERMINAL BLOCK - GRAY | | 10 |
| STOCK | 1 | SQUARE D | 9001KN8330 | EMERGENCY STOP CIRCULAR LEGEND | | 1 |
| | 1 | ALLEN BRADLEY | 800H-FPX6A1 | MUSHROOM HEAD PUSH-PULL PUSHBUTTON, RED, NEMA 7 | | 1 |
| | 1 | ALLEN BRADLEY | 800H-HP2KB6 | 2-POSITION SWITCH, MAINTAINED, NEMA 7 | | 1 |
| | 1 | ALLEN BRADLEY | 800H-BP1A | GREEN PUSH BUTTON, NEMA 7 | | 1 |
| | 1 | ALLEN BRADLEY | 800H-BP6A | RED PUSH BUTTON, NEMA 7 | | 1 |
| | 2 | ALLEN BRADLEY | 800H-QPH2M | LED PILOT LIGHT, MULTI COLORED BULB KIT, NEMA 7 | | 2 |
| | 1 | ADALET | XCE101406-N4 | XPROOF JUNCTION BOX, NEMA 7, 4X OPTION | | 1 |
| | 5 | MIECO | LEG-1 | LEGENDS PER PRINT | | 5 |

MAIN CONTROL PANEL

SLUDGE PUMP DRIVE POWER — VFD

POLYMER UNIT POWER — 120V

POLYMER PUMP SPEED

POLYMER PUMP RUNNING

POLYMER PUMP START/STOP

WW PUMP POWER — MS

FLOWMETER POWER — 120V

FLOW SIGNAL — AI

TWAS LEVEL SENSOR — PT

DRUM ZERO SPEED — ZSH

EMERGENCY STOP — HS

DRUM #1 POWER — VFD

DRUM #2 POWER — VFD

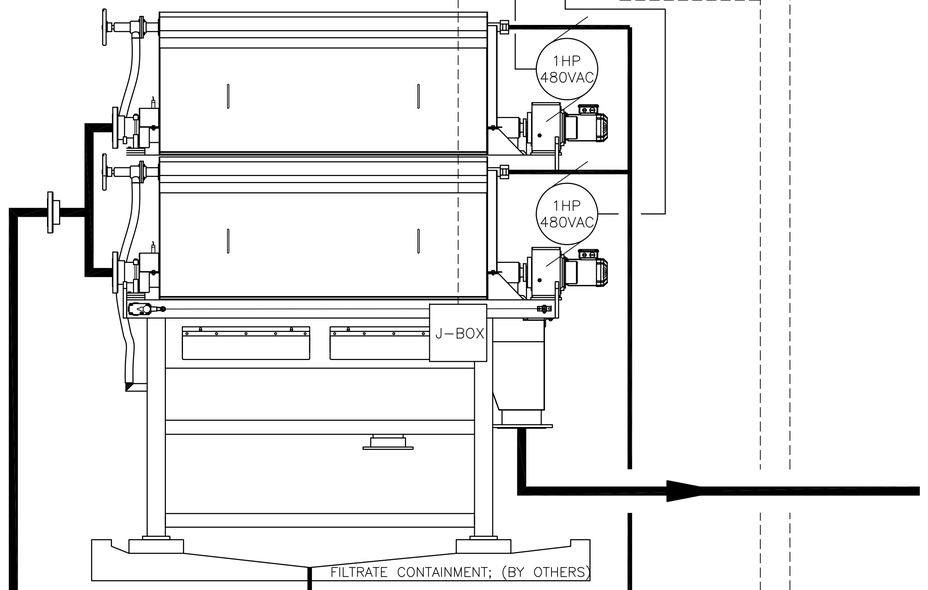
LOW WW PRESSURE — PS-2

WW VALVE — SOL-1

WW VALVE OPEN — ZSH

WW VALVE CLOSED — ZSL

ROTARY DRUM THICKENER




FROM PLANT WATER SOURCE

NEAT POLYMER SOURCE BY OTHERS

POLYMER UNIT BY OTHERS

1-1/2" POLYMER LINE

4" SLUDGE LINE

4" VENTURI MIXER WITH POLYMER MANIFOLD BY BDP

4" FLOWMETER BY BDP

7.5HP 480VAC

FROM PLANT SLUDGE SOURCE

SLUDGE FEED PUMP 150 GPM BY OTHERS

3 HP 480VAC

FROM PLANT WATER SOURCE 36 GPM

WASHWATER PUMP BY BDP

FILTRATE DRAIN

PS-2

M

SOL-1

80 PSI BOOSTED WATER

NOTES:

1. ALL INTERCONNECTING PIPING TO AND FROM THICKENER SUPPLIED BY OTHERS.
2. ALL WIRING FROM 120V JUNCTION BOX TO DEVICES MOUNTED ON THICKENER ARE BY BDP.
3. DRAWING IS FOR REFERENCE ONLY. NOT TO BE USED FOR CONSTRUCTION.

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|

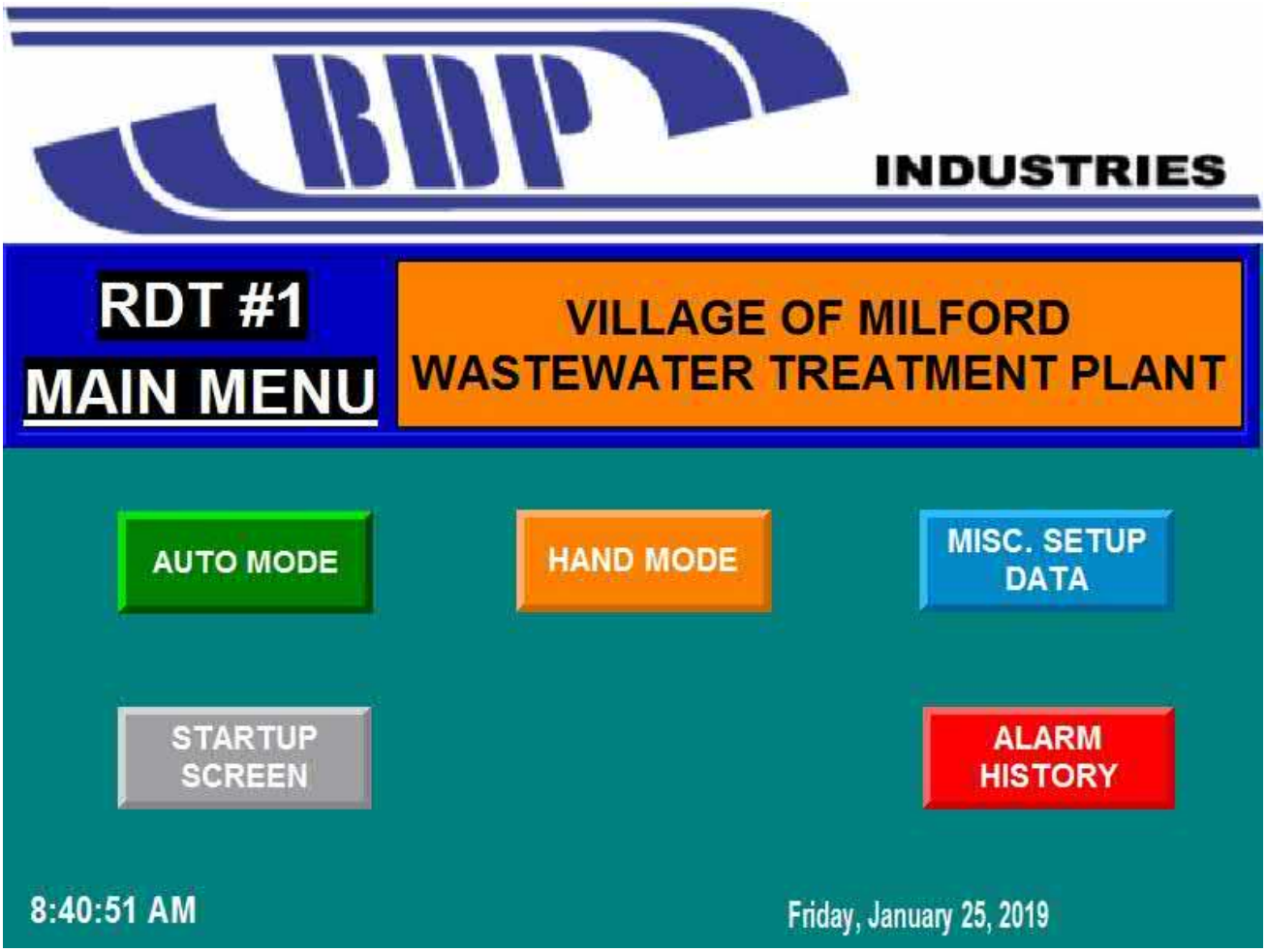
| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| CUSTOMER: | MACHINE: | DWG TITLE |
|---|---|---|
| ORLEANS, MA | ø4' x 10' RDT | DUAL ø4' x 10' RDT P & ID |
| **BDP JOB NO.** 1529 | **DWN BY:** SKD | **DATE:** 8/28/19 |
| **APP'D BY:** | **SCALE:** NONE | **SHT.** 1 **OF** 1 |
| | | **DWG NO.** 1-1529-2 **REV.** 1 |

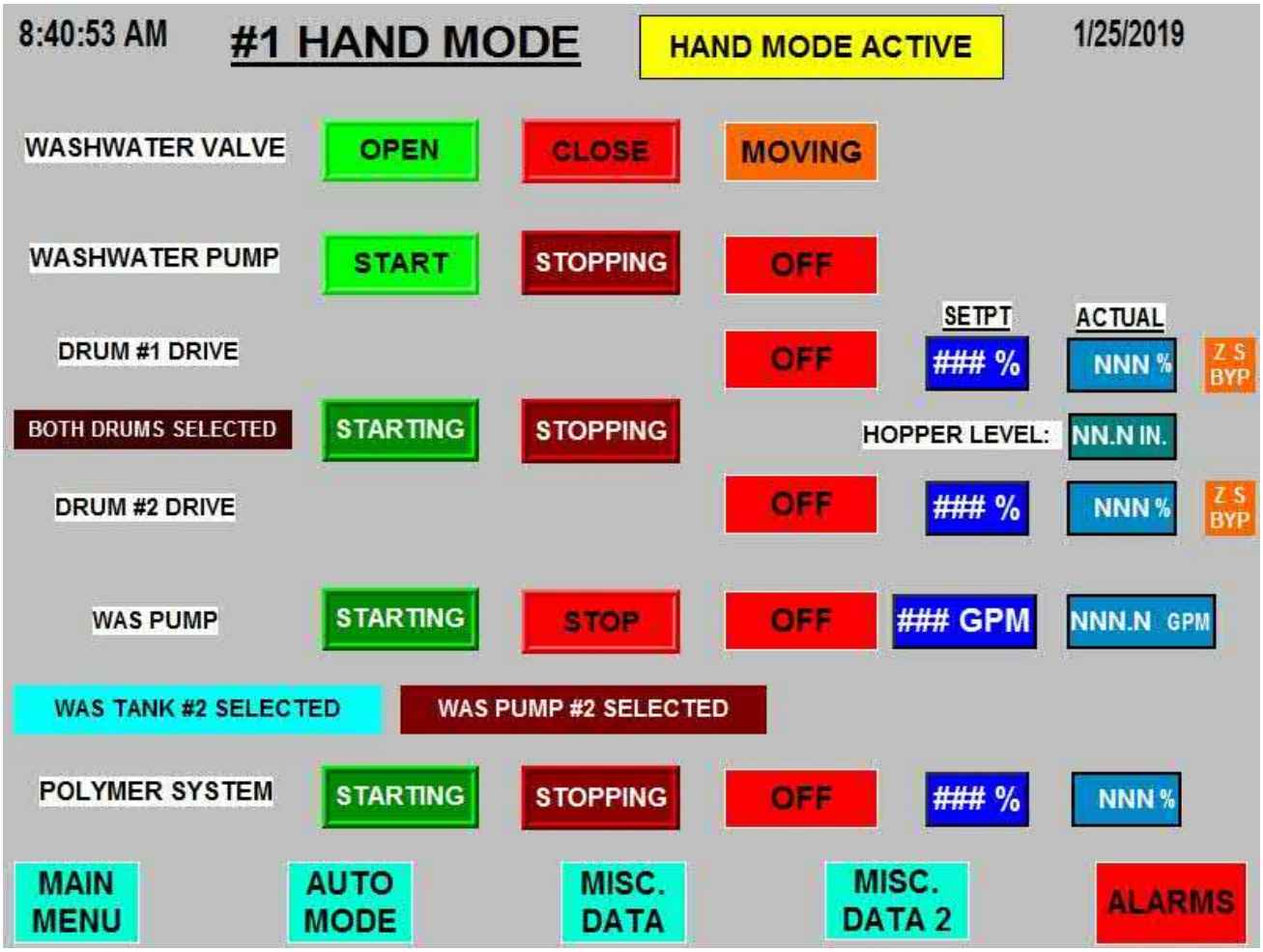
## 1.1.1.1.7 Graphics\Displays\5 - STARTUP

### 1.1.1.1.3 Graphics\Displays\1 - menu

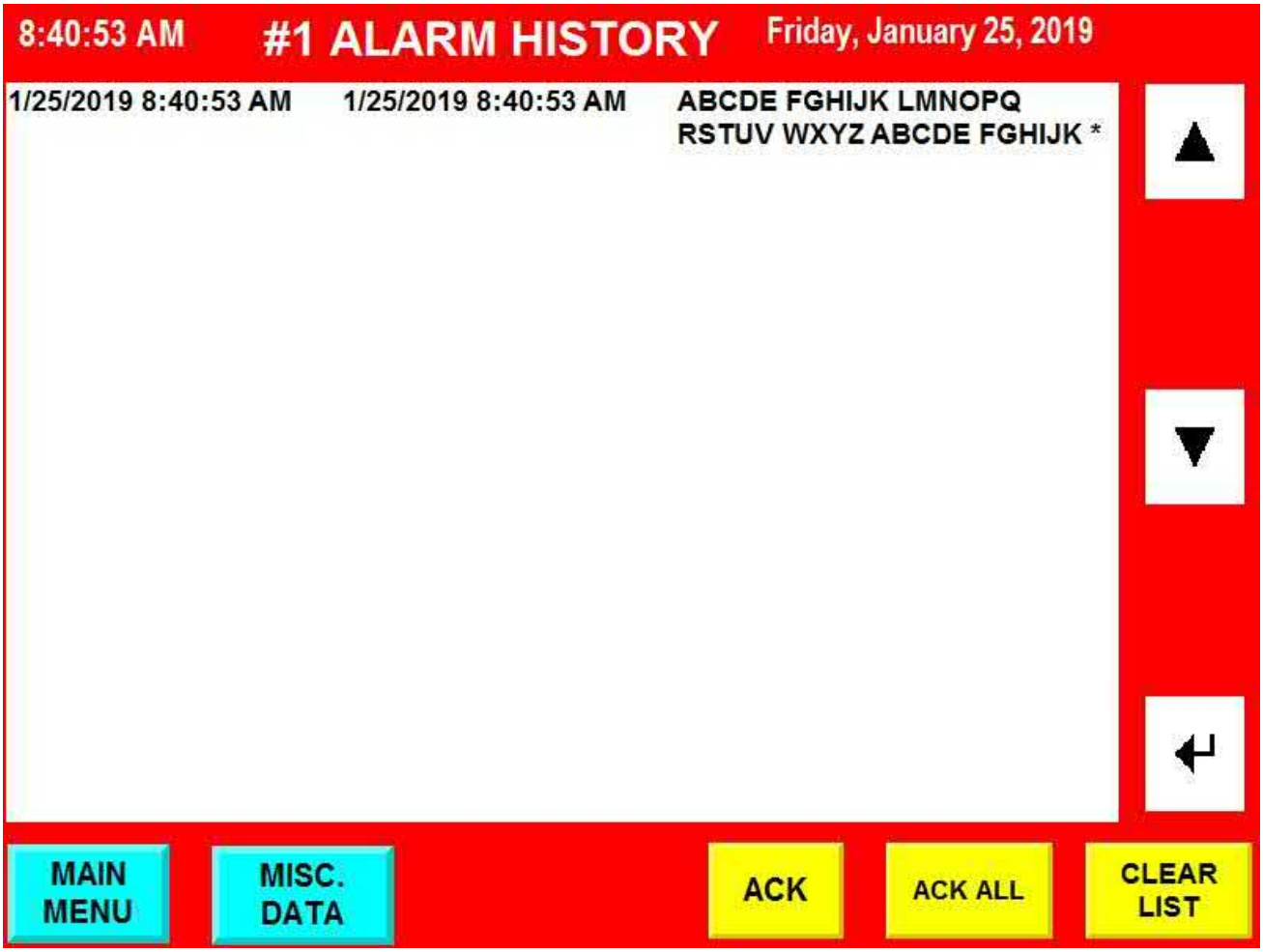


### 1.1.1.1.4 Graphics\Displays\[ALARM]

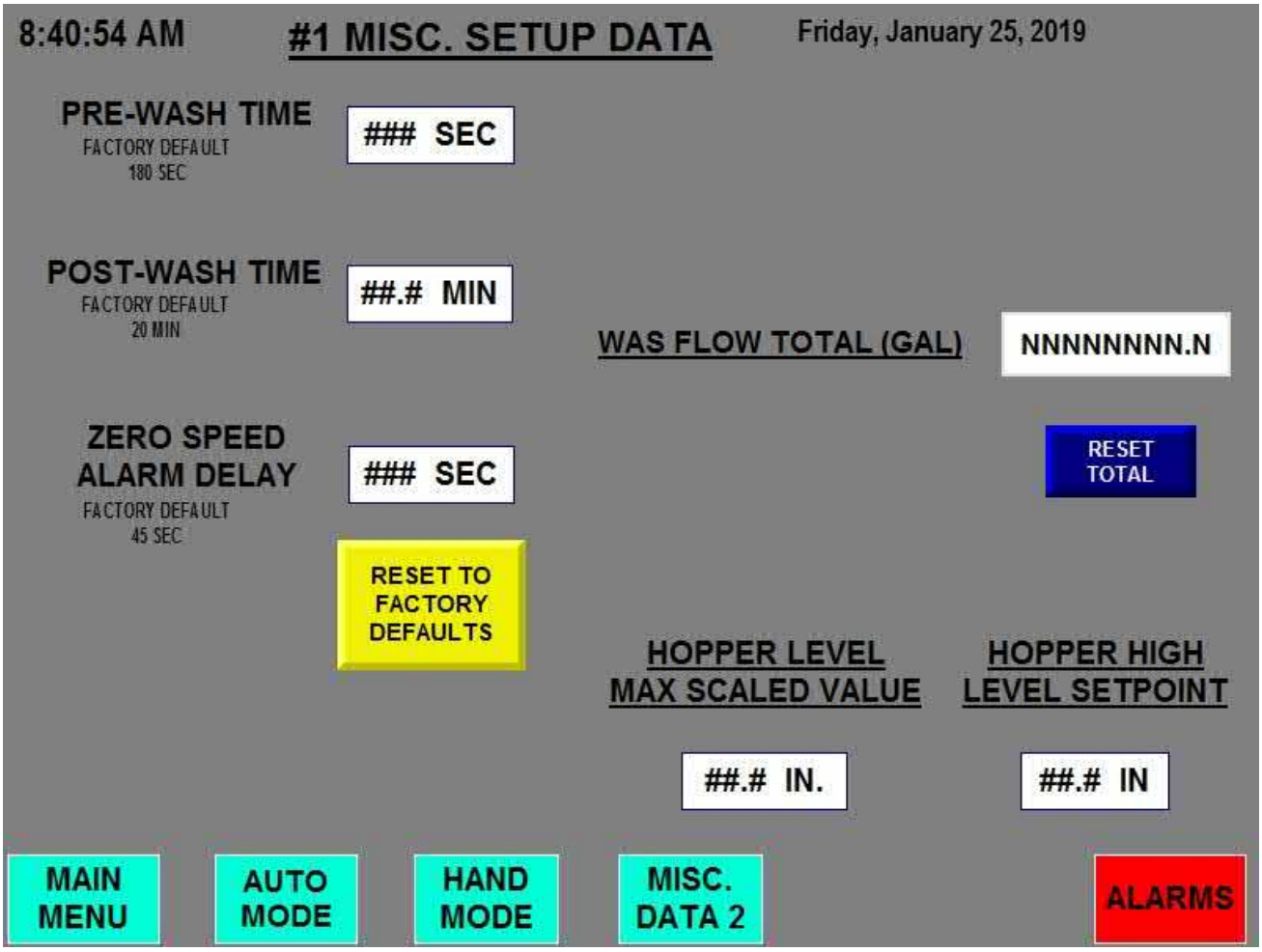
## 1.1.1.1.5 Graphics\Displays\3 - HAND MODE



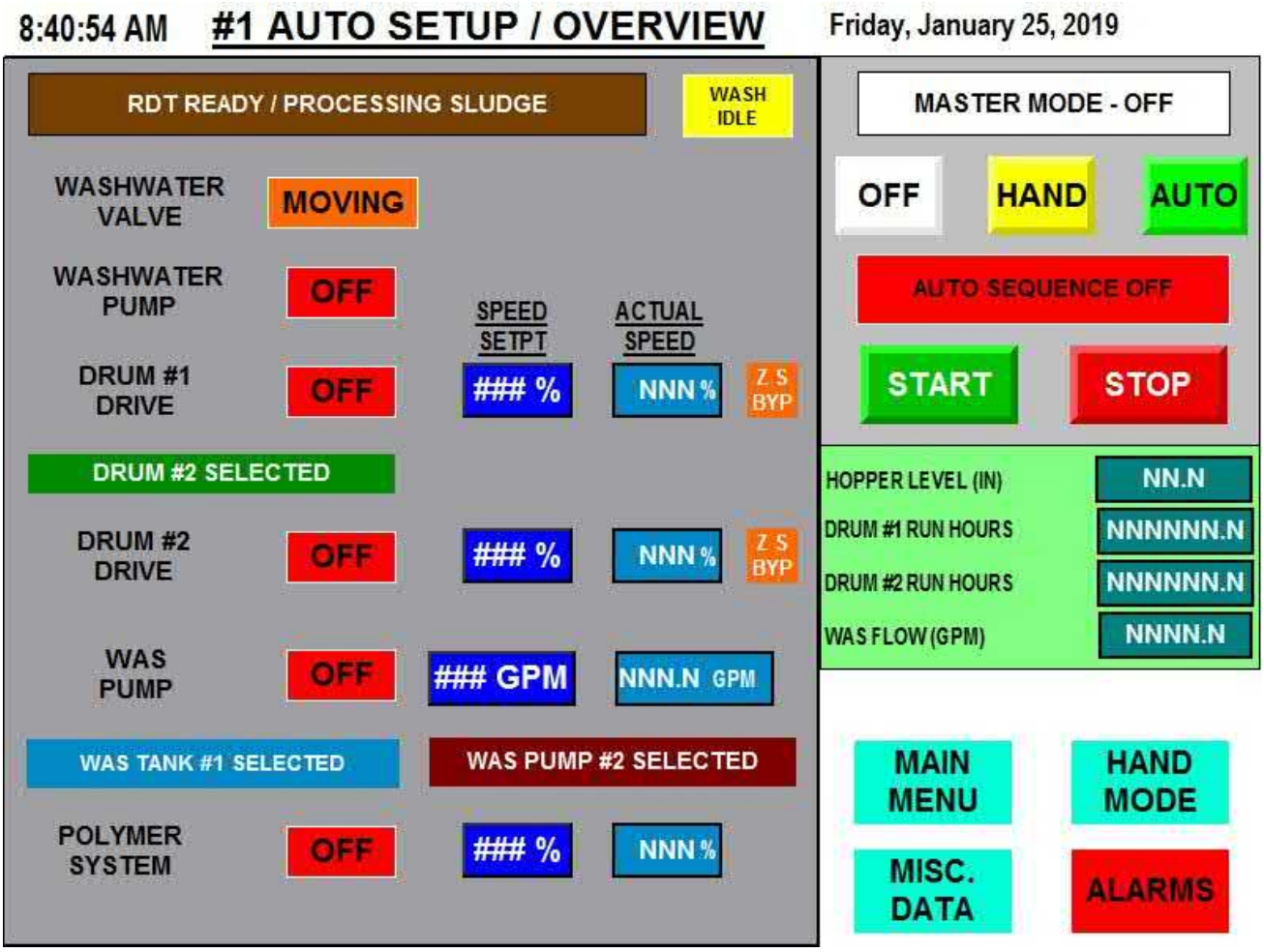
### 1.1.1.1.6 Graphics\Displays\4 - ALARMS



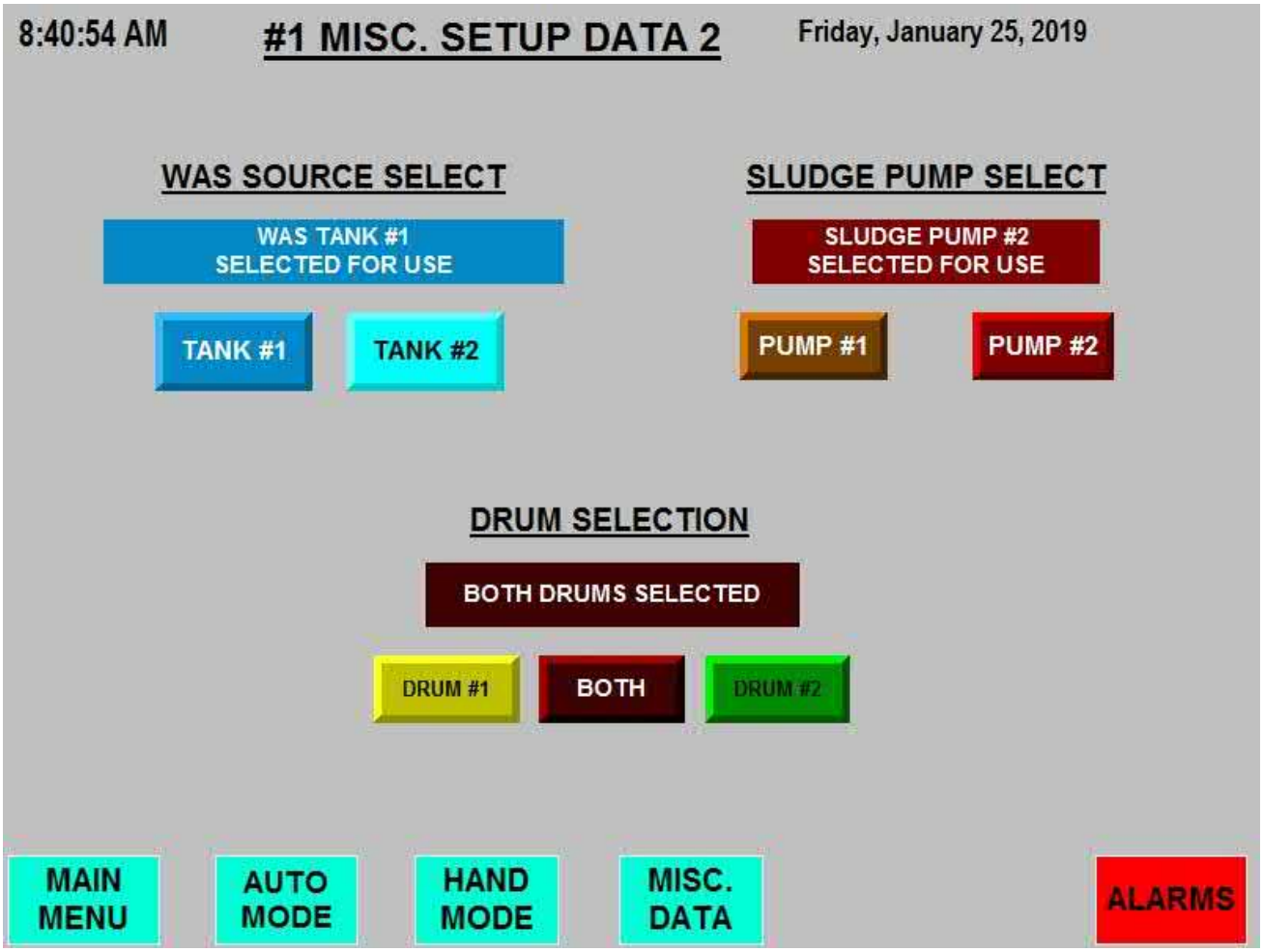
## 1.1.1.1.8 Graphics\Displays\6 - MISC DATA



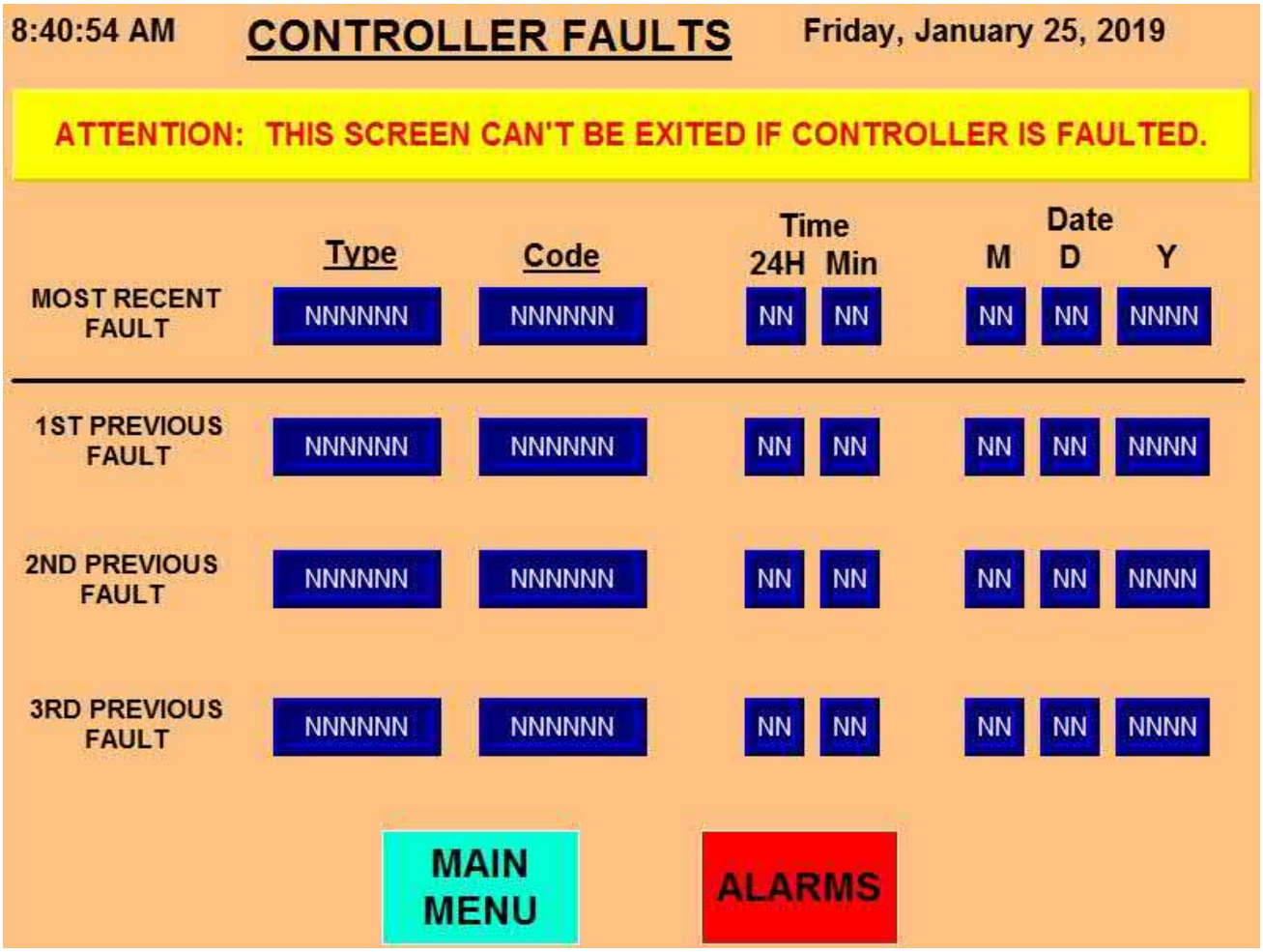
## 1.1.1.1.9 Graphics\Displays\2 - AUTO MODE

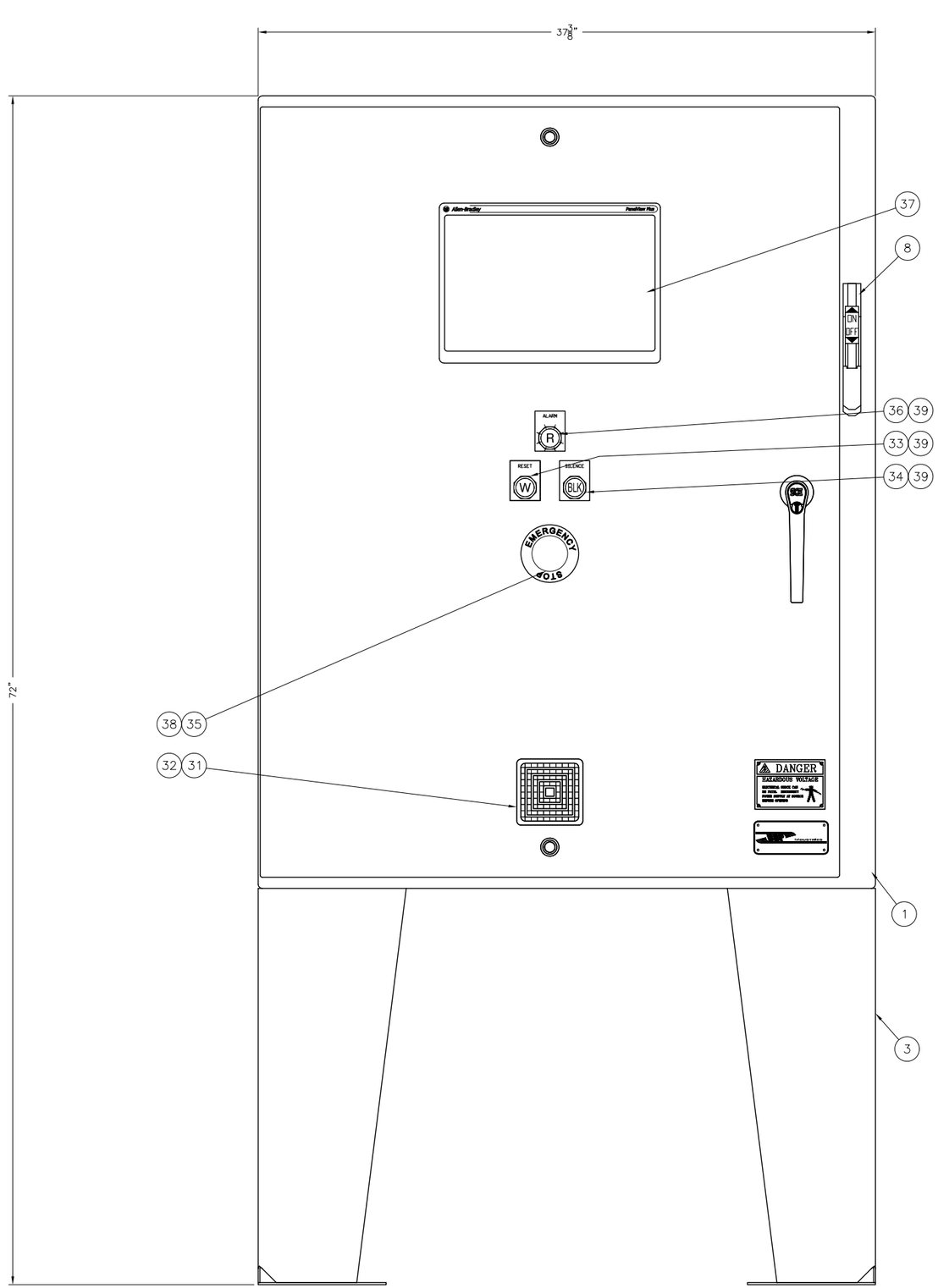


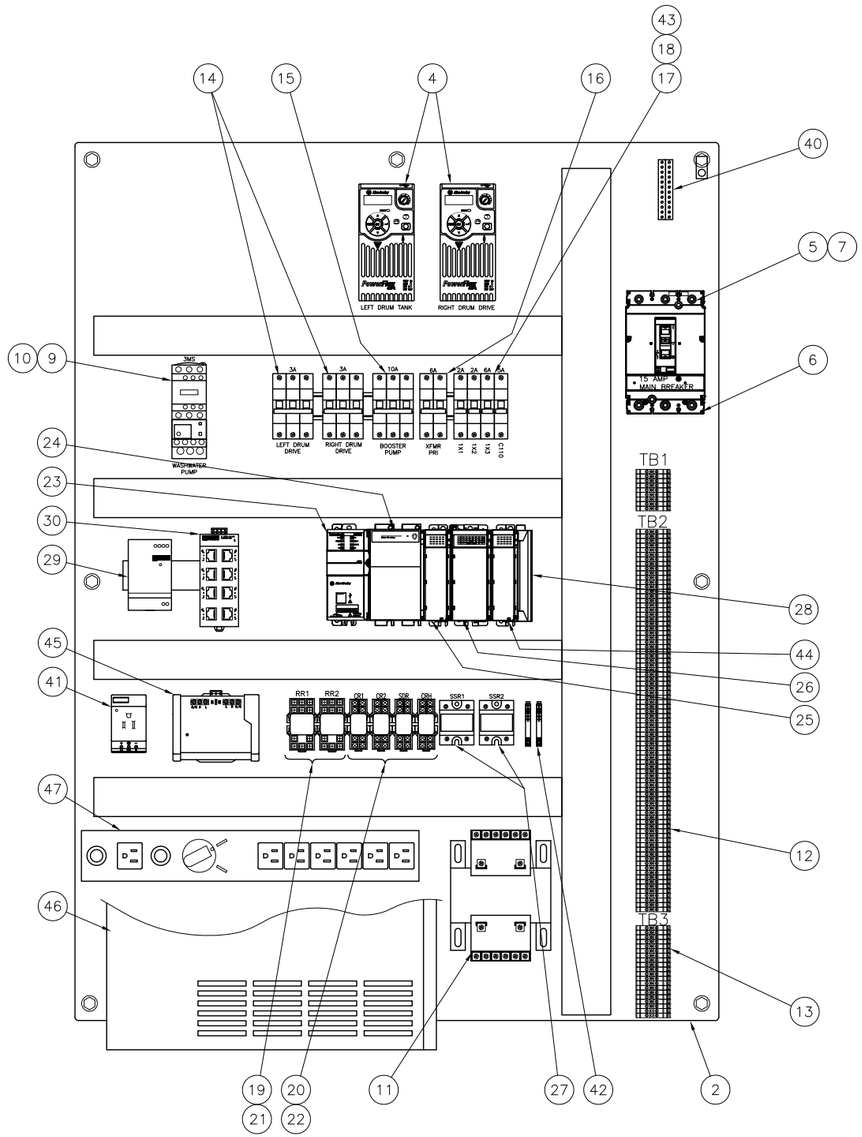
## 1.1.1.1.10 Graphics\Displays\7 - MISC DATA 2



## 1.1.1.1.11 Graphics\Displays\9 - PLC FAULT CODES






UL 508A CONTROL PANEL

INCOMING POWER
480VAC, 3ϕ, 60Hz

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|
| 1 | UPS BYPASS SWITCH | EATON | 47 | EHBPL1500R-PDUIU |
| 1 | UPS BATTERY BACKUP, 700VA | EATON | 46 | 9SX700 |
| 1 | 120VAC SURGE SUPPRESSOR | PHOENIX | 45 | 2856702 |
| 1 | ANALOG INPUT CARD | ALLEN BRADLEY | 44 | 1769-IF4 |
| 1 | 1P, C CURVE BREAKER; 6 AMP | PHOENIX | 43 | 2907563 |
| 2 | SAFETY BARRIER | ALLEN BRADLEY | 42 | 937ZH-DPDP-2 |
| 1 | RECEPTACLE | PHOENIX | 41 | 2963860 |
| 1 | GROUND BAR | PANDUIT | 40 | UGB2/0-414-12 |
| 3 | ENGRAVED LEGENDS | MIECO | 39 | LEG-1 |
| 1 | E-STOP CIRCULAR LEGEND | SQUARE-D | 38 | 9001KN8330 |
| 1 | PVP 7; 12" STANDARD | ALLEN BRADLEY | 37 | 2711P-T12W21D8S |
| 1 | RED PILOT LIGHT | ALLEN BRADLEY | 36 | 800H-QRH2R |
| 1 | MUSHROOM HEAD E-STOP | ALLEN BRADLEY | 35 | 800H-FRXJT6A1 |
| 1 | BLACK PUSHBUTTON | ALLEN BRADLEY | 34 | 800H-BR2A |
| 1 | WHITE PUSHBUTTON | ALLEN BRADLEY | 33 | 800H-BR5A2 |
| 1 | ALARM HORN MOUNTING KIT | FEDERAL | 32 | K8435666A |
| 1 | ALARM HORN; 120VAC | FEDERAL | 31 | 350-120-30 |
| 1 | 8 PORT ETHERNET SWITCH | PHOENIX | 30 | 2891929 |
| 1 | 24V DC POWER SUPPLY, 90W | PHOENIX | 29 | 2902994 |
| 1 | END CAP | ALLEN BRADLEY | 28 | 1769-ECR |
| 2 | SOLID STATE RELAY | ALLEN BRADLEY | 27 | 700-SH10JZ24 |
| 1 | 16 POINT OUTPUT CARD, 120VAC | ALLEN BRADLEY | 26 | 1769-OA16 |
| 1 | 16 POINT INPUT CARD, 120VAC | ALLEN BRADLEY | 25 | 1769-IA16 |
| 1 | PLC POWER SUPPLY | ALLEN BRADLEY | 24 | 1769-PA2 |
| 1 | COMPACTLOGIX PROCESSOR | ALLEN BRADLEY | 23 | 1769-L30ER |
| 4 | 2 POLE RELAY BASE | IDEC | 22 | SH2B-05 |
| 2 | 3 POLE RELAY BASE | IDEC | 21 | SH3B-05 |
| 4 | 2 POLE RELAY | IDEC | 20 | RH2B-UL-120VAC |
| 2 | 3 POLE RELAY | IDEC | 19 | RH3B-UL-120VAC |
| 2 | 1P, C CURVE BREAKER; 2 AMP | PHOENIX | 18 | 2907559 |
| 1 | 1P, C CURVE BREAKER; 5 AMP | PHOENIX | 17 | 2907562 |
| 1 | 2P, D CURVE BREAKER; 6 AMP | PHOENIX | 16 | 2907588 |
| 1 | 3P, D CURVE BREAKER; 10 AMP | PHOENIX | 15 | 2907684 |
| 2 | 3P, C CURVE BREAKER; 3 AMP | PHOENIX | 14 | 2907609 |
| 25 | TERMINAL BLOCKS, BLUE | PHOENIX | 13 | 3044115 |
| 100 | TERMINAL BLOCKS, GRAY | PHOENIX | 12 | 3044102 |
| 1 | TRANSFORMER; 1000VA | HAMMOND | 11 | PH1000MQMJ |
| 1 | CONTACTOR OVERLOAD | SQUARE D | 10 | LRD10 |
| 1 | MOTOR CONTACTOR | SQUARE D | 9 | LC1D12G7 |
| 1 | DISCONNECT HANDLE; NEMA 4X | SQUARE D | 8 | 9422A2 |
| 1 | VARIABLE DEPTH MECHANISM | SQUARE D | 7 | 9422RQ1 |
| 1 | POWER DISTRIBUTION KIT | SQUARE D | 6 | PDC6HD6 |
| 1 | MAIN BREAKER; 15 AMPS | SQUARE D | 5 | HJL36015 |
| 2 | VFD; 1HP | ALLEN BRADLEY | 4 | 25BD2P3N104 |
| 1 | 24" PANEL LEGS | BDP | 3 | |
| 1 | BACK PANEL | SAGINAW | 2 | SCE-48P36 |
| 1 | ENCLOSURE; 316SS NEMA 4X | SAGINAW | 1 | SCE-48XEL3712SS6LP |

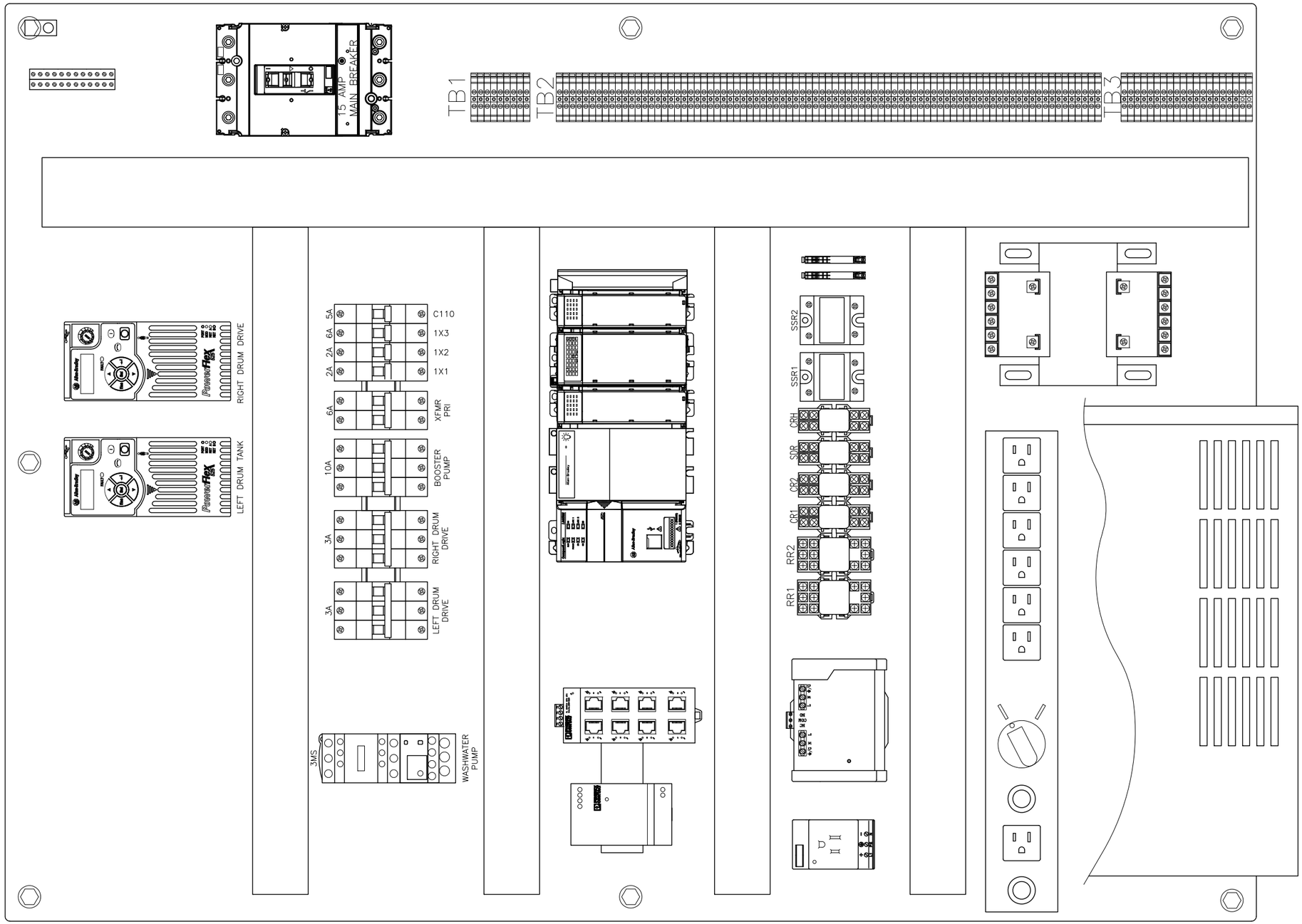
**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: GENERAL ARRANGEMENT ELECTRICAL CONTROL PANEL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 1 OF 3 | REV. 1 |
| | | DWG NO. 1-1529-4 | |

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: GENERAL ARRANGEMENT ELECTRICAL CONTROL PANEL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 2 OF 3 | REV. 1 |
| | | DWG NO. 1–1529–4 | |




NOTES:

1. THIS DRAWING TO BE USED WITH DRAWINGS 1–1529–5 & 1–1529–6.
2. WEIGHT DRY – 300 LBS
3. ALL DOOR MOUNTED OPERATOR DEVICES ARE ALLEN–BRADLEY AND ARE NEMA 4X RATED.
4. REFER TO VENDOR DATA SECTION OF SUBMITTAL FOR CATALOG CUTS AND ADDITIONAL INFORMATION.
5. SYMBOL ⟨#⟩ INDICATES A REVISION WHERE THE # IS THE REVISION NUMBER.

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | INITIAL RELEASE | 8/28/19 | MJG |

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
GREENWICH, N.Y. 12834

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: GENERAL ARRANGEMENT ELECTRICAL CONTROL PANEL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 3 OF 3 | REV. 1 |
| | | DWG NO. 1–1529–4 | |

480V, 3PH, 60Hz

RDT MAIN CIRCUIT BREAKER

L1 L2 L3

15 AMP

SHEET 4

1000 XFMR
480 PRIMARY VOLTS
120 SECONDARY VOLTS
60Hz

6A

H2 H1

2 3 4 5

X2A X1A

SURGE SUPPRESSOR

N L LINE GRD LOAD GRD

CO X1

X1

2A 1X1 WW VALVE POWER RUNG 60

2A 1X2 FLOWMETER POWER

6A 1X3

700VA
120V UPS
5.8A DRAW

UPS MAINTENANCE BYPASS

C110UPS COUPS

+ GRD - DC POWER SUPPLY +24VDC

C200 C201

RUNG 41

SSR1 A2 A1 C302

SAFETY BARRIER

C300 C301

ZS-1

RUNG 42

SSR2 A2 A1 C305

SAFETY BARRIER

C303 C304

ZS-2

+ GRD - OIT RJ45

+ ETHERNET SWITCH - RJ45

TO PLANT NETWORK

TO DRUM VFD RIGHT

TO DRUM VFD LEFT

COMPACTLOGIX PLC RACK

| CPU | POWER SUPPLY | SLOT 1 | SLOT 2 | SLOT 3 | |
|---|---|---|---|---|---|
| 1769-L30ER | 1769-PA2 | 1769-IA16 BEGINS RUNG 40 | 1769-OA16 BEGINS RUNG 60 | 1769-IF4 BEGINS RUNG 80 | 1769-ECR |

GRD L1 L2

5A C110

RDT CONTROL POWER FOR FIELD USE

CRH C2 HORN

RDT EMERGENCY STOP LS1 LS2 ES1

ES2 LOCAL PANEL EMERGENCY STOP ES2A

ES3 MAIN PANEL EMERGENCY STOP

TEST / RESET RR-1 RESET C30 C31 I:1/4

RR-1 3P 28,31,40

RR-2 3P 165,172 C0

RR-1 ES4-RUNG 60

C110

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
GREENWICH, N.Y. 12834

| CUSTOMER: | MACHINE: | DWG TITLE |
|---|---|---|
| ORLEANS, MA | 4x10 DUAL RDT | SCHEMATIC POWER AND CONTROL |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 |
| APP'D BY: | SCALE: | SHT. 1 OF 4 |
| DWG NO. 1-1529-5 | | REV. 1 |

C110

AC INPUT MODULE
1769-IA16
SLOT 1

C0

| | | | | |
|---|---|---|---|---|
| 40 | EMERGENCY STOP | RR–1 | C 1 | IN 0 |
| 41 | RIGHT DRUM ZERO SPEED | SSR1 L1 T1 | C 3 | IN 1 |
| 42 | LEFT DRUM ZERO SPEED | SSR2 L1 T1 | C 5 | IN 2 |
| 43 | LOW WASHWATER PRESSURE | PS–1 | C 6 | IN 3 |
| 44 | RESET | | C 31 | IN 4 |
| 45 | SILENCE | | C 32 | IN 5 |
| 46 | BOOSTER PUMP RUNNING | 3MS 13 14 | C 33 | IN 6 |
| 47 | WW VALVE OPEN | 1X1 | 34 | IN 7 |
| 48 | WW VALVE CLOSED | | 35 | IN 8 |
| 49 | LOCAL PANEL L–O–R SWITCH | LOCAL / REMOTE, XO | 36 | IN 9 |
| 50 | | 0X | 37 | IN 10 |
| 51 | AUTO START | | 38 | IN 11 |
| 52 | AUTO STOP | | 39 | IN 12 |
| 53 | WIRED SPARE | | 40 | IN 13 |
| 54 | WIRED SPARE | | 41 | IN 14 |
| 55 | WIRED SPARE | | 42 | IN 15 |
| 56 | | | | AC COM |
| 57 | | | | AC COM |

AC OUTPUT MODULE
1769-OA16
SLOT 2

ES4; RUNG 31

| | | | | |
|---|---|---|---|---|
| 59 | | | | VAC1 |
| 61 | OUT 0 | CR1 | C 111 | WW VALVE OPEN/CLOSE; 60,61 |
| 62 | OUT 1 | CR2 | C 112 | SPARE RELAY; 63 |
| 63 | OUT 2 | 3MS A1 A2, O/L 95 96 | C 113 | WASHWATER PUMP START/STOP |
| 64 | OUT 3 | | | |
| 65 | OUT 4 | | | |
| 66 | OUT 5 | | | |
| 67 | OUT 6 | | | |
| 68 | OUT 7 | | | UNWIRED SPARES |
| 69 | VAC2 | | | |
| 70 | OUT 8 | SDR | C 119 | SHUTDOWN RELAY; 71,72 |
| 71 | OUT 9 | CRH | C 120 | ALARM HORN RELAY; CONTACT RUNG 25 |
| 72 | OUT 10 | G | C 121 | LOCAL PANEL DRUM RUNNING |
| 73 | OUT 11 | A | C 122 | ALARM LIGHT |
| 74 | OUT 12 | | | TO LOCAL FAULT LIGHT SEE 1–1529–8 |
| 75 | OUT 13 | | | |
| 76 | OUT 14 | | | |
| 77 | OUT 15 | | | UNWIRED SPARES |

C110

C0

START / STOP CONTACTS

WW VALVE
1X1 — CR1 — C178
CR1 — C179

SPARE
C180 — CR2 — C181

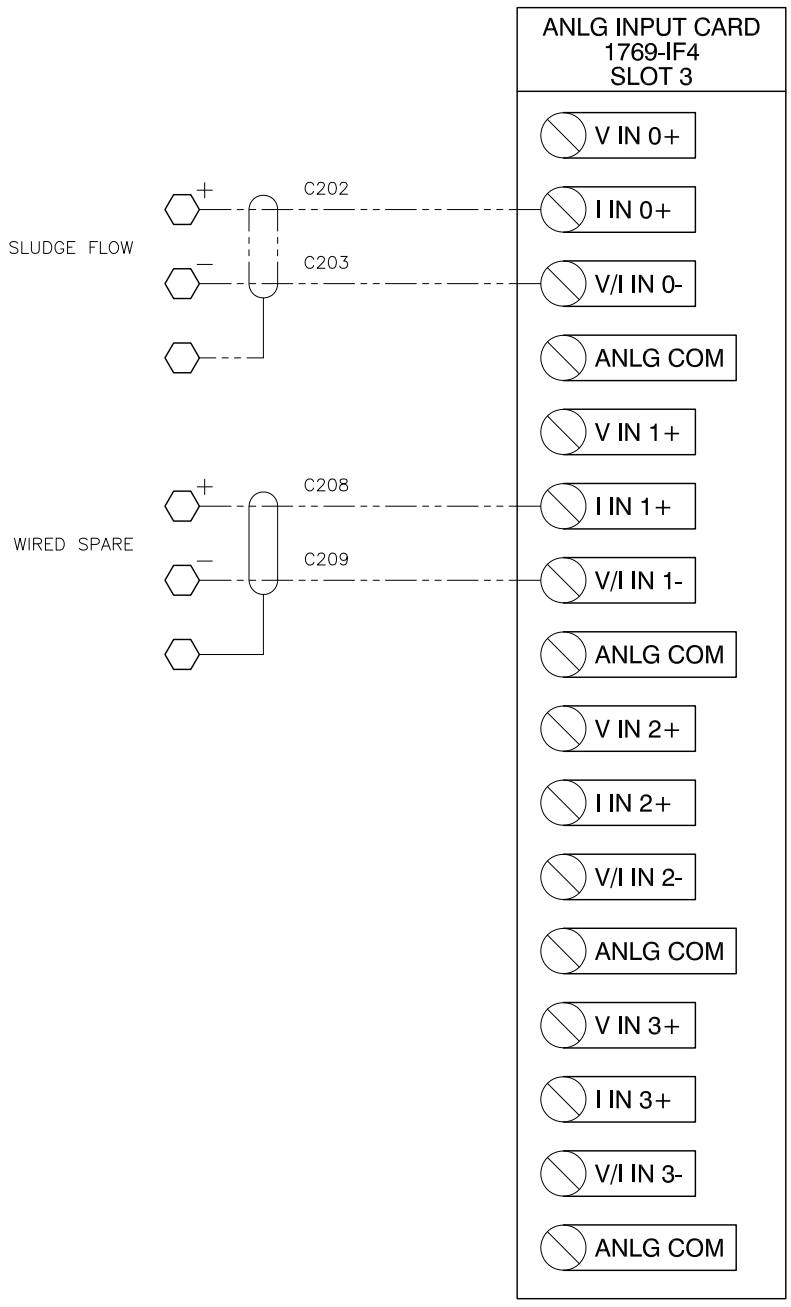
INTERLOCKS
DRY ALARM CONTACTS

COMMON ALARM / SHUTDOWN
C400 — SDR — C401
SDR — C402

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

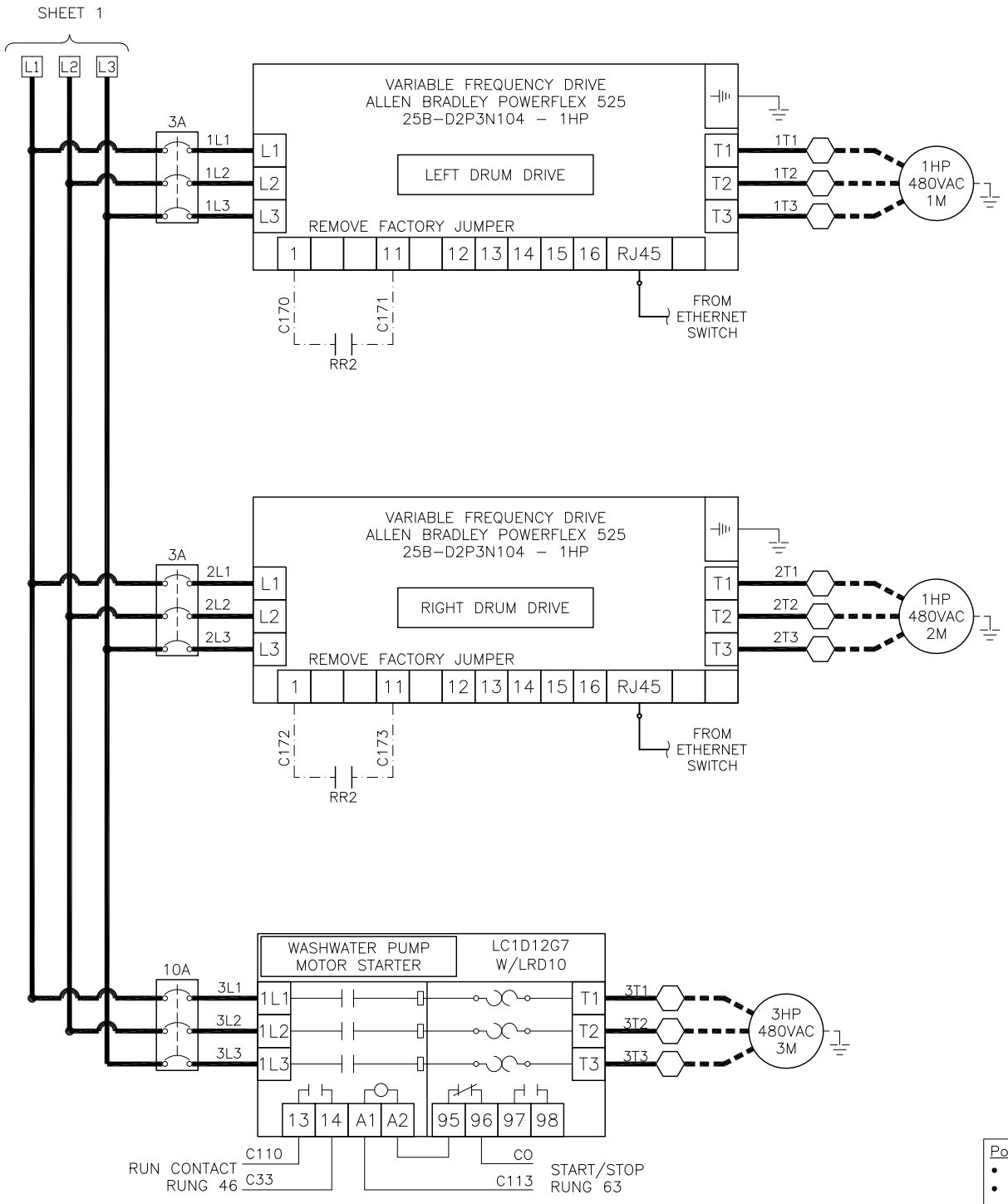
| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: SCHEMATIC POWER AND CONTROL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 2 OF 4 | REV. 1 |
| | | DWG NO. 1–1529–5 | |




| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: SCHEMATIC POWER AND CONTROL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 3 OF 4 | REV. 1 |
| | | DWG NO. 1−1529−5 | |




PowerFlex 525 Common Drive Parameters

- Set Control Source [b012] to 15 (Ethernet/IP)
- Set Accel Time 1 [P041] to 5 sec
- Set Decel Time 1 [P042] to 5 sec
- Set Min Freq [P043] to 10 Hz
- Set Stop Mode [P045] to 1 (Coast)
- Set Start Src 2 [P046] to 5 (Ethernet/IP)
- Set Speed Ref 2 [P047] to 15 (Ethernet/IP)
- Set Maximum Voltage [A534] to 480
- Set Auto Restrt Tries [A541] to 3
- Set Auto Restrt Delay [A542] to 2.0 sec

LEGEND

- – NORMALLY OPEN RELAY CONTACT
- – NORMALLY CLOSED RELAY CONTACT
- – CIRCUIT BREAKER
- – TERMINAL BLOCK
- – PUSH-TO-TEST PILOT LIGHT
- – PILOT LIGHT
- – LIMIT SWITCH
- – PUSHBUTTON
- – RELAY COIL
- – HORN
- – PRESSURE SWITCH
- – FLOAT SWITCH
- – ZERO SPEED SWITCH
- – REVISION
- – CUSTOMER SUPPLIED CONTACT
- – WIRING EXTERNAL TO PANEL (BY CONTRACTOR)
- – 120VAC CONTROL WIRING
- – VDC WIRING
- – ETHERNET CABLE
- – SHIELDED 4–20mA CABLE
- – HIGH VOLTAGE WIRING (208/240/460/575V)

NOTES:

1. THIS DRAWING TO BE USED WITH DRAWINGS 1–1529–4 & 1–1529–6.

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | INITIAL RELEASE | 8/28/19 | MJG |

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: SCHEMATIC POWER AND CONTROL | |
| BDP JOB NO.: 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 4 OF 4 | REV. 1 |
| | | DWG NO. 1–1529–5 | |

## TB–1

| | | |
|---|---|---|
| 1T1 | LEFT DRUM DRIVE MOTOR | 1T1 |
| 1T2 | | 1T2 |
| 1T3 | | 1T3 |
| 2T1 | RIGHT DRUM DRIVE MOTOR | 2T1 |
| 2T2 | | 2T2 |
| 2T3 | | 2T3 |
| 3T1 | WASHWATER PUMP MOTOR | 3T1 |
| 3T2 | | 3T2 |
| 3T3 | | 3T3 |

1HP 480VAC 1M

1HP 480VAC 2M

3HP 480VAC 3M

## TB–2

| | | |
|---|---|---|
| C110 | CONTROL POWER | C110 |
| C110 | | C110 |
| C110 | CONTROL POWER | C110 |
| C110 | | C110 |
| C110 | CONTROL POWER | C110 |
| C110 | | C110 ---{ TO LOCAL PANEL; SEE 1–1529–6 ◇2 |
| C0 | NEUTRAL | C0 ---{ |
| C0 | | C0 |
| C0 | NEUTRAL | C0 |
| C0 | | C0 |
| ES2 | LOCAL PANEL E–STOP BUTTON | ES2 ---{ TO LOCAL PANEL; |
| ES2A | | ES2A ---{ SEE 1–1529–6 |
| ES2 | E–STOP LOOP | ES2 |
| GND | GROUND | GND |
| C6 | LOW WASHWATER PRESSURE SWITCH | C6 ---{ PS–1 |
| C34 | VALVE OPEN | C34 ---{ |
| C35 | VALVE CLOSED | C35 ---{ |
| C36 | LOCAL MODE PLC INPUT | C36 ---{ |
| C37 | REMOTE MODE PLC INPUT | C37 ---{ TO LOCAL PANEL; |
| C38 | AUTO START | C38 ---{ SEE 1–1529–6 |
| C39 | AUTO STOP | C39 ---{ |
| C40 | SPARE PLC INPUT | C40 |
| C41 | SPARE PLC INPUT | C41 |
| C42 | SPARE PLC INPUT | C42 |
| C121 | DRUM RUNNING LIGHT | C121 ---{ TO LOCAL PANEL; |
| C122 | ALARM LIGHT | C122 ---{ SEE 1–1529–6 |
| C178 | WASHWATER VALVE OPEN/CLOSE CONTACT | C178 ---{ |
| C179 | | C179 ---{ |
| C180 | SPARE RELAY | C180 |
| C181 | | C181 |
| C400 | "DRY" ALARM CONTACTS (CUSTOMER USE) | C400 |
| C401 | | C401 |
| C402 | | C402 |
| 1X1 | WW VALVE 120V POWER | 1X1 ---{ |
| 1X2 | FLOWMETER 120V POWER | 1X2 ---{ |

1X1 CR1 C178 C179

CR2 C180 C181

SDR C400 C401 C402

## TB–3

| | | |
|---|---|---|
| C200 | 24V DC POWER | C200 |
| C200 | | C200 |
| C201 | 24V DC COMMON | C201 |
| C201 | | C201 |
| C202 | SLUDGE FLOW ANALOG INPUT | C202 (+) |
| C203 | | C203 (–) |
| SHLD | | SHLD |
| C300 | RIGHT DRUM ZERO SPEED SWITCH | C300 ---{ |
| C301 | | C301 ---{ |
| C303 | LEFT DRUM ZERO SPEED SWITCH | C303 ---{ |
| C304 | | C304 ---{ |

## JUNCTION BOX

- SWITCHES PRE–WIRED TO JUNCTION BOX BY BDP
- PULL (8) MINIMUM 16GA. WIRES FROM PANEL TO JUNCTION BOX FOR CONTROL WIRING

| | | |
|---|---|---|
| C0 | NEUTRAL | C0 |
| C0 | | C0 |
| C110 | CONTROL POWER | C110 |
| C110 | CONTROL POWER | C110 |
| C110 | CONTROL POWER | C110 |
| ES1 | EMERGENCY STOP LOOP | ES1 |
| ES2 | | ES2 |
| C300 | RIGHT DRUM ZERO SPEED SWITCH | C300 |
| C301 | | C301 |
| C303 | LEFT DRUM ZERO SPEED SWITCH | C303 |
| C304 | | C304 |
| GND | GROUND | GND |

◇1 JUMPER

LS1 LS2 ES1 ES2

ZS1 C300 C301

ZS2 C303 C304

## WW VALVE

C0 C178 C179 C34 C35 1X1 — M

## LEGEND

- NORMALLY OPEN RELAY CONTACT
- NORMALLY CLOSED RELAY CONTACT
- CIRCUIT BREAKER
- TERMINAL BLOCK
- PUSH–TO–TEST PILOT LIGHT
- PILOT LIGHT
- LIMIT SWITCH
- PUSHBUTTON
- RELAY COIL
- HORN
- PRESSURE SWITCH
- FLOAT SWITCH
- ZERO SPEED SWITCH
- REVISION
- CUSTOMER SUPPLIED CONTACT
- WIRING EXTERNAL TO PANEL
- 120VAC CONTROL WIRING
- VDC WIRING
- ETHERNET CABLE
- SHIELDED 4–20mA CABLE
- HIGH VOLTAGE WIRING (208/240/460/575V)
- ◇1 – RUN WITH C110 FROM TOP OF TB–2
- ◇2 – RUN WITH C0 FROM TOP OF TB–2

NOTES:

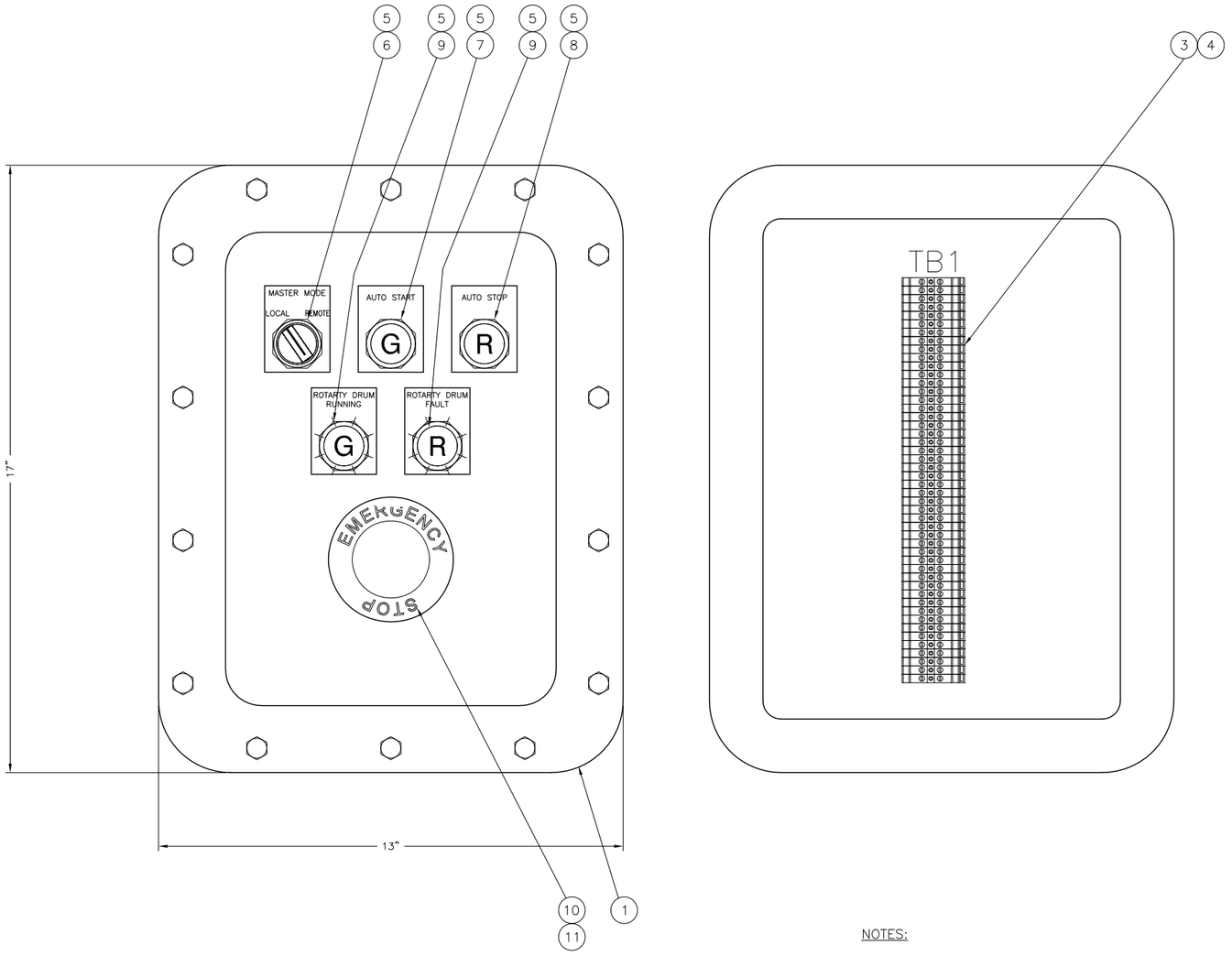
1. THIS DRAWING TO BE USED WITH DRAWINGS 1–1529–4 & 1–1529–5.

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | INITIAL RELEASE | 8/28/19 | MJG |

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4x10 DUAL RDT | DWG TITLE: TERMINAL STRIP ARRANGEMENT | |
| BDP JOB NO.: 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 1 OF 1 | REV. 1 |
| | | DWG NO. 1–1529–6 | |







NOTES:

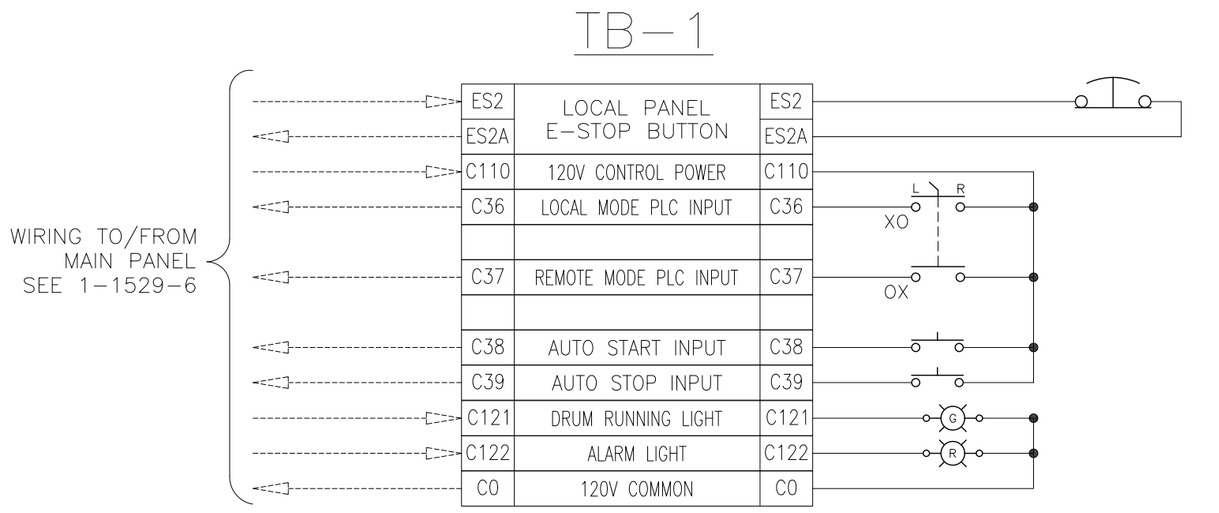
1. THIS DRAWING TO BE USED WITH DRAWINGS 1–1529–8.
2. WEIGHT DRY – 60 LBS
3. ALL DOOR MOUNTED OPERATOR DEVICES ARE ALLEN–BRADLEY AND ARE NEMA 7 RATED.
4. REFER TO VENDOR DATA SECTION OF SUBMITTAL FOR CATALOG CUTS AND ADDITIONAL INFORMATION.

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|
| 1 | E–STOP CIRCULAR LEGEND | SQUARE–D | 11 | 9001KN8330 |
| 1 | MUSHROOM HEAD E–STOP | ALLEN BRADLEY | 10 | 800H–FPX6A1 |
| 2 | MULTI COLORED PILOT LIGHT | ALLEN BRADLEY | 9 | 800H–QPH2M |
| 1 | RED PUSHBUTTON | ALLEN BRADLEY | 8 | 800H–BP6A |
| 1 | GREEN PUSHBUTTON | ALLEN BRADLEY | 7 | 800H–BP1A |
| 1 | 2 POSITION SWITCH | ALLEN BRADLEY | 6 | 800H–HP2KB6 |
| 5 | LEGENDS | MIECO | 5 | LEG–1 |
| 15 | TERMINAL BLOCKS, BLUE | PHOENIX | 4 | 3044115 |
| 10 | TERMINAL BLOCKS, GRAY | PHOENIX | 3 | 3044102 |
| | | | 2 | |
| 1 | ENCLOSURE; NEMA 7 | ADALET | 1 | XCE101406–N4 |

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4X10 RDT | DWG TITLE: GENERAL ARRANGEMENT RDT LOCAL CONTROL PANEL | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 1 OF 1 | REV. 1 |
| | | DWG NO. 1–1529–7 | |

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | INITIAL RELEASE | 8/28/19 | MJG |




NOTES:

1. THIS DRAWING TO BE USED WITH DRAWINGS 1–1529–7.
2. POWER WIRING TO BE SIZED FOR LOAD.
3. WIRING SHALL BE COLOR CODED:
   (A) BLACK – LOAD & CONTROL AT LINE VOLTAGE, AC OR DC
   (B) RED – AC CONTROL CIRCUITS
   (C) BLUE – DC CONTROL CIRCUITS
   (D) GREEN – EQUIPMENT GROUNDING CONDUCTOR(S)
   (E) WHITE – NEUTRAL
4. USE 16 GAUGE (MIN.) STRANDED MACHINE TOOL WIRE FOR CONTROL WIRING.
5. WIRING SHOWN BROKEN ---- IS EXTERNAL TO PANEL JUNCTION BOX AND REMOTE EQUIPMENT ARE FURNISHED BY CONTRACTOR.
6. WIRING SHOWN SOLID IS PREWIRED BY BDP.
7. ALL WIRES MUST BE TAGGED AT BOTH ENDS, TERMINAL STRIP TERMINALS AND WIRE NUMBERS TO HAVE SAME LABEL.
8. CONTROL CIRCUIT VOLTAGE IS 120VAC.
9. SYMBOL ✳ INDICATES CUSTOMER SUPPLIED CONTACT.

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: ORLEANS, MA | MACHINE: 4X10 RDT | DWG TITLE: LOCAL PANEL TERM. STRIP ARRANGEMENT | |
| BDP JOB NO. 1529 | DWN BY: MJG | DATE: 8/28/19 | |
| APP'D BY: | SCALE: | SHT. 1 OF 1 | REV. 1 |
| | | DWG NO. 1–1529–8 | |

| REV. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | INITIAL RELEASE | 8/28/19 | MJG |

# Hazardous Location Push Buttons

Product Overview/Specifications

## Bulletin 800H/Hazardous Location Push Buttons

- Hazardous locations push buttons and stations
- Classes I, II & III Divisions 1 & 2
- 3/4 in. - 14 NPSM barrel
- Type 7 & 9
- Explosion-proof operators

## Table of Contents

**See below.**

## Standards Compliance

UL698, UL1604
CSA 22.2, No. 14

## Certifications

**Enclosures:**
UL Listed (File No. E71673 Guide No. NNNY)
**Devices:**
UL Listed (File No. E10314 Guide No. NOIV)
**Stations:**
CSA (File No. LR11924)

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## Description

### Application

When properly mounted in a Type 7 & 9 enclosure, Bulletin 800H Type 7 & 9 operators are designed to meet the requirements of the National Electrical Code for Class I, Divisions 1 & 2, Groups B, C & D Hazardous Gas; Class II, Divisions 1 & 2, Groups E, F and G Hazardous Dust; and, Class III Hazardous Fiber Locations. In addition, the single gang shallow base, Cat. No. 800H-IHZX7, meets Class I, Group B requirements. This Type 7 & 9 equipment is listed by Underwriters Laboratories, Inc.

**Per National Electrical Code:**

**Zone 1.** In Class I, Zone 1 locations, all wiring methods permitted for Class I, Division 1 locations and Class I, Zone 0 or Zone 1 locations, including requirements for sealing, shall be permitted.

**Zone 2.** In Class I, Zone 2 locations, all wiring methods permitted for Class I, Division 2, Class I, Division 1 or Division 2, and Class I, Zone 0 or Zone 1 locations, including requirements for sealing, shall be permitted.

10

### Operator Construction

The Allen-Bradley line of hazardous location devices features copper-free (less than 0.4 of 1% copper content) die cast aluminum bushings and mounting rings, Type #316 stainless steel operating shafts and an O-ring seal for added corrosion resistance. These components mount into a threaded hole (3/4 in.-14 NPSM) in a suitable enclosure.

Bulletin 800H Type 7 & 9 components are available in two basic formats: standard barrel (Bulletin 800H) and long barrel (Bulletin 800HL). Standard barrel devices are suitable for mounting in panel thickness up to 1 in.; Long barrel devices are suitable for mounting in panel thickness greater than 1 in. and no thicker than 2-1/2 in. Both style operators offer a unique locking bracket which provides an anti-turn feature to guard against loosening. The mounting rings in front of the panel are knurled to provide a second means of tightening each unit into the panel.

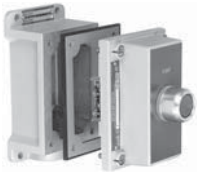
### Outdoor Use

Bulletin 800H Type 7 & 9 stations and enclosures are not configured for outdoor use as standard. A Type 3 rating is available, while maintaining Type 7 & 9 integrity of the enclosure, by the addition of a Type 3 sealing flange and an approved drain. The sealing flange shown below may be purchased as an option or as an accessory. A Type 4 rating can be achieved by using sealing nuts to seal the push button operators in addition to using the sealing flange. Sealing nuts are available as accessories (see page 10-179.)

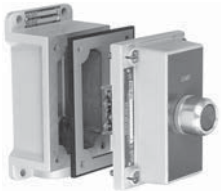
### Elimination of Conduit Seal Off Requirement

Bulletin 800H Type 7 & 9 units may be installed with a variety of sealing options. By utilizing either a sealing well or flanged sealing well, these stations may be installed without a conduit seal off in most applications (subject to applicable codes and laws). The sealing wells shown below may be purchased as an option or as an accessory. Sealing wells are also available with an integral Type 3 flange seal for outdoor applications.

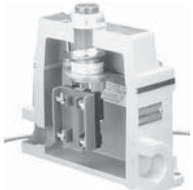
Sealed switch contact blocks are another way to eliminate the need for conduit seal fittings in most applications (subject to applicable codes and laws). Sealed switch contact blocks may be purchased as an option on assembled stations by changing the Bulletin No. from 800H to 800R. Sealed switch contact blocks can be ordered as an accessory (see page 10-175). A push button station with a sealed switch contact block is shown below.



*Type 3 Flange Seal*



*Sealing Wells*



*Sealed Switch Contact Blocks*

## Specifications*

| | | |
|---|---|---|
| **Electrical Ratings** | | |
| Contact Ratings | | Refer to the contact ratings tables below. |
| Dielectric Strength | | 2200V for one minute, 1300V for one minute (Logic Reed) |
| Electrical Design Life Cycles | | 1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed) |
| **Mechanical Ratings** | | |
| Vibration | | 10…2000 Hz 1.52 mm displacement (peak-to-peak) Max./10 G Max. (except Logic Reed) |
| Shock | | 1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G |
| Degree of Protection | | Type 7 & 9 Explosion Proof (Type 3 and Type 4 ratings available with accessories) |
| Mechanical Design Life Cycles | | |
| Push Buttons | | 250 000 minimum |
| Potentiometers | | 100 000 minimum |
| All other devices | | 200 000 minimum |
| Contact Operation | | Shallow and mini contact blocks: slow double make and break<br>Logic Reed & sealed switch contact blocks: snap-action |
| Wire Guage/Terminal Screw Torque | | # 18…12 AWG/6…8 lb•in |
| Typical Operating Forces | | |
| Operators without contact blocks: | | Flush, extended, standard mushroom, jumbo mushroom: 2.9 lb max.<br>Jumbo and extended aluminum mushroom head: 3.95 lb maximum<br>Maintained selector switch: 4.0 in•lb maximum |
| Spring Return Selector Switches: | | 5 in•lb to stop, 0.2 in•lb to return |
| Illuminated Push Buttons and Push-to-Test Pilot Lights | | 5.6 lb maximum |
| 2-Position Push-Pull | | 9 lb maximum push or pull |
| 3-Position Push-Pull | | 12 lb maximum push to in position or pull to center position<br>(15 lb maximum pull to out position) |
| Contact Blocks: | 800T-XA | 1 lb |
| | Logic Reed | 1 lb maximum |
| | Sealed Switch | 3 lb maximum at 0.205 in. plunger travel |
| | Stackable Sealed Switch | 1 lb maximum |
| **Environment** | | |
| Temperature Range | Operating | –4…+13 °F (–20…+55 °C) |
| | Storage | –40…+185 °F (–40…+85 °C) |
| **Note:** Operating temperatures below freezing are based on the absence of freezing moisture and liquids. | | |
| Humidity | | 50% at +104 °F (+40 °C) |

* Performance Data — See page Important-3.

❄ External thread major diameter: 1.034 in. max., 1.024 in. min. Internal thread minor diameter: 0.958 in. min., 0.970 in. max.

### Standard Contact Ratings

Maximum thermal continuous current $I_{th}$ 10 A AC/2.5 A DC.
Bulletin 800H Type 7 & 9 units with 800T-XA contacts have ratings as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 600 | AC-15 | A600 | 120…600 | 7200VA | 720VA |
| | | | 72…120 | 60 A | 720VA |
| | | | 24…28❄ | 60 A | 10 A |
| DC 600 | DC-13 | Q600 | 28…600 | 69VA | |
| | | | 24…28❄ | 2.5 A | |

❄ For applications below 24V and 24 mA, Pen*TUFF*™, Logic Reed or stackable sealed switch contacts are recommended.

### Sealed Switch Contact Ratings

Maximum continuous current $I_{th}$ 5 A.

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 600 | AC-15 | B600 | 120…600 | 3600VA | 360VA |
| | | | 0…120 | 30 A | 3 A |
| DC 300 | DC-13 | P300 | 24…300 | 138VA | |
| | | | 0…24 | 5.0 A | |

### Stackable Sealed Switch Contact Ratings

Maximum continuous current $I_{th}$ 3 A. Bulletin 800T units have control circuit ratings with sealed switch contact blocks as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 300 | AC-15 | C300 | 120…300 | 1800VA | 180VA |
| | | | 0…120 | 15 A | 1.5 A |
| DC 150 | DC-13 | Q150 | 24…150 | 69VA | |
| | | | 0…24 | 2.5 A | |

### Logic Reed Contact Ratings

Maximum: 150V AC, 0.15 A, 8 VA and 30V DC, 0.06 A, 1.8 VA.

Should only be used with resistive loads.

### Pen*TUFF*™ (Low Voltage) Contact Ratings

Minimum DC: 5V, 1 mA

Maximum thermal continuous current Ith 2.5 A AC/1.0 A DC.
Bulletin 800H units with 800T-XAV contacts have ratings as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 300 | AC-15 | C300 | 120…300 | 1800VA | 180VA |
| | | | 0…120 | 15 A | 1.5 A |
| DC 150 | DC-13 | R150 | 24…150 | 28VA | |
| | | | 0…24 | 1.0 A | |

10

## 2-Position Push-Pull Units, Non-Illuminated

***2-Position Push-Pull***
*Cat. No. 800H-FPX6A5*

| Contact Type | Operator Position: Maintained Out | Operator Position: Maintained In | Button Color | Push-Pull Cat. No.∗ |
|---|---|---|---|---|
| N.C.L.B. | X | O | Red | **800H-FPX6D4** |
| N.O. - N.C.L.B. | O<br>X | X<br>O | Red | **800H-FPX6A1** |
| N.C.L.B. - N.C.L.B. | X<br>X | O<br>O | Red | **800H-FPX6A5** |

**Note:** X = Closed/O = Open
∗ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-FPX6D4.

## 3-Position Push-Pull Units, Non-Illuminated

***3-Position Push-Pull***
*Cat. No. 800H-FPXM6A7*

| Contact Type | Operator Position: Momentary Out | Operator Position: Maintained Center | Operator Position: Maintained In | Button Color | Push-Pull Cat. No.❄ |
|---|---|---|---|---|---|
| N.C. - N.C.L.B. | X<br>X | O<br>X | O<br>O | Red | 800H-FPXM6A7 |

| Contact Type | Operator Position: Momentary Out | Operator Position: Maintained Center | Operator Position: Momentary In | Button Color | Push-Pull Cat. No.❄ |
|---|---|---|---|---|---|
| N.C. - N.C.L.B. | X<br>X | O<br>X | O<br>O | Red | 800H-FPXN6A7 |

**Note:** X = Closed/O = Open
❄ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-FPXM6A7.

10

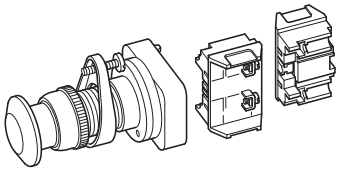
# Hazardous Location Push Buttons

## Product Selection

### 2-Position Push-Pull Units, Non-Illuminated

800 H – FPX ____ 1 A1

a b c d e



**a**

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

**b**

| Operator Type | |
|---|---|
| Code | Description |
| FPX | Push-pull unit |

**c**

| Head Type | |
|---|---|
| Code | Description |
| Blank | Mushroom head |
| J | Jumbo mushroom head∗ |

**d**

| Color Cap | |
|---|---|
| Code | Color |
| Blank | No cap |
| 1 | Green |
| 2 | Black |
| 4 | Grey (silver) |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow (gold) |

**e**

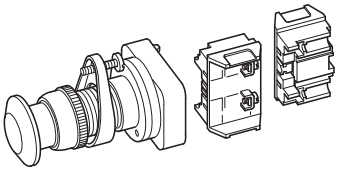
| Contact Block(s) | | | |
|---|---|---|---|
| Standard | | | |
| Code | Operator Position: Out | Operator Position: In | Description |
| Blank | — | — | No contacts |
| A1 | O<br>X | X<br>O | 1 N.O. -<br>1 N.C.L.B.∗ |
| A5 | X<br>X | O<br>O | 2 N.C.L.B.∗ |
| D1 | O | X | 1 N.O. |
| D4 | X | O | 1 N.C.L.B.∗ |
| Pen*TUFF* (Low Voltage) | | | |
| D1V | O | X | 1 N.O. |
| AV | O<br>X | X<br>O | 1 N.O. - 1 N.C. |
| **Note:** X = Closed/O = Open. | | | |

∗ Normally closed late break contact. When button is pushed from the OUT to the IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

### 3-Position Push-Pull Units, Non-Illuminated

800 H – FPX ____ M 1 A7

a b c d e f



**a**

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

**b**

| Operator Type | |
|---|---|
| Code | Description |
| FPX | Push-pull unit |

**c**

| Head Type | |
|---|---|
| Code | Description |
| Blank | Mushroom head |
| J | Jumbo mushroom head❄ |

❄ Not valid with color cap option **Blank** (no cap).

**d**

| Operator Function | | | |
|---|---|---|---|
| Code | Operator Position: Out | Operator Position: Center | Operator Position: In |
| M | Momentary | Maintained | Maintained |
| N | Momentary | Maintained | Momentary |

**e**

| Color Cap | |
|---|---|
| Code | Color |
| Blank | No cap |
| 1 | Green |
| 2 | Black |
| 4 | Grey (silver) |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow (gold) |

**f**

| Contact Block(s) | | | | |
|---|---|---|---|---|
| Standard | | | | |
| Code | Operator Position: Out | Operator Position: Ctr. | Operator Position: In | Description |
| Blank | — | — | — | No contacts |
| A | O<br>X | O<br>O | X<br>O | 1 N.O. -<br>1 N.C. |
| A1 | O<br>X | O<br>X | X<br>O | 1 N.O. -<br>1 N.C.L.B. |
| A7 | X<br>X | O<br>X | O<br>O | 1 N.C. -<br>1 N.C.L.B. |
| B6 | X<br>X | O<br>X | O<br>O | 2 N.C. -<br>2 N.C.L.B. |
| Pen*TUFF* (Low Voltage) | | | | |
| AV | O<br>X | O<br>O | X<br>O | 1 N.O. -<br>1 N.C. |
| **Note:** X = Closed/O = Open. | | | | |

ONE BUTTON IS MOUNTED ON RDT JUNCTION BOX, ANOTHER ON OPPOSITE SIDE OF RDT IN INDIVIDUAL NEMA 7 ENCLOSURE.

# 871TM Intrinsically Safe, 2-Wire DC

## Stainless Steel Face and Barrel

*871TM Intrinsically Safe*
*Cable Style*

*871TM Intrinsically Safe*
*Micro Quick-Disconnect Style*

## Description

These special 871TM models are approved as Intrinsically Safe for use in hazardous areas. These special models are designed for use in Division 1, 2; Class I, II, III; Groups A, B, C, D, E, F, G areas when used in conjunction with an appropriate Intrinsically Safe approved zener diode barrier. Recommended barriers are available from Rockwell Automation/Allen-Bradley. These approved units can also be used in Division 2 locations without a barrier.

## Features

- 2-wire operation
- 2 conductor or 4 pin connection
- 10…31.5V DC
- Normally open output
- Short circuit, overload, false pulse, transient noise, and reverse polarity protection
- FM and CSA entity approved

## Specifications

| | |
|---|---|
| Outputs | Normally Open |
| Max. Load Current | 25 mA |
| Min. Load Current | 2 mA |
| Leakage Current | <1.0 mA |
| Operating Voltage | 10…31.5V DC |
| Voltage Drop | <8V DC |
| Repeatability | 10% typical |
| Hysteresis | 10% typical |
| Reverse Polarity Protection | Incorporated |
| False Pulse Protection | Incorporated |
| Transient Noise Protection | Incorporated |
| Short Circuit Protection | Incorporated |
| Overload Protection | Incorporated |
| Enclosure | NEMA 1, 2, 3, 3R, 4, 4X, 6, 6P, 12, 13, IP67 (IEC 529) all models;<br>1200 psi (8270 kPa) washdown; stainless steel face and barrel;<br>ToughLink™ and micro connector versions are also rated IP69K (IEC 529) |
| Certifications | FM and CSA Approved for<br>- Class I, II, III; Divisions 1, 2; Groups A, B, C, D, E, F, G when used in conjunction with an approved intrinsic safety barrier<br>- Class I, II, III; Division 2; Groups A, B, C, D, E, F, G without intrinsic safety barrier<br>(See control drawing 75001-437 for approval details and wiring diagrams) |
| Connections | Cable: 2 m (6.5 ft) length<br>A2 - 2 conductor #22AWG PVC<br>C2 - 2 conductor #22AWG ToughLink<br>H2 - 2 conductor #18 AWG ToughLink<br>Quick Disconnect: 4-pin micro style |
| LED | Red: Output Energized |
| Operating Temperature [C (F)] | -25…70° (-13…158°) |
| Shock | 30 g, 11 ms |
| Vibration | 55 Hz, 1 mm amplitude, 3 planes |

### Correction Factors

| Target Material | Correction Factor |
|---|---|
| Steel | 1.0 |
| Stainless Steel | 0.9…1.0 |
| Brass | 0.3…0.5 |
| Aluminum | 0.1…0.4 |
| Aluminum ≤0.020 Thick | 0.9…1.1 |
| Copper | 0.4…0.6 |

### Entity Parameters

| Sensor | | | Barrier |
|---|---|---|---|
| $V_{max}$ | 31.5V | ≥ | $V_t$ |
| $I_{max}$ | 130 mA | ≥ | $I_t$ |
| $P_{max}$ | 1.25 W | ≥ | $P_t$ |
| $C_i$ | 0 µF | ≤ | $C_a$ |
| $L_i$ | 0 mH | ≤ | $L_a$ |

**ATTENTION**

Operating parameters must be adhered to.

# 871TM Intrinsically Safe, 2-Wire DC

## Stainless Steel Face and Barrel

## Product Selection

| Barrel Dia. | Nominal Sensing Distance [mm (in.)] | Shielded | Output Configuration | Switching Frequency [Hz] | Cat. No. | | |
|---|---|---|---|---|---|---|---|
| | | | | | PVC Cable | ToughLink™ Cable | Micro QD Style |
| 12 mm | 2 (0.08) | Y | N.O. | 75 | 871TM-DR2NE12-A2 | 871TM-DR2NE12-C2 | 871TM-DR2NE12-D4 |
| | 4 (0.16) | N | | | 871TM-DR4NE12-A2 | 871TM-DR4NE12-C2 | 871TM-DR4NE12-D4 |
| 18 mm | 5 (0.20) | Y | | 60 | 871TM-DR5NE18-A2 | 871TM-DR5NE18-H2 | 871TM-DR5NE18-D4 |
| | 8 (0.31) | N | | | 871TM-DR8NE18-A2 | 871TM-DR8NE18-H2 | 871TM-DR8NE18-D4 |
| 30 mm | 10 (0.39) | Y | | 40 | 871TM-DR10NE30-A2 | 871TM-DR10NE30-H2 | 871TM-DR10NE30-D4 |
| | 15 (0.59) | N | | | 871TM-DR15NE30-A2 | 871TM-DR15NE30-H2 | 871TM-DR15NE30-D4 |
| Recommended Standard QD Cordset (-2 = 2 m (6.5 ft)) | | | | | | | 889D-F4LC-2 ❶ |

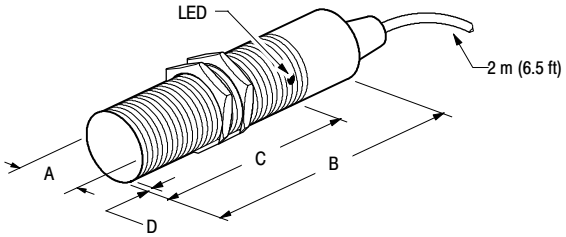
❶ Intrinsically Safe wiring labels 897H-L1 or 897H-L2 must be applied every 7.6 m (25 ft).

## QD Cordsets and Accessories

| Description | Page Number |
|---|---|
| Other Cordsets Available | 8-2 |
| Terminal Chambers | 8-2 |
| Zener Diode Barriers | NO TAG |
| Intrinsically Safe Wiring Labels | 12-8 |

## Approximate Dimensions [mm (in.)]

### Cable Style

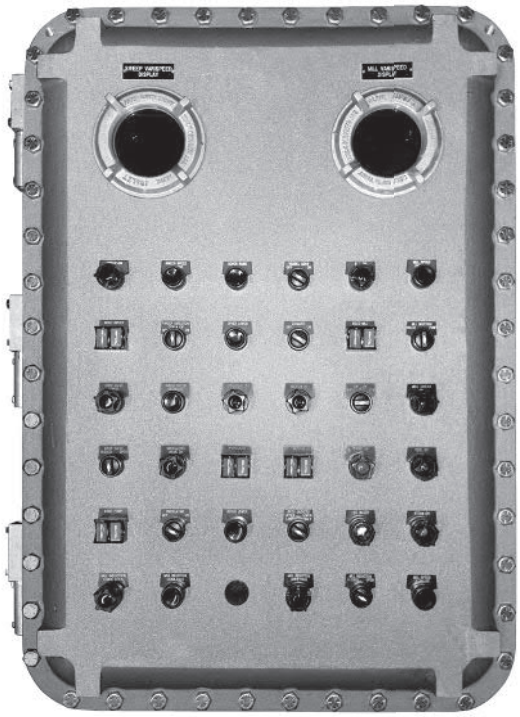



| Thread Size | Shielded | [mm (in.)] | | | |
|---|---|---|---|---|---|
| | | A | B | C | D |
| M12 x 1 | Y | 12.0 (0.47) | 72.1 (2.84) | 38.4 (1.51) | 2.5 (0.10) |
| | N | | | 31.5 (1.24) | 9.4 (0.37) |
| M18 x 1 | Y | 18.0 (0.71) | 74.7 (2.94) | 60.0 (2.36) | 2.5 (0.10) |
| | N | | | 48.2 (1.90) | 14.4 (0.56) |
| M30 x 1.5 | Y | 30.0 (1.18) | 77.2 (3.04) | 61.3 (2.41) | 2.5 (0.10) |
| | N | | | 41.6 (1.64) | 17.9 (0.70) |

## Wiring Diagrams

See pages 2-39 and 2-40.

# XCE: Explosionproof Control Enclosures
# XCEX: Flameproof Control Enclosures
# XCEQ: Explosionproof Quad-Lead Control Enclosures
# XJF: Explosionproof Junction Boxes



## STANDARD FEATURES

- 75 standard sizes available
- Corrosion resistant, copper free aluminum (3⁄10 of 1%)
- Pre-drilled hinge holes (hinge optional)
- Pre-drilled mounting panel bosses (mounting panel optional)
- NEMA 4 watertight gasket
- Premium, high strength steel cover bolts (zinc plated and coated)
- Internal / external grounding screws
- Removable lifting eye bolts (18x24 and larger)
- Lid-lifter cover alignment device (18x24 and larger)
- Cast-on mounting lugs / feet
- Tumblast, natural aluminum finish

## DESIGN OPTIONS

- Stainless steel cover bolts for NEMA 4X corrosion protection
- Mounting panels - Available in galvanized steel (XSM) or aluminum (XSA)
- Aluminum hinge kits with stainless steel hardware
- Conduit (NPT & metric) and device (NPSM) drilling & tapping
- Operators and auxiliary devices such as breather / drains and flame arrestors
- Quad lead, quick thread cover bolts (designate XCEQ when ordering, not available on XCEX)
- Window kits - Round (up to 8" viewing diameter or square/rectangular (up to 13" x 13"))
- Custom machining - Milling, counter-boring, spot-facing, blind drilled entries, chamfers
- Panel assembly / population
- Custom cast-on logos
- Powder and epoxy coating for additional corrosion resistance
- Special mounting provisions
- Captive bolt retainer plate

## MATERIAL

- Enclosure - Copper free aluminum (3⁄10 of 1%)
- Cover Bolts - Steel, zinc plated and coated

## CERTIFICATIONS

| **XCE Series:** | |
|---|---|
| Class I, Division 1, Gas Groups BCD | UL 1203 |
| Class II, Division 1, Gas Groups EFG | CSA C22.2 No. 30 |
| Class III | UL 50 |
| NEMA Type 4, 7, 9 | |
| NEMA Type 4X (w/ SS cover bolts) | |

| **XCEX Series:** | |
|---|---|
| Class I, Division 1, Gas Groups BCD | UL 1203 |
| Class II, Division 1, Gas Groups EFG | CSA C22.2 No. 30 |
| Class III | UL 50 |
| NEMA Type 4, 7, 9 | |
| NEMA Type 4X (w/ SS cover bolts) | |
| Class I, Zone 1, AExd IIB | UL 60079-0 / UL 60079-1 |
| Exd IIB | CSA 60079-0 / CSA 60079-1 |
| CE 0539 Ex II 2GD (Optional) | EN 60079-0 / EN 60079-1 |
| IP66 | IEC 60529 |
| NEMA Type 4X (w/ N4X suffix) | |





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# Certifications

## XJF: Explosionproof Junction Boxes

### CERTIFICATIONS

Class I, Division 1, Gas Groups B*,C, D
Class II, Division 1, Gas Groups E, F, G
NEMA Type 4 (with N4 suffix)

*N4 suffix may affect Group B approval, consult factory

LISTED 437S

## XCE/XCEQ: Explosionproof / Quad-Lead Enclosures

### CERTIFICATIONS

Class I, Division 1, Gas Groups B*,C, D
Class II, Division 1, Gas Groups E, F, G
Class III
NEMA Type 4 (with N4 suffix)
NEMA Type 4X (w/SS cover bolts)

*Specify Group B if required w/N4 suffix

## XCEX: Flameproof Enclosures

### CERTIFICATIONS

Class I, Division 1, Gas Groups B*,C, D
Class II, Division 1, Gas Groups E, F, G
Class III
Class I, Zone 1, AEx d IIB
Ex d IIB
Epsilon 07 ATEX 2251U
CE 0539 Ex II 2GD Ex d II B
Ex d IIB+H2 (Optional)*
Ex tD A21: IP 66

NEMA Type 4 (with N4 suffix)
NEMA Type 4X (w/SS cover bolts)
IECEx UL 10.0046U
Exd IIB Gb
Extd A21 / IP66
DEMKO 01 ATEX 01294724
Ex II 2 G Exd IIB Gb
Ex II 2 D Extd A21
IP66

* Specify ATEX / IECEx if required

**NOTE:** Where reference is made to Class I and Class II hazardous locations, the equipment is suitable for both Div. 1 and Div. 2 locations.





*SEND ORDERS TO ORDERS@ADALET.COM*
*T: 216.267.9000 | F:216.267.1681 | info@adalet.com*
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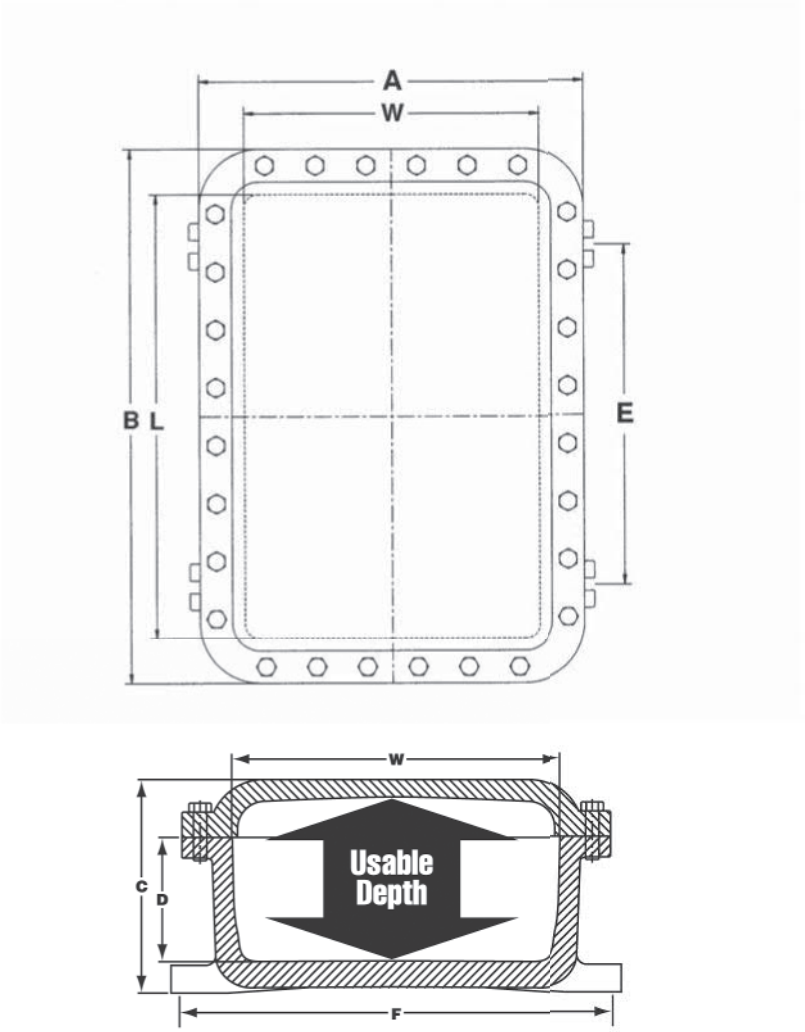


## DESIGN OPTIONS

### Mounting Panels

- Steel: (XSM) Galvanized 12 gauge steel plate. The catalog number includes the steel mounting pan complete with 1/4" high spacers and stainless steel mounting screws.
- Aluminum: (XSA) consult factory for availablility.

NOTE 1. No installation charge when customer specifies factory installation of mounting pan.

2. Enclosures are pre-drilled for mounting panel unless otherwise specified.

### Hinge Kits

Made of extruded aluminum alloy consisting of two sections, female and male (with stainless steel pin) and four stainless steel hex head bolts. Designed to allow right or left hand removable or non-removable installation.

Unless specifed, left hand removable hinge installation will be furnished by factory when hinged enclosures are ordered.

NOTE 1. Catalog number represents complete hinge sets necessary for enclosure assembly.

2. Enclosures are pre-drilled for hinge kits unless otherwise specified.

3. Hinges are left side removable standard



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## XCE Series

| CAT. NUMBER XCE or XJF | INSIDE NOM. DIM. | | | USABLE DEPTH | OVERALL DIM. | | | MTG LUG E | MTG LUG F | MTG BOLT SIZE | SHIPPING WT. (LBS) | PANEL PART NO. | | PANEL DIM. X | PANEL DIM. Y | HINGE CAT# |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -041604 | 4 | 16 | 4 | 4 3/4 | 7 1/4 | 19 1/4 | 6 | 12 1/8 | 6 3/4 | 3/8 | 25 | XSM0416 | XSA0416 | 3 1/4 | 15 1/4 | XHB-2 |
| -060804 | 6 | 8 | 4 | 4 5/8 | 9 1/4 | 11 1/4 | 5 15/16 | 4 1/2 | 9 1/8 | 3/8 | 21 | XSM0608 | XSA0608 | 5 1/8 | 7 1/8 | XHB-2 |
| -060805 | 6 | 8 | 5 | 5 5/8 | 9 1/4 | 11 1/4 | 6 15/16 | 4 1/2 | 9 1/8 | 3/8 | 23 | XSM0608 | XSA0608 | 5 1/8 | 7 1/8 | XHB-2 |
| -061105 | 6 | 11 | 5 | 5 7/8 | 9 1/4 | 14 1/4 | 7 3/16 | 7 1/2 | 9 1/8 | 3/8 | 24 | XSM0611 | XSA0611 | 5 1/8 | 10 1/8 | XHB-2 |
| -061206 | 6 | 12 | 6 | 6 3/4 | 9 1/4 | 15 1/4 | 8 1/16 | 8 1/2 | 9 1/8 | 3/8 | 29 | XSM0612 | XSA0612 | 5 1/8 | 11 1/8 | XHB-2 |
| -061305 | 6 | 13 | 5 | 5 7/8 | 9 1/4 | 16 1/4 | 7 3/16 | 9 1/2 | 9 1/8 | 3/8 | 26 | XSM0613 | XSA0613 | 5 1/8 | 12 1/8 | XHB-2 |
| -071004 | 7 | 10 | 4 | 4 3/4 | 10 3/8 | 13 3/8 | 6 3/16 | 6 1/2 | 9 3/4 | 3/8 | 27 | XSM0710 | XSA0710 | 6 1/8 | 9 1/8 | XHB-2 |
| -071006 | 7 | 10 | 6 1/8 | 6 3/4 | 10 3/8 | 13 3/8 | 8 3/16 | 6 1/2 | 9 3/4 | 3/8 | 31 | XSM0710 | XSA0710 | 6 1/8 | 9 1/8 | XHB-2 |
| -071805 | 7 | 18 | 5 | 5 3/4 | 10 3/8 | 21 5/8 | 7 3/16 | 14 1/2 | 9 3/4 | 3/8 | 55 | XSM0718 | XSA0718 | | | |
| -080804 | 8 | 8 | 4 | 4 13/16 | 11 3/8 | 11 3/8 | 6 3/16 | 4 1/4 | 11 | 3/8 | 24 | XSM0808 | XSA0808 | | | |
| -080806 | 8 | 8 | 6 | 6 13/16 | 11 3/8 | 11 3/8 | 8 3/8 | 4 1/4 | 11 | 3/8 | 28 | XSM0808 | XSA0808 | | | |
| -080808 | 8 | 8 | 8 | 8 13/16 | 11 3/8 | 11 3/8 | 10 3/8 | 4 1/4 | 11 | 3/8 | 35 | XSM0808 | XSA0808 | 7 | 7 | XHB-2 |
| -081004 | 8 | 10 | 4 | 4 3/4 | 11 3/8 | 13 3/8 | 6 1/4 | 6 1/2 | 10 3/4 | 3/8 | 30 | XSM0810 | XSA0810 | 7 | 9 1/8 | XHB-2 |
| -081006 | 8 | 10 | 6 | 6 3/4 | 11 3/8 | 13 3/8 | 8 1/4 | 6 1/2 | 10 3/4 | 3/8 | 34 | XSM0810 | XSA0810 | 7 | 9 1/8 | XHB-2 |
| -081008 | 8 | 10 | 8 | 8 3/4 | 11 3/8 | 13 3/8 | 10 1/4 | 6 1/2 | 10 3/4 | 3/8 | 39 | XSM0810 | XSA0810 | 7 | 9 1/8 | XHB-2 |
| -081204 | 8 | 12 | 4 | 4 3/4 | 11 3/8 | 15 3/8 | 6 1/4 | 8 1/2 | 10 3/4 | 3/8 | 34 | XSM0812 | XSA0812 | 6 7/8 | 10 7/8 | XHB-2 |
| -081206 | 8 | 12 | 6 | 6 3/4 | 11 3/8 | 15 3/8 | 8 1/4 | 8 1/2 | 10 3/4 | 3/8 | 42 | XSM0812 | XSA0812 | 6 7/8 | 10 7/8 | XHB-2 |
| -081208 | 8 | 12 | 8 | 8 3/4 | 11 3/8 | 15 3/8 | 10 1/4 | 8 1/2 | 10 3/4 | 3/8 | 48 | XSM0812 | XSA0812 | 6 7/8 | 10 7/8 | XHB-2 |
| -091105 | 9 | 11 | 5 | 5 3/4 | 12 3/8 | 14 3/8 | 7 5/16 | 7 1/2 | 12 | 3/8 | 41 | XSM0911 | XSA0911 | 8 | 10 | XHB-2 |
| -101004 | 10 | 10 | 4 | 4 3/4 | 13 3/8 | 13 3/8 | 6 5/16 | 6 1/2 | 13 | 3/8 | 34 | XSM1010 | XSA1010 | 8 7/8 | 8 7/8 | XHB-2 |
| -101006 | 10 | 10 | 6 | 6 3/4 | 13 3/8 | 13 3/8 | 8 5/16 | 6 1/2 | 13 | 3/8 | 44 | XSM1010 | XSA1010 | 8 7/8 | 8 7/8 | XHB-2 |
| -101008 | 10 | 10 | 8 | 8 3/4 | 13 3/8 | 13 3/8 | 10 5/16 | 6 1/2 | 13 | 3/8 | 50 | XSM1010 | XSA1010 | 8 7/8 | 8 7/8 | XHB-2 |
| -101206 | 10 | 12 | 6 1/4 | 7 1/4 | 13 3/8 | 15 3/8 | 8 7/8 | 8 1/2 | 13 | 3/8 | 46 | XSM1012 | XSA1012 | 10 7/8 | 8 7/8 | XHB-2 |
| -101404 | 10 | 14 | 4 | 4 3/4 | 13 3/8 | 17 3/8 | 6 7/16 | 10 5/8 | 13 | 3/8 | 42 | XSM1014 | XSA1014 | 8 7/8 | 12 7/8 | XHB-2 |
| -101406 | 10 | 14 | 6 | 6 3/4 | 13 3/8 | 17 3/8 | 8 7/16 | 10 5/8 | 13 | 3/8 | 49 | XSM1014 | XSA1014 | 8 7/8 | 12 7/8 | XHB-2 |
| -101408 | 10 | 14 | 8 | 8 3/4 | 13 3/8 | 17 3/8 | 10 1/2 | 10 5/8 | 13 | 3/8 | 57 | XSM1014 | XSA1014 | 8 7/8 | 12 7/8 | XHB-2 |
| -101410 | 10 | 14 | 10 | 10 3/4 | 13 | 17 3/8 | 12 1/2 | 10 5/8 | 13 | 3/8 | 62 | XSM1014 | XSA1014 | 8 7/8 | 12 7/8 | XHB-2 |
| -121204 | 12 | 12 | 4 | 5 | 16 1/4 | 16 1/4 | 6 15/16 | 8 5/8 | 16 | 1/2 | 60 | XSM1212 | XSA1212 | 10 7/8 | 10 7/8 | XHC-2 |
| -121206 | 12 | 12 | 6 | 7 | 16 1/4 | 16 1/4 | 8 15/16 | 8 5/8 | 16 | 1/2 | 68 | XSM1212 | XSA1212 | 10 7/8 | 10 7/8 | XHC-2 |
| -121208 | 12 | 12 | 8 | 9 | 16 1/4 | 16 1/4 | 10 15/16 | 8 5/8 | 16 | 1/2 | 80 | XSM1212 | XSA1212 | 1 | | |
| -121804 | 12 | 18 | 4 | 4 3/4 | 16 1/4 | 22 1/4 | 6 3/4 | 14 1/8 | 16 | 1/2 | 85 | XSM1218 | XSA1218 | 1 | | |
| -121806 | 12 | 18 | 6 | 6 3/4 | 16 1/4 | 22 1/4 | 8 3/4 | 14 1/8 | 16 | 1/2 | 93 | XSM1218 | XSA1218 | 10 1/2 | 16 1/2 | XHC-2 |
| -121808 | 12 | 18 | 8 | 8 3/4 | 16 1/4 | 22 1/4 | 10 3/4 | 14 1/8 | 16 | 1/2 | 101 | XSM1218 | XSA1218 | 10 1/2 | 16 1/2 | XHC-2 |
| -122005 | 12 | 20 | 5 | 5 3/4 | 16 1/4 | 24 1/4 | 8 1/8 | 14 3/8 | 16 | 1/2 | 104 | XSM1220 | XSA1220 | 11 | 19 | XHC-2 |
| -122404 | 12 | 24 | 4 | 4 15/16 | 16 1/4 | 24 1/4 | 7 1/4 | 18 3/8 | 16 | 1/2 | 115 | XSM1224 | XSA1224 | 11 | 23 | XHC-2 |
| -122406 | 12 | 24 | 6 | 6 15/16 | 16 1/4 | 28 1/4 | 9 1/4 | 18 3/8 | 16 | 1/2 | 127 | XSM1224 | XSA1224 | 11 | 23 | XHC-2 |
| -122408 | 12 | 24 | 8 | 8 15/16 | 16 1/4 | 28 1/4 | 11 1/4 | 18 3/8 | 16 | 1/2 | 142 | XSM1224 | XSA1224 | 11 | 23 | XHC-2 |
| -122410 | 12 | 24 | 10 | 10 15/16 | 16 1/4 | 28 1/4 | 13 1/4 | 18 3/8 | 16 | 1/2 | 154 | XSM1224 | XSA1224 | 11 | 23 | XHC-2 |

RDT JUNCTION BOX

LOCAL CONTROL PANEL

*Information is subject to change without notice*

*Measurements in inches*

**NOTES**

1. To indicate Quad-Lead bolt option, add suffix "Q" after XCE. (Not available on XCEX models.)
2. Operators, windows and hinges are ordered separately.
3. Ex d approval optional on XCEX series only.
4. To indicate Type 4 / IP66 option, add suffix "N4" after size (catalog number)
5. Where reference is made to Class I and Class II hazardous locations, the equipment is suitable for both Div. 1 and Div. 2 locations.
6. Enclosures are pre-drilled for mounting panel and hinge kit unless otherwise specified.







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# XCE SERIES & XJF



## XCE Series

| CAT. NUMBER XCE or XJF | INSIDE NOM. DIM. | | | USABLE DEPTH | OVERALL DIM. | | | MTG LUG E | MTG LUG F | MTG BOLT SIZE | SHIPPING WT. (LBS) | PANEL PART NO. | | PANEL DIM. X | PANEL DIM. Y | HINGE CAT# |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -123006 | 12 | 30 | 6 | 6 11/16 | 16 3/4 | 34 1/4 | 9 5/8 | 23 | 16 | 1/2 | 180 | XSM1230 | XSA1230 | 10 3/4 | 28 3/4 | XHC-2 |
| -123604 | 12 | 36 | 4 | 4 15/16 | 16 1/4 | 40 1/4 | 7 11/16 | 29 | 16 | 1/2 | 200 | XSM1236 | XSA1236 | 10 3/4 | 34 3/4 | XHC-3 |
| -123606 | 12 | 36 | 6 | 6 15/16 | 16 1/4 | 40 1/4 | 9 11/16 | 29 | 16 | 1/2 | 212 | XSM1236 | XSA1236 | 10 3/4 | 34 3/4 | XHD-3 |
| -123608 | 12 | 36 | 8 | 8 15/16 | 16 1/4 | 40 1/4 | 11 11/16 | 29 | 16 | 1/2 | 232 | XSM1236 | XSA1236 | 10 3/4 | 34 3/4 | XHD-3 |
| -124608 | 12 | 46 | 8 | 8 15/16 | 16 1/4 | 50 1/4 | 11 11/16 | 39 | 16 | 5/8 | 280 | XSM1246 | XSA1246 | 10 3/4 | 44 3/4 | XHD-4 |
| -141404 | 14 | 14 | 4 | 5 | 18 1/4 | 18 1/4 | 7 1/8 | 9 3/4 | 17 3/4 | 1/2 | 91 | XSM1414 | XSA1414 | 12 7/8 | 12 7/8 | XHC-2 |
| -141406 | 14 | 14 | 6 | 7 | 18 1/4 | 18 1/4 | 9 1/4 | 9 3/4 | 17 3/4 | 1/2 | 97 | XSM1414 | XSA1414 | 12 7/8 | 12 7/8 | XHC-2 |
| -141408 | 14 | 14 | 8 | 9 | 18 1/4 | 18 1/4 | 11 1/8 | 9 3/4 | 17 3/4 | 1/2 | 103 | XSM1414 | XSA1414 | 12 7/8 | 12 7/8 | XHC-2 |
| -142210 | 14 | 22 | 10 | 11 1/4 | 18 1/4 | 26 1/4 | 13 5/8 | 16 1/2 | 17 3/4 | 1/2 | 181 | XSM1422 | XSA1422 | 12 7/8 | 20 7/8 | XHD-2 |
| -142213 | 14 | 22 | 13 | 13 | 18 1/4 | 26 1/4 | 15 1/8 | 16 1/2 | 17 3/4 | 1/2 | 235 | XSM1422 | XSA1422 | 12 7/8 | 20 7/8 | XHD-2 |
| -142806 | 14 | 28 | 6 | 7 13/16 | 18 1/4 | 32 1/4 | 9 9/16 | 22 1/2 | 17 3/4 | 1/2 | 120 | XSM1428 | XSA1428 | 12 7/8 | 26 7/8 | XHF-2 |
| -161604 | 16 | 16 | 4 | 5 5/8 | 20 7/8 | 20 7/8 | 7 15/16 | 11 | 19 3/4 | 5/8 | 123 | XSM1616 | XSA1616 | 14 3/4 | 14 3/4 | XHD-2 |
| -161606 | 16 | 16 | 6 | 7 5/8 | 20 7/8 | 20 7/8 | 9 15/16 | 11 | 19 3/4 | 5/8 | 135 | XSM1616 | XSA1616 | 14 3/4 | 14 3/4 | XHD-2 |
| -161608 | 16 | 16 | 8 | 9 5/8 | 20 7/8 | 20 7/8 | 11 15/16 | 11 | 19 3/4 | 5/8 | 156 | XSM1616 | XSA1616 | 14 3/4 | 14 3/4 | XHD-2 |
| -162406 | 16 | 24 | 6 | 7 13/16 | 20 7/8 | 28 7/8 | 10 3/8 | 18 3/8 | 19 3/4 | 5/8 | 109 | XSM1624 | XSA1624 | 14 1/2 | 22 1/2 | XHF-2 |
| -162408 | 16 | 24 | 8 | 9 13/16 | 20 7/8 | 28 7/8 | 12 3/8 | 18 3/8 | 19 3/4 | 5/8 | 209 | XSM1624 | XSA1624 | 14 1/2 | 22 1/2 | XHF-2 |
| -162410 | 16 | 24 | 10 | 11 13/16 | 20 7/8 | 28 7/8 | 14 3/8 | 18 3/8 | 19 3/4 | 5/8 | 225 | XSM1624 | XSA1624 | 14 1/2 | 22 1/2 | XHF-2 |
| -162806 | 16 | 28 | 6 | 6 13/16 | 20 1/2 | 32 11/16 | 9 1/2 | 22 1/2 | 19 3/4 | 5/8 | 220 | XSM1628 | XSA1628 | 26 1/2 | 14 1/2 | XHF-2 |
| -163406 | 16 | 34 | 6 | 6 15/16 | 20 1/2 | 38 1/2 | 9 1/2 | 27 | 19 3/4 | 5/8 | 277 | XSM1634 | XSA1634 | 14 1/2 | 28 1/2 | XHF-2 |
| -164610 | 16 | 46 | 10 | 11 13/16 | 20 7/8 | 50 7/8 | 14 9/16 | 39 | 19 3/4 | 5/8 | 390 | XSM1646 | XSA1646 | 14 1/2 | 44 1/2 | XHF-4 |
| -181804 | 18 | 18 | 4 | 5 13/16 | 22 7/8 | 22 7/8 | 8 1/2 | 13 | 21 3/4 | 5/8 | 154 | XSM1818 | XSA1818 | 16 3/4 | 16 3/4 | XHF-2 |
| -181806 | 18 | 18 | 6 | 7 13/16 | 22 7/8 | 22 7/8 | 10 1/2 | 13 | 21 3/4 | 5/8 | 177 | XSM1818 | XSA1818 | 16 3/4 | 16 3/4 | XHF-2 |
| -181808 | 18 | 18 | 8 | 9 13/16 | 22 7/8 | 22 7/8 | 12 1/2 | 13 | 21 3/4 | 5/8 | 200 | XSM1818 | XSA1818 | 16 3/4 | 16 3/4 | XHF-2 |
| -182406 | 18 | 24 | 6 | 7 7/16 | 22 7/8 | 28 7/8 | 10 13/16 | 18 3/8 | 21 3/4 | 5/8 | 226 | XSM1824 | XSA1824 | 16 1/2 | 22 1/2 | XHF-2 |
| -182408 | 18 | 24 | 8 | 9 7/16 | 22 7/8 | 28 7/8 | 12 13/16 | 18 3/8 | 21 3/4 | 5/8 | 239 | XSM1824 | XSA1824 | 16 1/2 | 22 1/2 | XHF-2 |
| -182410 | 18 | 24 | 10 | 11 7/16 | 22 7/8 | 28 7/8 | 14 13/16 | 18 3/8 | 21 3/4 | 5/8 | 260 | XSM1824 | XSA1824 | 16 1/2 | 22 1/2 | XHF-2 |
| -183008 | 18 | 30 | 8 | 9 3/8 | 22 7/8 | 34 7/8 | 12 13/16 | 23 | 21 3/4 | 5/8 | 293 | XSM1830 | XSA1830 | 16 1/2 | 28 1/2 | XHF-2 |
| -183608 | 18 | 36 | 8 | 9 3/8 | 22 7/8 | 40 7/8 | 12 7/8 | 29 | 21 3/4 | 5/8 | 318 | XSM1836 | XSA1836 | 16 1/2 | 34 1/2 | XHF-3 |
| -183610 | 18 | 36 | 10 | 11 3/8 | 22 7/8 | 40 7/8 | 14 7/8 | 29 | 21 3/4 | 5/8 | 340 | XSM1836 | XSA1836 | 16 1/2 | 34 1/2 | XHF-3 |
| -242408 | 24 | 24 | 8 | 9 7/16 | 28 7/8 | 28 7/8 | 12 7/16 | 18 3/8 | 28 | 5/8 | 302 | XSM2424 | XSA2424 | 22 | 22 | XHF-2 |
| -242410 | 24 | 24 | 10 | 11 7/16 | 28 7/8 | 28 7/8 | 14 7/16 | 18 3/8 | 28 | 5/8 | 330 | XSM2424 | XSA2424 | 22 | 22 | XHF-2 |
| -243008 | 24 | 30 | 8 | 9 1/4 | 28 7/8 | 34 7/8 | 12 15/16 | 23 | 28 | 5/8 | 356 | XSM2430 | XSA2430 | 22 | 28 | XHF-2 |
| -243608 | 24 | 36 | 8 | 9 1/4 | 28 7/8 | 40 7/8 | 12 7/16 | 29 | 28 | 5/8 | 408 | XSM2436 | XSA2436 | 34 | 22 | XHF-3 |
| -243610 | 24 | 36 | 10 | 11 1/4 | 28 7/8 | 40 7/8 | 14 7/8 | 29 | 28 | 5/8 | 433 | XSM2436 | XSA2436 | 34 | 22 | XHF-3 |
| -323612*** | 32 | 36 | 12 | 12 | 37 3/4 | 41 3/4 | 15 1/2 | 29 | 36 1/8 | 5/8 | 691 | XSM3236 | XSA3236 | 29 | 33 | XHF-3 |

***This unit has limited approval dependent on number of entries

Some XJF Series enclosures do not have UL approval - consult factory

**NOTES**

1. To indicate Quad-Lead bolt option, add suffix "Q" after XCE. (Not available on XCEX models.)
2. Operators, windows and hinges are ordered separately.
3. Ex d approval optional on XCEX series only.
4. To indicate Type 4 / IP66 option, add suffix "N4" after size (catalog number)
5. Where reference is made to Class I and Class II hazardous locations, the equipment is suitable for both Div. 1 and Div. 2 locations.
6. Enclosures are pre-drilled for mounting panel and hinge kit unless otherwise specified.
7. Lid Lifter Cover Assist standard on all XCE enclosures 18 x 24 and higher



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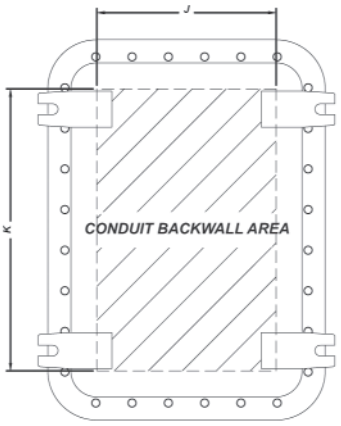
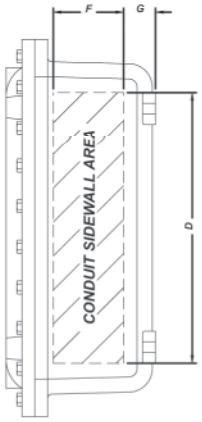
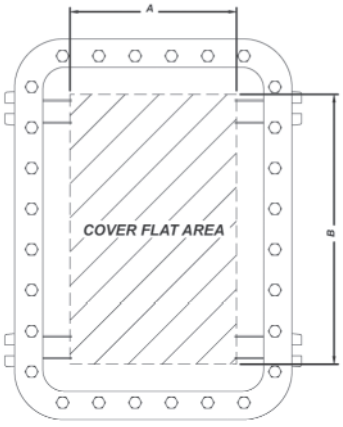
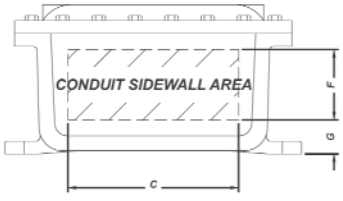
# Cover & Sidewall Area

| | COVER FLAT | | CONDUIT - SIDEWALL | | | | BACK WALL | |
|---|---|---|---|---|---|---|---|---|
| Enclosure Series | A | B | C | D | F | G | J | K |
| -041604 | 2 1/8 | 14 1/8 | 2 11/16 | 14 11/16 | 2 7/8 | 1 | 3 1/8 | 15 1/8 |
| -060804 | 3 7/8 | 5 7/8 | 4 11/16 | 6 11/16 | 2 7/8 | 1 | 5 1/8 | 7 1/8 |
| -060805 | 3 7/8 | 5 7/8 | 4 5/8 | 6 5/8 | 3 7/8 | 1 | 5 1/16 | 7 1/16 |
| -060806 | 3 7/8 | 5 7/8 | 4 9/16 | 6 9/16 | 4 7/8 | 1 | 4 15/16 | 6 15/16 |
| -061105 | 3 7/8 | 8 7/8 | 4 5/8 | 9 5/8 | 3 5/8 | 1 | 5 1/8 | 10 1/8 |
| -061204 | 3 7/8 | 9 7/8 | 4 11/16 | 10 11/16 | 2 7/8 | 1 | 5 1/8 | 11 1/8 |
| -061206 | 3 7/8 | 9 7/8 | 4 9/16 | 10 9/16 | 4 9/16 | 1 5/16 | 4 7/16 | 10 7/16 |
| -061305 | 3 7/8 | 10 7/8 | 4 5/8 | 11 5/8 | 3 5/8 | 1 | 5 1/8 | 12 1/8 |
| -071004 | 4 7/8 | 7 7/8 | 5 5/8 | 8 5/8 | 2 1/2 | 1 3/8 | 5 5/8 | 8 5/8 |
| -071006 | 4 7/8 | 7 7/8 | 5 9/16 | 8 9/16 | 4 5/8 | 1 3/8 | 5 9/16 | 8 9/16 |
| -071805 | 5 | 16 1/4 | 5 7/16 | 16 11/16 | 3 1/2 | 1 3/8 | 5 7/16 | 16 11/16 |
| -080804 | 5 7/8 | 5 7/8 | 6 5/8 | 6 5/8 | 2 11/16 | 1 3/8 | 7 1/8 | 7 1/8 |
| -080806 | 5 7/8 | 5 7/8 | 6 9/16 | 6 9/16 | 4 11/16 | 1 3/8 | 7 1/16 | 7 1/16 |
| -080808 | 5 7/8 | 5 7/8 | 6 7/16 | 6 7/16 | 6 11/16 | 1 3/8 | 6 15/16 | 6 15/16 |
| -081004 | 5 7/8 | 7 7/8 | 6 5/8 | 8 5/8 | 2 1/2 | 1 3/8 | 6 5/8 | 8 5/8 |
| -081006 | 5 7/8 | 7 7/8 | 6 9/16 | 8 9/16 | 4 1/2 | 1 3/8 | 6 9/16 | 8 9/16 |
| -081008 | 5 7/8 | 7 7/8 | 6 7/16 | 8 7/16 | 6 1/2 | 1 3/8 | 6 7/16 | 8 7/16 |
| -081204 | 5 7/8 | 9 7/8 | 6 5/8 | 10 5/8 | 2 1/2 | 1 3/8 | 6 5/8 | 10 5/8 |
| -081206 | 5 7/8 | 9 7/8 | 6 9/16 | 10 9/16 | 4 1/2 | 1 3/8 | 6 9/16 | 10 9/16 |
| -081208 | 5 7/8 | 9 7/8 | 6 7/16 | 10 7/16 | 6 1/2 | 1 3/8 | 6 7/16 | 10 7/16 |
| -091105 | 6 7/8 | 8 7/8 | 7 5/16 | 9 5/16 | 3 3/8 | 1 9/16 | 7 5/16 | 9 5/16 |
| -101004 | 7 7/8 | 7 7/8 | 8 3/8 | 8 3/8 | 2 3/8 | 1 9/16 | 8 3/8 | 8 3/8 |
| -101006 | 7 7/8 | 7 7/8 | 8 5/16 | 8 5/16 | 4 3/8 | 1 9/16 | 8 5/16 | 8 5/16 |
| -101008 | 7 7/8 | 7 7/8 | 8 3/16 | 8 3/16 | 6 3/8 | 1 9/16 | 8 3/16 | 8 3/16 |
| -101206 | 7 3/4 | 9 3/4 | 8 1/4 | 10 1/4 | 4 5/8 | 1 9/16 | 8 1/4 | 10 1/4 |
| -101404 | 7 7/8 | 11 7/8 | 8 3/8 | 12 3/8 | 2 3/8 | 1 9/16 | 8 3/8 | 12 3/8 |
| -101406 | 7 7/8 | 11 7/8 | 8 5/16 | 12 5/16 | 4 3/8 | 1 9/16 | 8 5/16 | 12 5/16 |
| -101408 | 7 7/8 | 11 7/8 | 8 1/16 | 12 1/16 | 6 1/4 | 1 3/4 | 7 5/8 | 11 5/8 |
| -121204 | 9 3/4 | 9 3/4 | 10 | 10 | 2 1/8 | 1 7/8 | 10 | 10 |
| -121206 | 9 3/4 | 9 3/4 | 9 13/16 | 9 13/16 | 4 1/8 | 1 7/8 | 9 13/16 | 9 13/16 |
| -121208 | 9 3/4 | 9 3/4 | 9 11/16 | 9 11/16 | 6 1/8 | 1 7/8 | 9 11/16 | 9 11/16 |
| -121804 | 9 3/4 | 15 3/4 | 10 1/8 | 16 1/8 | 2 1/8 | 1 7/8 | 10 1/8 | 16 1/8 |
| -121806 | 9 3/4 | 15 3/4 | 9 13/16 | 15 13/16 | 4 1/8 | 1 7/8 | 9 13/16 | 15 13/16 |
| -121808 | 9 3/4 | 15 3/4 | 9 11/16 | 15 11/16 | 6 1/8 | 1 7/8 | 9 11/16 | 15 11/16 |
| -122005 | 9 3/4 | 17 3/4 | 10 1/16 | 18 1/16 | 3 3/16 | 2 | 10 1/16 | 18 1/16 |
| -122404 | 9 5/8 | 21 3/4 | 10 1/8 | 22 1/8 | 2 1/8 | 2 | 10 1/8 | 22 1/8 |
| -122406 | 9 5/8 | 21 5/8 | 10 1/16 | 22 1/16 | 4 1/8 | 2 | 10 1/16 | 22 1/16 |





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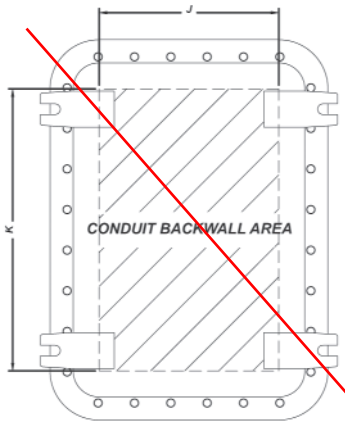


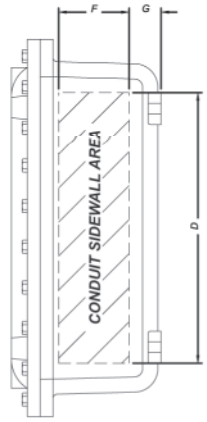


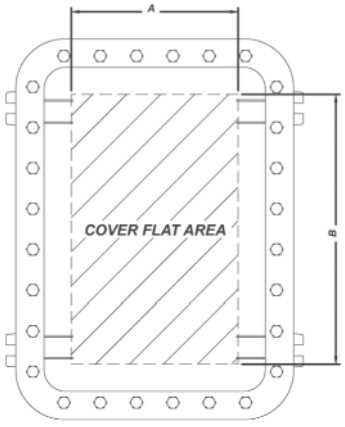


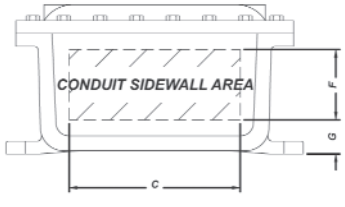


# Cover & Sidewall Area

| | COVER FLAT | | CONDUIT - SIDEWALL | | | | BACK WALL | |
|---|---|---|---|---|---|---|---|---|
| Enclosure Series | A | B | C | D | F | G | J | K |
| -122408 | 9 5/8 | 21 5/8 | 9 15/16 | 21 15/16 | 6 1/8 | 2 | 9 15/16 | 21 15/16 |
| -122410 | 9 5/8 | 21 5/8 | 9 13/16 | 21 13/16 | 8 1/8 | 2 | 9 13/16 | 21 13/16 |
| -123006 | 9 5/8 | 27 7/8 | 10 1/8 | 28 1/16 | 4 | 2 5/16 | 10 1/8 | 28 1/16 |
| -123604 | 9 5/8 | 33 7/8 | 10 1/8 | 34 1/8 | 2 | 2 3/8 | 10 1/8 | 34 1/8 |
| -123606 | 9 5/8 | 33 7/8 | 10 1/16 | 34 1/16 | 4 | 2 3/8 | 10 1/16 | 34 1/16 |
| -123608 | 9 5/8 | 33 7/8 | 9 15/16 | 33 15/16 | 6 | 2 3/8 | 9 15/16 | 33 15/16 |
| -124608 | 9 5/8 | 42 1/4 | 9 7/16 | 43 7/16 | 5 5/8 | 2 11/16 | 9 3/16 | 43 3/16 |
| -141404 | 11 | 11 | 12 1/8 | 12 1/8 | 1 3/4 | 2 1/8 | 11 5/8 | 11 5/8 |
| -141406 | 11 | 11 | 12 1/16 | 12 1/16 | 3 3/4 | 2 1/8 | 11 9/16 | 11 9/16 |
| -141408 | 11 | 11 | 11 15/16 | 11 15/16 | 5 3/4 | 2 1/8 | 11 7/16 | 11 7/16 |
| -142806 | 11 | 25 | 11 5/8 | 25 5/8 | 4 | 2 | 11 5/8 | 25 5/8 |
| -161604 | 12 1/2 | 12 1/2 | 14 1/8 | 14 1/8 | 2 | 2 1/16 | 14 1/8 | 14 1/8 |
| -161606 | 12 1/2 | 12 1/2 | 14 1/16 | 14 1/16 | 4 | 2 1/16 | 14 1/16 | 14 1/16 |
| -161608 | 12 1/2 | 12 1/2 | 13 15/16 | 13 15/16 | 6 | 2 1/16 | 13 15/16 | 13 15/16 |
| -162406 | 12 1/2 | 20 1/2 | 13 1/2 | 21 1/2 | 3 7/8 | 2 5/16 | 13 1/2 | 21 1/2 |
| -162408 | 12 1/2 | 20 1/2 | 13 3/8 | 21 3/8 | 5 7/8 | 2 5/16 | 13 3/8 | 21 3/8 |
| -162410 | 12 1/2 | 20 1/2 | 13 1/4 | 21 1/4 | 7 7/8 | 2 5/16 | 13 1/4 | 21 1/4 |
| -162806 | 13 1/4 | 25 1/4 | 14 1/16 | 26 1/16 | 3 11/16 | 2 3/16 | 14 1/16 | 26 1/16 |
| -163406 | 13 7/8 | 31 3/8 | 14 1/16 | 32 1/16 | 3 15/16 | 2 5/16 | 14 1/16 | 32 1/16 |
| -164610 | 12 1/2 | 42 1/4 | 13 7/8 | 43 7/8 | 7 7/8 | 2 7/16 | 13 7/8 | 43 7/8 |
| -181804 | 14 1/4 | 14 1/4 | 16 3/16 | 16 3/16 | 1 7/8 | 2 5/16 | 16 3/16 | 16 3/16 |
| -181806 | 14 1/4 | 14 1/4 | 16 1/16 | 16 1/16 | 3 7/8 | 2 5/16 | 16 1/16 | 16 1/16 |
| -181808 | 14 1/4 | 14 1/4 | 15 15/16 | 15 15/16 | 5 7/8 | 2 5/16 | 15 15/16 | 15 15/16 |
| -182406 | 14 1/4 | 20 1/4 | 15 7/16 | 21 7/16 | 3 7/8 | 2 1/2 | 15 7/16 | 21 7/16 |
| -182408 | 14 1/4 | 20 1/4 | 15 3/8 | 21 3/8 | 5 7/8 | 2 1/2 | 15 3/8 | 21 3/8 |
| -182410 | 14 1/4 | 20 1/4 | 15 1/4 | 21 1/4 | 7 7/8 | 2 1/2 | 15 1/4 | 21 1/4 |
| -183008 | 14 1/4 | 26 1/4 | 15 3/8 | 27 3/8 | 5 7/8 | 2 1/2 | 15 3/8 | 27 3/8 |
| -183608 | 14 1/4 | 32 1/4 | 15 3/8 | 33 3/8 | 5 7/8 | 2 1/2 | 15 3/8 | 33 3/8 |
| -183610 | 14 1/4 | 32 1/4 | 15 1/4 | 33 1/4 | 7 7/8 | 2 1/2 | 15 1/4 | 33 1/4 |
| -242408 | 20 1/4 | 20 1/4 | 20 7/8 | 20 7/8 | 5 5/8 | 2 9/16 | 20 7/8 | 20 7/8 |
| -242410 | 20 1/4 | 20 1/4 | 20 3/4 | 20 3/4 | 7 5/8 | 2 9/16 | 20 3/4 | 20 3/4 |
| -243008 | 20 1/4 | 26 1/4 | 20 5/8 | 26 5/8 | 5 7/8 | 2 7/16 | 21 3/8 | 27 3/8 |
| -243608 | 20 1/4 | 32 1/4 | 21 3/16 | 33 3/16 | 5 7/8 | 2 1/2 | 21 15/16 | 33 15/16 |
| -243610 | 20 1/4 | 32 1/4 | 21 1/8 | 33 1/8 | 7 7/8 | 2 3/4 | 20 7/8 | 32 7/8 |
| -323612 | 28 3/4 | 32 3/4 | 30 | 34 | 3 3/8 | 2 3/4 | 28 7/8 | 32 7/8 |



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# HPS Imperator™ Series Control Transformer - Applications

## The Perfect Solution

The HPS Imperator series of machine tool industrial control transformers are specifically designed to meet the high inrush industrial applications where electromagnetic components such as relays, solenoids etc. are used.

With 11 standard voltage groups, a VA range from 50VA to 5000VA and available with standard secondary and optional primary fuse kits, the HPS Imperator series from HPS provides the perfect solution for any applications.

## Superior Quality and Value

The HPS Imperator series design, utilizing superior insulation systems and being constructed with high quality silicon steel laminations for optimum performance, will meet or exceed UL and CE standards.

Backed by an industry leading LIFETIME warranty, the HPS Imperator™ industrial control transformer line offers superior performance, quality and value.

## Innovative Design

The HPS Imperator series is a unique, fresh and innovative compact design that provides the ideal solution for any industrial control application and will change the way the industrial machine tool industry looks at the control transformer.

The HPS Imperator's unique terminal block design (patent pending) allows for the quick and easy installation of standard secondary or optional primary 13/32" x 1 1/2" midget/type CC fuse clips on every unit. This is the simplest and most inexpensive fusing installation provided on any industrial control transformer in the market today.

The windings and internal terminations of the HPS Imperator are encapsulated, which protects them from moisture, dirt and other airborne contaminants. The custom molded coil covers with their unique 'fin shaped' design combine superior transformer cooling properties with a clean bold look.

The HPS Imperator utilizes custom serrated terminals, in combination with standard SEMS washer screws making assembly easier and quicker to install; and provides superior connection strength when connecting with bare, solid or stranded wire. It also allows for ring or spade termination connectors.

**STANDARDS**

HPS Industrial and Machine Tool Control and Instrument Transformers meet or exceeds the standards established by UL, IRC, ANSI, NEMA.

| Standard | File # | VA Size |
|---|---|---|
| UL (ANSI/UL 506) | E50394 | All PH |
| IEC 61558 | | All PH (excluding PH***AJ & PH***AR) |
| NEMA (ST-1) | | All PH |

**At HPS, we rate the VA capacity of our transformers at the output ..... where it counts. Other transformer manufacturers rate their capacity on the input side of the transformer, which can result in a 5% to 20% lower actual VA at the output.**


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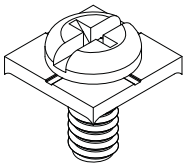
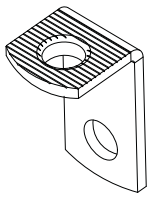
Data subject to change without notice.

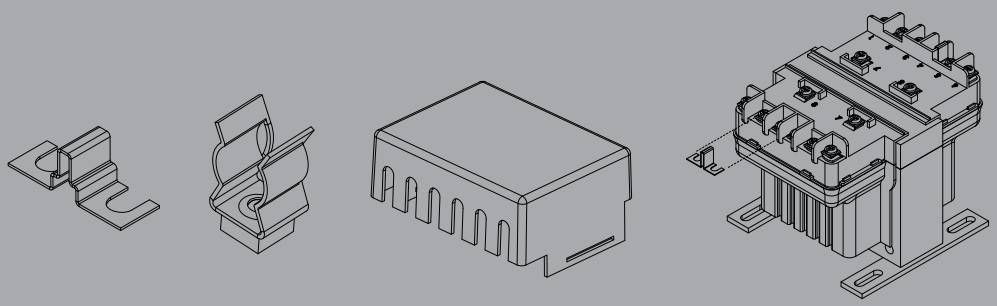
## Features & Benefits

- 600V class, machine tool rated industrial control transformers
- 11 standard multi primary and secondary voltage groups available[1]
- 50/60 Hertz (60Hz on PH***AJ & PH***AR)
- VA range from 50 to 5000[1]
- Superior insulation system
    - 50-150VA, temperature rise 55°C, insulation class 105°C
    - 250-1500VA, temperature rise 80°C, insulation class 130°C
    - 2000-5000VA, temperature rise 115°C, insulation class 180°C
- Constructed with high quality silicon steel laminations that provide optimum performance and reliability
- Encapsulated coils (up to and including 1500VA) encased in a custom injection molded cover, protects coils and terminations from moisture, dirt and other industrial airborne contaminants.
- Mounting Feet: made of heavy steel and welded or bolted to the core, these mounting feet provide superior strength in a compact design.
- Termination: combination slot/Philips #6 screw, complete with SEMS washer (suitable for 18 AWG to 14 AWG solid or 14 AWG stranded wire)
- Standard SEMS washers - supplied on all units up to and including 1500VA[2]
- Standard secondary fuse kits -utilizing 13/32" x 1 1/2" midget/type CC fuse clips (supplied with all standard units up to and including 1500VA)
- Optional primary fuse kits available utilizing 13/32" x 1 1/2" midget/type CC fuse clips (available on all standard units up to and including 1500VA)
- Optional finger safe terminal covers available on all units up to and including 1500VA
- UL Listed (approved for U.S. and Canada)
- CE Mark standard on all molded units up to and including 1500VA (excluding PH***AJ & PH***AR)
- LIFETIME Warranty (Limited)
- RoHS Compliant

[1] special voltages and VA sizes available upon request
[2] excluding PH750PG, PH1000PG, PH750MLI, PH1000MLI







Lifetime WARRANTY

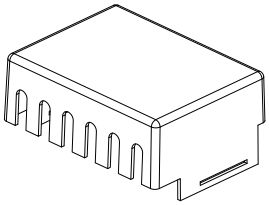
## Features & Benefits Continued

Terminal connection numbers molded into the terminal block and correspond to the nameplate and wiring diagrams which makes connecting the HPS Imperator quick and simple.

Standard secondary and optional primary fuse kits utilizing 13/32" x 1 1/2" midget/type CC fuse clips provide an economical solution to your fusing requirements (fuses not available).

Innovative terminal block design (patent pending) provides for easy hook-up and installation of fuse clips.

Optional removable finger safe terminal covers available on all units up to and including 1500VA.



Custom injection molded coil cover with its unique "fin shaped" design combines superior cooling properties with a clean, bold look.

Made of heavy steel and welded or bolted to the core, these mounting feet provide superior strength in a compact design.

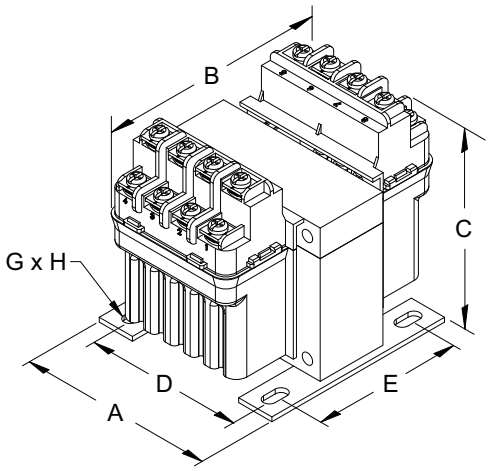



FIGURE A

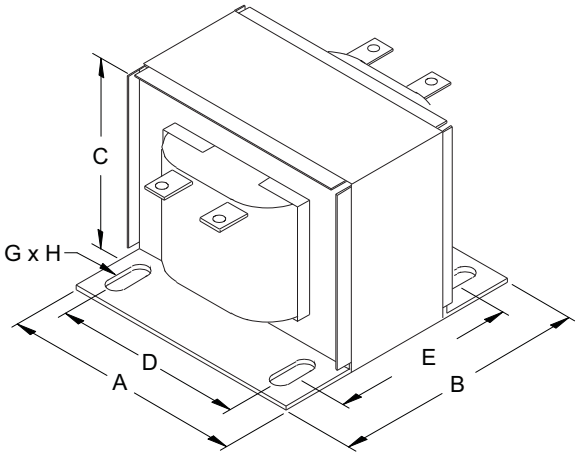



FIGURE C

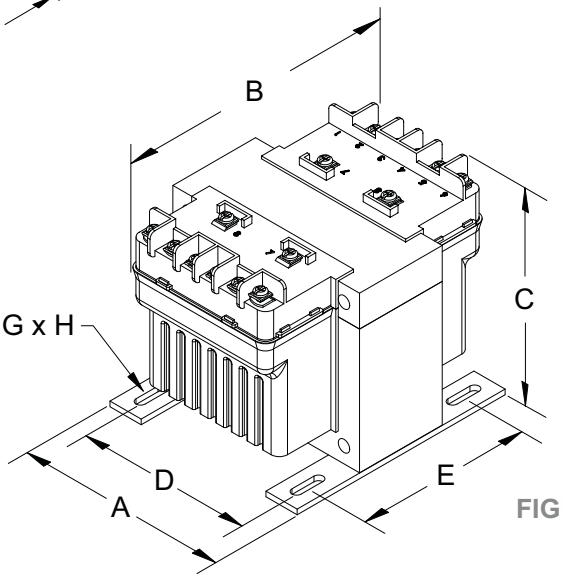



FIGURE B

## Group C

**Primary Voltage:** **240 x 480** || 230 x 460 || 220 x 440
**Secondary Voltage:** **120 x 240** || 115 x 230 || 110 x 220

**50/60 Hertz**

| VA Rating | Catalog Number | Mtg. Fig. | Output Amps | Overall Dimensions | | | Mounting Centers | | Mounting Slot | Height with Finger Guard | Depth with Finger Guard | Approx. Ship Weight Lbs. | Optional Primary Fuse Kit P/N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | E | G X H | | | | |
| 50 | **PH50MQMJ** | A | 0.42/0.21 | 3.00 | 4.38 | 3.19 | 2.50 | 2.25 | 0.22 x 0.44 | 4.00 | 5.82 | 3.50 | PFK1 |
| 75 | **PH75MQMJ** | A | 0.63/0.31 | 3.25 | 3.88 | 3.56 | 2.63 | 2.50 | 0.22 x 0.44 | 4.37 | 5.32 | 3.54 | PFK1 |
| 100 | **PH100MQMJ** | A | 0.83/0.42 | 3.25 | 4.19 | 3.63 | 2.63 | 2.63 | 0.22 x 0.44 | 4.44 | 5.63 | 4.50 | PFK1 |
| 150 | **PH150MQMJ** | B | 1.25/0.63 | 4.00 | 4.94 | 3.81 | 3.38 | 2.75 | 0.22 x 0.75 | 4.50 | 6.44 | 5.70 | PFK2 |
| 250 | **PH250MQMJ** | B | 2.08/1.04 | 4.50 | 5.44 | 3.81 | 3.75 | 3.13 | 0.22 x 0.75 | 4.50 | 6.94 | 7.50 | PFK2 |
| 350 | **PH350MQMJ** | B | 2.92/1.46 | 4.50 | 5.19 | 4.44 | 3.75 | 3.75 | 0.22 x 0.75 | 4.94 | 6.69 | 10.1 | PFK3 |
| 500 | **PH500MQMJ** | B | 4.17/2.08 | 4.75 | 5.94 | 4.31 | 4.06 | 3.81 | 0.31 x 0.94 | 4.81 | 7.44 | 14.2 | PFK3 |
| 750 | **PH750MQMJ** | B | 6.25/3.13 | 5.13 | 6.69 | 4.31 | 4.38 | 4.31 | 0.31 x 0.81 | 4.81 | 8.19 | 16.6 | PFK3 |
| 1000 | **PH1000MQMJ** | B | 8.33/4.17 | 5.25 | 6.81 | 4.94 | 4.50 | 4.44 | 0.31 x 0.81 | 5.56 | 8.31 | 23.6 | PFK3 |
| 1500 | **PH1500MQMJ** | B | 12.5/6.25 | 5.25 | 8.19 | 4.94 | 4.50 | 6.06 | 0.38 x 1.00 | 5.56 | 9.69 | 32.0 | PFK3 |
| 2000 | **PH2000MQMJ** | C | 16.7/8.33 | 6.38 | 7.50 | 5.50 | 4.38/5.31 | 6.00 | 0.31 x 1.13 | N/A | N/A | 45.4 | N/A |
| 3000 | **PH3000MQMJ** | C | 25.0/12.5 | 7.50 | 10.00 | 6.25 | 4.50/6.00 | 7.00 | 0.38 x 1.00 | N/A | N/A | 76.7 | N/A |
| 5000 | **PH5000MQMJ** | C | 41.7/20.8 | 9.00 | 11.00 | 7.63 | 5.25/7.00 | 7.00 | 0.44 x 1.00 | N/A | N/A | 121.2 | N/A |

**Secondary fuse clips, fuse clip mounting screws and primary and secondary voltage links/jumpers supplied standard with transformers up to and including 1500VA. Refer to page 54 for wiring schematic drawing. Special voltages and VA sizes available upon request.**
**Units over 1500VA are UL approved and CSA certified, but do not carry the CE mark.**
***** Available with FACTORY INSTALLED Primary and Secondary Fuse Kits up to 1500VA. To order,add the suffix "-FK" to the abover part number. Refer to page 49 for details. *****

**All dimensions in inches**



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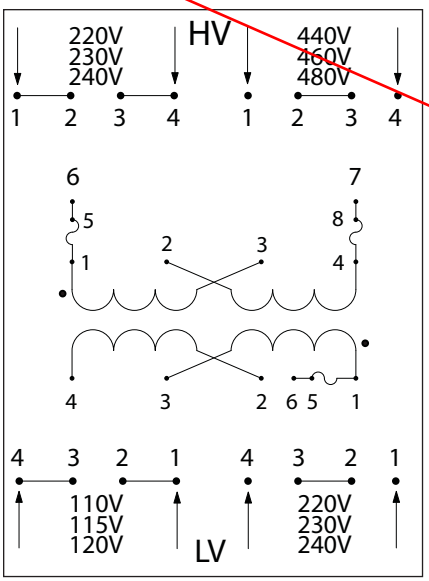
Data subject to change without notice.

## *HPS IMPERATOR* Series - Wiring Schematic Drawings continued



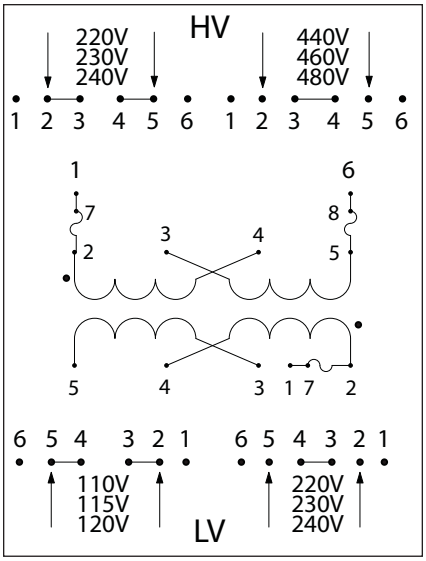
# Group C




### PH***MQMJ Schematic for 50, 75 and 100VA Units

| High Voltage (HV) (Primary Volts) | Install Supplied Links Between Terminals | Supply Lines Connect To | Install Fuse Clips To |
|---|---|---|---|
| 240 230 220 | 1-2, 3-4 | 1, 4 | Unfused |
| 480 460 440 | 2-3 | 1, 4 | Unfused |
| 240 230 220 | 1-2, 3-4 | 6, 7 | 1-5, 4-8 |
| 480 460 440 | 2-3 | 6, 7 | 1-5, 4-8 |

| Low Voltage (LV) (Secondary Volts) | Install Supplied Links Between Terminals | Load Lines Connect To | Install Fuse Clips To |
|---|---|---|---|
| 120 115 110 | 3-4, 1-2 | 1, 4 | Unfused |
| 240 230 220 | 2-3 | 1, 4 | Unfused |
| 120 115 110 | 3-4, 1-2 | 4, 6 | 1-5 |
| 240 230 220 | 2-3 | 4, 6 | 1-5 |




### PH***MQMJ Schematic for 150VA to 1500VA Units

| High Voltage (HV) (Primary Volts) | Install Supplied Links Between Terminals | Supply Lines Connect To | Install Fuse Clips To |
|---|---|---|---|
| 240 230 220 | 2-3, 4-5 | 2, 5 | Unfused |
| 480 460 440 | 3-4 | 2, 5 | Unfused |
| 240 230 220 | 2-3, 4-5 | 1, 6 | 2-7, 5-8 |
| 480 460 440 | 3-4 | 1, 6 | 2-7, 5-8 |

| Low Voltage (LV) (Secondary Volts) | Install Supplied Links Between Terminals | Load Lines Connect To | Install Fuse Clips To |
|---|---|---|---|
| 120 115 110 | 4-5, 2-3 | 2, 5 | Unfused |
| 240 230 220 | 3-4 | 2, 5 | Unfused |
| 120 115 110 | 4-5, 2-3 | 1, 5 | 2-7 |
| 240 230 220 | 3-4 | 1, 5 | 2-7 |

Product brochure

700 VA – 3 kVA

# Eaton 9SX UPS

## Reliable power protection for the edge and beyond

**Combining reliable double-conversion topology, internal static bypass and an easy-to-ready LCD menu display, the Eaton 9SX UPS provides the highly efficient and reliable power you expect from a 9-series UPS in a convenient tower form factor. Network, Modbus, Relay and signal input functionality enables integration into a variety of IoT and IIoT applications.**

### Protect the business you've worked hard to grow:

**Reliable power for critical systems**
The 9SX offers the robust double-conversion, online power protection needed for medical, light industrial, automation and mission critical IT applications. With zero transfer time to battery, continuous filtering of power, and an internal, automatic static bypass, the 9SX ensures performance and compatibility.

**Increased battery life**
Eaton offers ABM technology that increases battery service life by 50 percent. ABM uses advanced charging techniques to extend battery life and provides advanced notice before batteries fail.

### Get more so you can do more

**More power**
By providing up to 28 percent more wattage compared to traditional UPSs, the 9SX allows you to connect more devices and leave room for expanding IT systems.

**More control**
Automate power delivery by utilizing switchable, programmable outlets, without the need of a third party device or PDU. Programmable signal input through the RPO port also enables the UPS to change operating modes in reaction to external events.

### Gain efficiencies in your operations

**Integrate and standardize communications**

Maximize uptime with remote monitoring and management of your 9SX via an Eaton connectivity and software. SNMP, serial, USB, Modbus, and relay options enable integration regardless of the system architecture. Remote Power Off/Remote On Off signal input also manages UPS On/Off state preserving battery life during process shutdown.

**Advanced LCD interface**

Simplify UPS monitoring with Eaton's advanced LCD display. Easy access to UPS alarm history, energy logs, unit serial numbers and firmware versions enable first time issue resolution right at the source. Eight, user-selectable languages ensure success for global deployments.

### Services and support:

Eaton provides product support 24 hours a day, 7 days a week. From battery replacement to full UPS service plans, Eaton has one of the top service models in the industry.

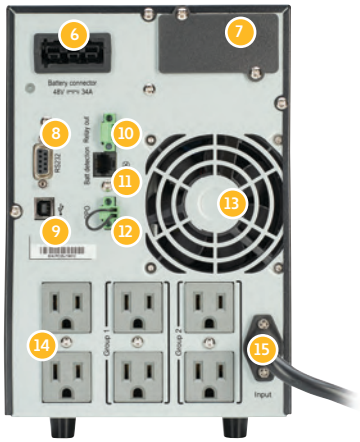
Powering Business Worldwide

## 9SX front panel

1. LED indicators
2. LCD panel
3. Hot swappable batteries
4. Sleek tower design
5. High efficiency mode

## 9SX back panel

6. EBM connector
7. Network Card-MS slot
8. RS-232 port
9. USB port
10. Standard relay output connector
11. Battery detection port
12. Remote Power Off (RPO)/Signal Input Connector
13. Fan
14. Switchable load groups
15. 5-15P input plug



Model 9SX1500 shown here

### 9SX MODEL SELECTION GUIDE*

| Catalog number | Rating (VA/watts) | Input connection | Output receptacles | Dimensions (H x W x D), in | Net weight, lb |
|---|---|---|---|---|---|
| **120V output, 50/60 Hz models** | | | | | |
| 9SX700 | 700/630 | 5-15P** | (6) 5-15R | 9.9 x 6.3 x 13.9 | 26.5 |
| 9SX1000 | 1000/900 | 5-15P** | (6) 5-15R | 9.9 x 6.3 x 15.1 | 30.9 |
| 9SX1500 | 1500/1350 | 5-15P** | (6) 5-15R | 9.9 x 6.3 x 17.1 | 41.9 |
| 9SX2000 | 1960/1770 | 5-20P** | (6) 5-20R, (1) L5-20R | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000 | 3000/2700 | L5-30P** | (4) 5-20R, (1) L5-30R | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000HW | 3000/2700 | Hardwired | Hardwired | 13.6 x 8.4 x 16.2 | 77.2 |
| **208V output, 50/60 Hz models** | | | | | |
| 9SX1000G | 1000/900 | C14 | (6) C13 | 9.9 x 6.3 x 15.1 | 30.9 |
| 9SX1500G | 1500/1350 | C14 | (8) C13 | 9.9 x 6.3 x 17.1 | 41.9 |
| 9SX2000G | 2000/1800 | C20/L6-20P*** | (8) C13 | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000G | 3000/2700 | C20/L6-20P*** | (8) C13, (1) C19 | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000GL | 3000/2700 | C20/L6-20P*** | (1) L6-30R, (2) L6-20R, (2) 6-20R | 13.6 x 8.4 x 16.2 | 77.2 |

* Due to continuous product improvement programs, all specifications are subject to change without notice.
** Input line cord is 8 feet long.
*** C19 to L6-20P input connector is 8 feet long.

### Optional extended battery module (EBM)

| UPS model | Internal runtime (min) Full / half load | +4 EBM Full / half load | Catalog number |
|---|---|---|---|
| 9SX700 | 5.8 / 16.6 | — | — |
| 9SX1000 | 6.7 / 18.5 | 113 / 269 | 9SXEBM36 |
| 9SX1000G | 5.9 / 16.2 | 108 / 232 | |
| 9SX1500 | 5.9 / 16.5 | 105 / 239 | 9SXEBM48 |
| 9SX1500G | 5.3 / 16.2 | 104 / 234 | |
| 9SX2000 | 10.3 / 26.2 | 162 / 363 | 9SXEBM96 |
| 9SX2000G | 10.4 / 27.5 | 164 / 396 | |
| 9SX3000 | 5.7 / 16.7 | 104 / 231 | |
| 9SX3000G | 5.8 / 15.7 | 104 / 231 | |

### Options

| Connectivity | Catalog number | Slot type |
|---|---|---|
| Network card | NETWORK-MS | Mini slot |
| Gigabit network card | NETWORK-M2 | Mini slot |
| Industrial relay | INDRELAY-MS | Mini slot |
| Modbus card | MODBUS-MS | Mini slot |
| Relay card | RELAY-MS | Mini slot |

For complete battery runtime information and to interact with the 9SX UPS, please visit:
**Eaton.com/9SX**

### What's in the box

- UPS
- Safety manual
- Quick start guide
- Reference guide
- RS-232 serial cable
- USB cable

### G models only

- Cable lockers
- Output cables
- C19 to L6-20P input cables (for 2000 VA – 3000 VA models)

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Cleveland, OH 44122
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Eaton.com

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Powering Business Worldwide

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# Eaton 9SX UPS technical specifications[1]

## Model overview

| Catalog number | Power rating (VA/watts) | Input connection | Output receptacles | Dimensions (HxWxD, in.) | Weight (lb.) |
|---|---|---|---|---|---|
| **120V output, 50/60 Hz** | | | | | |
| 9SX700 | 700/630 | 5-15P[2] | (6) 5-15R | 9.9 x 6.3 x 13.9 | 26.5 |
| 9SX1000 | 1000/900 | 5-15P[2] | (6) 5-15R | 9.9 x 6.3 x 15.1 | 30.9 |
| 9SX1500 | 1500/1350 | 5-15P[2] | (6) 5-15R | 9.9 x 6.3 x 17.1 | 41.9 |
| 9SX2000 | 1960/1770 | 5-20P[2] | (1) L5-20R, (6) 5-20R | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000 | 3000/2700 | L5-30P[2] | (1) L5-30R, (4) 5-20R | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000HW | 3000/2700 | Hardwired | Hardwired | 13.6 x 8.4 x 16.2 | 77.2 |
| **208V output, 50/60 Hz bundles** | | | | | |
| 9SX1000G | 1000/900 | C14 | (6) C13 | 9.9 x 6.3 x 15.1 | 30.9 |
| 9SX1500G | 1500/1350 | C14 | (6) C13 | 9.9 x 6.3 x 17.1 | 41.9 |
| 9SX2000G | 2000/1800 | C14 / L6-20P[3] | (8) C13 | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000G | 3000/2700 | C20 / L6-20P[3] | (8) C13, (1) C19 | 13.6 x 8.4 x 16.2 | 77.2 |
| 9SX3000GL | 3000/2700 | C20 / L6-20P[3] | (1) L6-30R, (2) L6-20R, (2) 6-20R | 13.6 x 8.4 x 16.2 | 77.2 |

## Additional specifications

| **General** | | |
|---|---|---|
| Topology | Double-conversion, online | |
| Configuration | Tower | |
| Color | Black and silver | |
| Diagnostics | Full system self-test at power up, ABM battery test every 30 days | |
| Warranty | 2 years electronics and battery | |
| Remote power off | Remote On/Off (ROO) and Remote Power Off (RPO) rear terminal blocks | |
| Contents (Ships with the following items) | UPS<br>Safety guide<br>Quick Start Guide<br>Reference guide<br>Output cables (for G models)<br>C19 to L6-20P input cables (for 9SX2000G, 9SX3000G, 9SX3000GL)<br>Cable lockers (for G models)<br>RS-232 serial cable<br>USB cable | |
| **Electrical input** | **208V** | **120V** |
| Nominal voltage | 208V default (200/208/220/230/240V) | 120V default (100/110/120/125V) |
| Input voltage range | Full load: 190-276V,<br>≤25% load: 120-276V | Full load: 100-138V,<br>≤25% load: 60-144V |
| Frequency | 50/60 Hz | |
| Frequency range | 60 Hz: 50–70 Hz, 50 Hz: 40–60 Hz | |
| Input power factor | ≥.99 | |
| Input current distortion | ≤8% | |
| **Electrical Output** | **208V** | **120V** |

[1] Due to continuing product improvement programs, specifications are subject to change without notice.
[2] Input line cord is 8 feet long.
[3] C19 to L6-20P input connector is 8 feet long.

| | | |
|---|---|---|
| Power ratings | 9SX1000G:<br>1000VA / 900W<br>9SX1500G:<br>1500VA / 1350W<br>9SX2000G:<br>220/230/240V: 2000VA / 1800W<br>208V: 1800VA / 1620W<br>200V: 1600VA / 1440W<br>9SX3000G & 9SX3000GL:<br>220/230/240V: 3000VA / 2700W<br>208V: 2700VA / 2430W<br>200V: 2400VA / 2160W | 9SX700:<br>700VA / 630W<br>9SX1000:<br>1000VA / 900W<br>9SX1500:<br>120/125V: 1500VA / 1350W<br>110V: 1350VA / 1215W<br>100V: 1200VA / 1080W<br>9SX2000:<br>120/125V: 1960VA / 1770W<br>110V: 1764VA / 1593W<br>100V: 1568VA / 1416W<br>9SX3000 & 9SX3000HW:<br>120/125V: 3000VA / 2700W<br>110V: 2700VA / 2430W<br>100V: 2400VA / 2160W |
| Circuit breaker | 2200VA: None<br>3000VA: None | 2000VA: None<br>3000VA: (3) 20A for (2) 5-20R each |
| Nominal voltage | 208V default (200/208/220/230/240V) | 120V default (100/110/120/125V) |
| Operating | | |
| Output voltage regulation, steady state | ±2% normal mode | ±2% normal mode |
| Output Voltage THD (online) | Linear: <3% | Linear: <3% |
| Power factor | 0.9 | |
| Efficiency (online mode with resistive load) | 9SX1000G: 88%<br>9SX1500G: 91%<br>9SX2000G: 92%<br>9SX3000G: 92%<br>9SX3000GL: 92% | 9SX700: 87%<br>9SX1000: 88%<br>9SX1500: 88%<br>9SX2000: 88%<br>9SX3000: 89%<br>9SX3000HW: 89% |
| Transfer time | 0 ms | |
| **Extended Battery Module** | | |
| Optional extended battery module (EBM) | 9SX700 | No optional EBM |
| | 9SX1000<br>9SX1000G | 9SXEBM36 |
| | 9SX1500<br>9SX1500G | 9SXEBM48 |
| | 9SX2000<br>9SX2000G<br>9SX3000<br>9SX3000HW<br>9SX3000G<br>9SX3000GL | 9SXEBM96 |
| Maximum number of EBMs | Add up to 4 EBMs | |
| Battery description | Sealed, lead-acid; maintenance free | |
| Battery management | ABM technology; 3-stage charging extends battery service life up to 50% and provides advance warning for battery replacement | |
| Battery replacement | Hot-swappable internal batteries and EBMs | |
| Start on battery | Cold-start enabled; first cold start is always forbidden | |
| **Communications** | | |
| User interface | Graphical display. UPS status in a single view. | |
| LEDs | 4 status-indicating LEDs | |
| Communication ports | RS-232 (RJ45) ports; USB port as standard (HID). 6-foot RS-232 and USB cables included | |

| | | |
|---|---|---|
| Communications card | Mini-Slot Expansion port. Optional cards:<br>-NETWORK-M2 Gigabit Web/SNMP Card<br>-MODBUS-MS Modbus RTU Card<br>-INDRELAY-MS Industrial Relay Card | |
| Power management software | Integrates with Eaton Intelligent Power Manager software | |
| **Environmental & standards** | | |
| Operating temperature | 0 to 40 °C (32 to 104 °F) in Online mode, with linear derating for altitude | |
| Storage temperature | 0 to 35°C (32°F to 95°F); without batteries: -25 to 55°C (-13°F to 131°F) | |
| Relative humidity | 0 to 96% non-condensing | |
| Altitude operating temperature range | Up to 3,000 meters (9,843 ft) above sea level, no derating for 35 °C (95 °F) room temperature | |
| Audible noise | < 50 dBA at 1 meter typical | |
| RoHS compliance | Yes | |
| Safety conformance | CE / cULus | |
| EMC markings | 9PX3000, 9PX3000HW:<br>FCC Part 15, Subpart B, Class A<br>ANSI C63.4-2014<br>EN 62040-2: 2018, C2<br><br>All other 120V models:<br>FCC Part 15, Subpart B, Class B<br>ANSI C63.4-2014<br>EN 62040-2: 2018, C1<br>IEC 62040-2: 2016 | CE / cULus / NOM |
| Surge protection | MOV: 510V, 296Joules | FCC Part 15, Subpart B, Class B<br>ANSI C63.4-2014<br>AS 62040.2-2008, C1<br>EN 62040-2: 2018, C1 |

**Battery backup times (in minutes)**[4]

| Load | Internal batteries | +1 EBM | +2 EBMs | +3 EBMs | +4 EBMs |
|---|---|---|---|---|---|
| 9SX700 | | | | | |
| 630W | 5.8 | | | | |
| 567W | 7.0 | | | | |
| 504W | 8.4 | | | | |
| 441W | 10.4 | | | | |
| 378W | 13.0 | | | | |
| 315W | 16.6 | | | | |
| 252W | 21.7 | | | | |
| 189W | 29.7 | | | | |
| 9SX1000 | | | | | |
| 900W | 6.7 | 31.6 | 58.4 | 88 | 113 |
| 810W | 7.9 | 35.7 | 66 | 99 | 130 |
| 720W | 9.5 | 41 | 76 | 113 | 151 |
| 630W | 11.7 | 47.9 | 88 | 132 | 180 |

[4] Runtimes are shown at full load with maximum power factor, are approximate and may vary with equipment, configuration, battery age, temperature, etc. View interactive runtime graphs at www.eaton.com/9PX.

# Eaton FlexPDU and Maintenance Bypass PDU

**FlexPDUs and HotSwap MBPs**

## Features

- Provides service continuity during battery replacement, UPS maintenance or upgrade
- Offers connections to all types of equipment
- Eases installation with flexible mounting options
- Minimal depth accommodates most space constraints

## Compatible with:

- Eaton® Evolution® UPS
- Eaton Evolution S UPS
- Eaton 5130 UPS
- Eaton 9130 UPS
- Eaton EX UPS

**Top mounting horizontal**

**Top mounting vertical**

**Side mounting**

**The FlexPDUs and HotSwap MBPs can also be rackmounted either horizontally or vertically**

Enhancing reliability and availability by providing service continuity in all situations, the Eaton FlexPDU and HotSwap Maintenance Bypass (MBP) enable easy UPS and battery replacement without interruption to the connected load. With two ranges of accessories to choose from, these product lines offer the flexibility of connections to meet the demanding requirements of today's data center architects.

Designed for reliable and cost-effective power distribution, FlexPDUs are available with 5-15R, 5-20R or L5-20R output receptacles, for easy connection to a wide range of equipment.

**20A FlexPDU**

Facilitating hot-swappable battery replacement from the front panel—with no need to remove the UPS from the rack—the HotSwap MBP is also ideal when exchanging a unit or servicing a UPS. By simply using the bypass feature, power is maintained to the connected equipment while the UPS is shut down. For added convenience, the HotSwap MBP offers two receptacles: 5-15R or 5-20R.

Even more, the 1U and 2U form factors of the FlexPDU and HotSwap MBP make the products easy to deploy even in a space-constrained environment. In addition, a variety of mounting options allow for flexible installation, with the ability to mount the units on the rear panel, the top, on the left or on the right of rackmount and rack/tower UPSs.

**30A HotSwap MBP**

To find out more about the FlexPDU and HotSwap MBP, visit us at:

**www.eaton.com/powerquality**
**800.356.5794**

EATON
*Powering Business Worldwide*

## FlexPDU and HotSwap MBP models

| Catalog number | Description | Style number | Rating | Cord (ft) | Orientation | Input plug | Output receptacles | Dimensions (H x W x D, in) |
|---|---|---|---|---|---|---|---|---|
| EFLXL1500R-PDU1U | FlexPDU 15 1U | 58015 | 1,440 VA | 3.3 | 1U | 5-15P | (12) 5-15R | 1.7 x 17.3 x 2.4 |
| EFLXL2000R-PDU1U | FlexPDU 20 1U | 58020 | 1,920 VA | 3.3 | 1U | 5-20P | (12) 5-20R | 1.7 x 17.3 x 2.4 |
| EFLXL2000R-PDU1UL | FlexPDU 20L 2U | 58021 | 1,920 VA | 3.3 | 2U | L5-20P | (5) L5-20R | 2.0 x 17.3 x 3.0 |
| EHBPL1500R-PDU1U | HotSwap MBP 15 2U | 58115 | 1,440 VA | 3.3 | 2U | 5-15P | (6) 5-15R | 2.1 x 17.3 x 3.8 |
| EHBPL2000R-PDU1U | HotSwap MBP 20 2U | 58120 | 1,920 VA | 3.3 | 2U | 5-20P | (6) 5-20R | 2.1 x 17.3 x 3.8 |
| EHBPL3000R-PDU1U | HotSwap MBP 30 2U | 58130 | 2,880 VA | 3.3 | 2U | L5-30P | (5) 5-20R | 2.1 x 17.3 x 3.8 |

5-15R

5-15P

5-20R

5-20P

L5-20R

L5-20P

## Compatibility matrix for rackmount UPSs*

| FlexPDU plug/amp rating | UPS model (North American only) | Rack mounting | Rear mounting** | Side mounting | Top mounting |
|---|---|---|---|---|---|
| 15A | Eaton Evolution Rack UPS, 650–1550 VA | ✓ | | | |
| | Eaton Evolution S Rack/Tower UPS, 1250 VA | ✓ | | ✓ | ✓ |
| | Eaton 5130 Rack/Tower UPS, 1250 VA | ✓ | | ✓ | ✓ |
| | Eaton 9130 Rack UPS, 700–1500 VA | ✓ | | | |
| | Eaton EX Rack UPS, 1000–1500 VA | ✓ | | ✓ | ✓ |
| 20A, 20A Locking | Eaton Evolution Rack/Tower UPS, 2000 VA | ✓ | | | |
| | Eaton Evolution S Rack/Tower UPS, 1750–3000 VA | ✓ | ✓ | ✓ | ✓ |
| | Eaton 5130 Rack/Tower UPS, 1750–3000 VA | ✓ | ✓ | ✓ | ✓ |
| | Eaton 9130 Rack UPS, 2000–3000 VA | ✓ | | | |
| | Eaton EX Rack/Tower UPS, 2200–3000 VA | ✓ | ✓ | ✓ | ✓ |

* For tower models, all FlexPDUs can be wall-mounted. ** Rear mounting available on 3U models only.

| HotSwap MBP plug/amp rating | UPS model (North American only) | Rack mounting | Rear mounting** | Side mounting | Top mounting |
|---|---|---|---|---|---|
| 15A | Eaton Evolution Rack UPS, 650–1550 VA | ✓ | | | |
| | Eaton Evolution S Rack/Tower UPS, 1250 VA | ✓ | | ✓ | ✓ |
| | Eaton 5130 Rack/Tower UPS, 1250 VA | ✓ | | ✓ | ✓ |
| | Eaton 9130 Rack UPS, 700–1500 VA | ✓ | | | |
| | Eaton EX Rack UPS, 1000–1500 VA | ✓ | | ✓ | ✓ |
| 20A | Eaton Evolution Rack/Tower UPS, 2000 VA | ✓ | | | |
| | Eaton Evolution S Rack/Tower UPS, 1750 VA | ✓ | | ✓ | ✓ |
| | Eaton 5130 Rack/Tower UPS, 1750 VA | ✓ | | ✓ | ✓ |
| | Eaton 9130 Rack UPS, 2000 VA | ✓ | | | |
| | Eaton EX Rack/Tower UPS, 2200 VA | ✓ | ✓ | ✓ | ✓ |
| 30A | Eaton Evolution S Rack/Tower UPS, 2500–3000 VA | ✓ | ✓ | ✓ | ✓ |
| | Eaton 5130 Rack/Tower UPS, 2500–3000 VA | ✓ | ✓ | ✓ | ✓ |
| | Eaton 9130 Rack UPS, 2500–3000 VA | ✓ | | | |
| | Eaton EX Rack/Tower UPS, 3000 VA | ✓ | ✓ | ✓ | ✓ |

* For tower models, all HotSwap MBPs can be wall-mounted. ** Rear mounting available on 3U models only.


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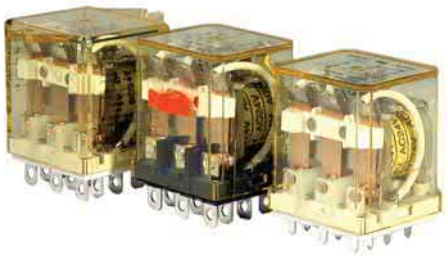
# RH Series Compact Power Relays

**SPDT through 4PDT, 10A contacts**
**Compact power type relays**

The RH series are miniature power relays with a large capacity. The RH relays feature 10A contact capacity as large as the RR series but in a miniature package. The compact size saves space.



## Part Number Selection

| Contact | Model | Part Number: Blade Terminal | Part Number: PCB Terminal | Coil Voltage Code (Standard Stock in bold) |
|---|---|---|---|---|
| SPDT | Basic | RH1B-U | RH1V2-U | AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V |
| | With Indicator | RH1B-UL | — | |
| | With Check Button | RH1B-UC | — | |
| | With Indicator and Check Button | RH1B-ULC | — | |
| | Top Bracket Mounting | RH1B-UT | — | |
| | With Diode (DC coil only) | RH1B-UD | RH1V2-UD | DC6V, **DC12V**, **DC24V**, DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH1B-ULD | — | **DC12V**, **DC24V**, DC48V, DC110V |
| DPDT | Basic | RH2B-U | RH2V2-U | AC6V, AC12V, **AC24V**, **AC110-120V**, **AC220-240V** DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V |
| | With Indicator | RH2B-UL | RH2V2-UL | |
| | With Check Button | RH2B-UC | — | |
| | With Indicator and Check Button | RH2B-ULC | — | |
| | Top Bracket Mounting | RH2B-UT | — | |
| | With Diode (DC coil only) | RH2B-UD | RH2V2-UD | DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V |
| | With Indicator and Diode (DC coil only) | RH2B-ULD | — | |
| 3PDT | Basic | RH3B-U | RH3V2-U | AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V |
| | With Indicator | RH3B-UL | RH3V2-UL | |
| | With Check Button | RH3B-UC | — | |
| | With Indicator and Check Button | RH3B-ULC | — | |
| | Top Bracket Mounting | RH3B-UT | — | |
| | With Diode (DC coil only) | RH3B-D* | RH3V2-D* | DC6V, DC12V, DC24V, DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH3B-LD* | — | |
| 4PDT | Basic | RH4B-U | RH4V2-U | AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V |
| | With Indicator | RH4B-UL | RH4V2-UL | |
| | With Check Button | RH4B-UC | — | |
| | With Indicator and Check Button | RH4B-ULC | — | |
| | Top Bracket Mounting | RH4B-UT | — | |
| | With Diode (DC coil only) | RH4B-UD | RH4V2-UD | DC6V, DC12V, DC24V, DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH4B-LD* | — | |

1. *Carries no UL recognition mark.
2. PCB terminal relays are designed to mount directly to a circuit board without any socket.

**Ordering Information**
When ordering, specify the Part No. and coil voltage code:
(example) **RH3B-U** **AC120V**
Part No. — Coil Voltage Code

## Sockets (for Blade Terminal Models)

| Relays | Standard DIN Rail Mount [1] | Finger-safe DIN Rail Mount [1] | Through Panel Mount | PCB Mount |
|---|---|---|---|---|
| RH1B | SH1B-05 | SH1B-05C | SH1B-51 | SH1B-62 |
| RH2B | SH2B-05 | SH2B-05C | SH2B-51 | SH2B-62 |
| RH3B | SH3B-05 | SH3B-05C | SH3B-51 | SH3B-62 |
| RH4B | SH4B-05 | SH4B-05C | SH4B-51 | SH4B-62 |
| | | | | |

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

## Hold Down Springs & Clips

| Appearance | Description | Relay | For DIN Mount Socket | For Through Panel & PCB Mount Socket | Min Order Qty |
|---|---|---|---|---|---|
| | Pullover Wire Spring | RH1B | SY2S-02F1 [2] | SY4S-51F1 | 10 |
| | | RH2B | SY4S-02F1 [2] | | |
| | | RH3B | SH3B-05F1 [2] | | |
| | | RH4B | SH4B-02F1 [2] | | |
| | Leaf Spring (side latch) | RH1B, RH2B, RH3B, RH4B | SFA-202 [3] | SFA-302 [3] | 20 |
| | Leaf Spring (top latch) | RH1B, RH2B, RH3B, RH4B | SFA-101 [3] | SFA-301 [3] | |

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip part number is Y778-011.
3. Two required per relay.

## AC Coil Ratings

| Voltage (V) | Rated Current (mA) ±15% at 20°C | | | | | | | | Coil Resistance (Ω) ±10% at 20°C | | | | Operation Characteristics (against rated values at 20°C) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AC 50Hz | | | | AC 60Hz | | | | | | | | | | |
| | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage |
| 6 | 170 | 240 | 330 | 387 | 150 | 200 | 280 | 330 | 330 | 9.4 | 6.4 | 5.4 | 110% | 80% maximum | 30% minimum |
| 12 | 86 | 121 | 165 | 196 | 75 | 100 | 140 | 165 | 165 | 39.3 | 25.3 | 21.2 | | | |
| **24** | 42 | 60.5 | 81 | 98 | 37 | 50 | 70 | 83 | 83 | 153 | 103 | 84.5 | | | |
| 110 | 9.6 | — | 18.1 | 21.6 | 8.4 | — | 15.5 | 18.2 | 18.2 | — | 2,200 | 1,800 | | | |
| **110-120** | — | 9.4-10.8 | — | — | — | 8.0-9.2 | — | — | — | — | — | — | | | |
| **120** | 8.6 | — | 16.4 | 19.5 | 7.5 | — | 14.2 | 16.5 | 16.5 | — | 10,800 | 7,360 | | | |
| 220 | 4.7 | — | 8.8 | 10.7 | 4.1 | — | 7.7 | 9.1 | 9.1 | — | 10,800 | 7,360 | | | |
| **220-240** | — | 4.7-5.4 | — | — | — | 4.0-4.6 | — | | — | 18,820 | — | — | | | |
| **240** | 4.9 | — | 8.2 | 9.8 | 4.3 | — | 7.1 | 8.3 | 8.3 | — | 12,100 | 9,120 | | | |

## DC Coil Ratings

| Voltage (V) | Rated Current (mA) ±15% at 20°C | | | | Coil Resistance (Ω) ±10% at 20°C | | | | Operation Characteristics (against rated values at 20°C) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage |
| 6 | 128 | 150 | 240 | 250 | 47 | 40 | 25 | 24 | 110% | 80% maximum | 10% minimum |
| 12 | 64 | 75 | 120 | 125 | 188 | 160 | 100 | 96 | | | |
| **24** | 32 | 36.9 | 60 | 62 | 750 | 650 | 400 | 388 | | | |
| 48 | 18 | 18.5 | 30 | 31 | 2,660 | 2,600 | 1,600 | 1,550 | | | |
| 100-110 | — | 8.2-9.0 | — | — | — | 12,250 | — | — | | | |
| 110 | 8 | — | 12.8 | 15 | 13,800 | — | 8,600 | 7,340 | | | |

Standard coil voltages are in **BOLD**.

## Contact Ratings

| Maximum Contact Capacity | | | | | | |
|---|---|---|---|---|---|---|
| Model | Continuous Current | Allowable Contact Power | | Rated Load | | |
| | | Resistive Load | Inductive Load | Voltage (V) | Res. Load | Ind. Load |
| SPDT | 10A | 1540VA 300W | 990VA 210W | 110 AC | 10A | 7A |
| | | | | 220 AC | 7A | 4.5A |
| | | | | 30 DC | 10A | 7A |
| DPDT 3PDT 4PDT | 10A | 1650VA 300W | 1100VA 225W | 110 AC | 10A | 7.5A |
| | | | | 220 AC | 7.5A | 5A |
| | | | | 30 DC | 10A | 7.5A |

Note: Inductive load for the rated load — cos ø = 0.3, L/R = 7 ms

## TÜV Ratings

| Voltage | RH1 | RH2 | RH3 | RH4 |
|---|---|---|---|---|
| 240V AC | 10A | 10A | 7.5A | 7.5A |
| 30V DC | 10A | 10A | 10A | 10A |

AC: cos ø = 1.0, DC: L/R = 0 ms

## UL Ratings

| Voltage | Resistive | | | General Use | | | Horse Power Rating | | |
|---|---|---|---|---|---|---|---|---|---|
| | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 |
| 240V AC | 10A | 7.5A | 7.5A | 7A | 6.5A | 5A | 1/3 HP | 1/3 HP | — |
| 120V AC | — | 10A | 10A | — | 7.5A | 7.5A | 1/6 HP | 1/6 HP | — |
| 30V DC | 10A | 10A | — | 7A | — | — | — | — | — |
| 28V DC | — | — | 10A | — | — | — | — | — | — |

## CSA Ratings

| Voltage | Resistive | | | | General Use | | | | Horse Power Rating |
|---|---|---|---|---|---|---|---|---|---|
| | RH1 | RH2 | RH3 | RH4 | RH1 | RH2 | RH3 | RH4 | RH1, 2, 3 |
| 240V AC | 10A | 10A | — | 7.5A | 7A | 7A | 7A | 5A | 1/3 HP |
| 120V AC | 10A | 10A | 10A | 10A | 7.5A | 7.5A | — | 7.5A | 1/6 HP |
| 30V DC | 10A | 10A | 10A | 10A | 7A | 7.5A | — | — | — |

## Socket Specifications

| | Sockets | Terminal | Electrical Rating | Wire Size | Torque |
|---|---|---|---|---|---|
| DIN Rail Mount Sockets | SH1B-05 | (Coil) M3 screws (contact) M3.5 screws with captive wire clamp | 250V, 10A | Maximum up to 2–#12AWG | 5.5 - 9 in•lbs 9 - 11.5 in•lbs |
| | SH2B-05 SH3B-05 SH4B-05 | M3.5 screws with captive wire clamp | 300V, 10A | Maximum up to 2–#12AWG | 9 - 11.5 in•lbs |
| Finger-safe DIN Rail Mount | SH1B-05C | (coil) M3 screws (contact) M3.5 screws with captive wire clamp, fingersafe | 250V, 10A | Maximum up to 2–#12AWG | 5.5 - 9 in•lbs 9 - 11.5 in•lbs |
| | SH2B-05C SH3B-05C SH4B-05C | M3.5 screws with captive wire clamp, fingersafe | 300V, 10A | Maximum up to 2–#12AWG | 9 - 11.5 in•lbs |
| Through Panel Mount Socket | SH1B-51 SH2B-51 SH3B-51 SH4B-51 | Solder | 300V, 10A | — | — |
| PCB Mount Socket | SH1B-62 | PCB mount | 250V, 10A | — | — |
| | SH2B-62 SH3B-62 SH4B-62 | PCB mount | 300V, 10A | — | — |

## Accessories

| Description | Appearance | Use with | Part No. | Remarks |
|---|---|---|---|---|
| Aluminum DIN Rail (1 meter length) | | All DIN rail sockets | BNDN1000 | IDEC offers a low-profile DIN rail (BNDN1000). The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm). |
| DIN Rail End Stop | | DIN rail | BNL5 | 9.1 mm wide. |
| Replacement Hold-Down Spring Anchor | | DIN mount sockets and hold down springs. | Y778-011 | For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket. |

## Specifications

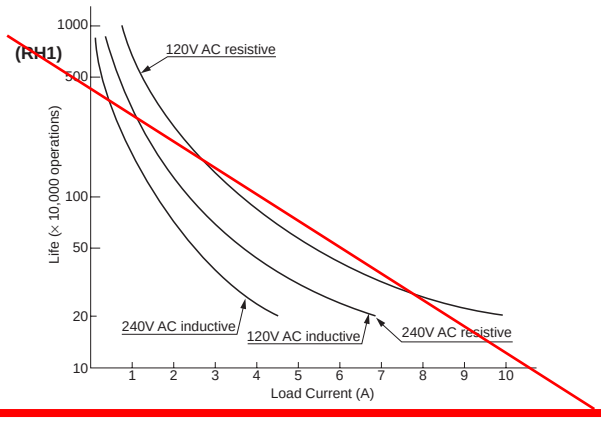
| | | |
|---|---|---|
| **Contact Material** | | Silver cadmium oxide |
| **Contact Resistance** [1] | | 50mΩ maximum |
| **Minimum Applicable Load** | | 24V DC, 30 mA; 5V DC, 100 mA (reference value) |
| **Operate Time** [2] | SPDT<br>DPDT | 20ms maximum |
| | 3PDT<br>4PDT | 25ms maximum |
| **Release Time** [2] | SPDT<br>DPDT | 20ms maximum |
| | 3PDT<br>4PDT | 25ms maximum |
| **Power Consumption (approx.)** | SPDT | AC: 1.1VA (50Hz), 1VA (60Hz) DC: 0.8W |
| | DPDT | AC: 1.4VA (50Hz), 1.2VA (60Hz) DC: 0.9W |
| | 3PDT | AC: 2VA (50Hz), 1.7VA (60Hz) DC: 1.5W |
| | 4PDT | AC: 2.5VA (50Hz), 2VA (60Hz) DC: 1.5W |
| **Insulation Resistance** | | 100MΩ minimum (500V DC megger) |
| **Dielectric Strength** [3] | SPDT | Between live and dead parts: 2,000V AC, 1 minute<br>Between contact and coil: 2,000V AC, 1 minute<br>Between contacts of the same pole: 1,000V AC, 1 minute |
| | DPDT<br>3PDT<br>4PDT | Between live and dead parts: 2,000V AC, 1 minute<br>Between contact and coil: 2,000V AC, 1 minute<br>Between contacts of different poles: 2,000V AC, 1 minute<br>Between contacts of the same pole: 1,000V AC, 1 minute |
| **Operating Frequency** | | Electrical: 1,800 operations/hour maximum<br>Mechanical: 18,000 operations/hour maximum |
| **Vibration Resistance** | | Damage limits: 10 to 55Hz, amplitude 0.5 mm<br>Operating extremes: 10 to 55Hz, amplitude 0.5 mm |
| **Shock Resistance** | | Damage limits: 1,000m/s² (100G)<br>Operating extremes: 200m/s² (20G - SPDT, DPDT)<br>100m/s² (10G - 3PDT, 4PDT) |
| **Mechanical Life** | | 50,000,000 operations minimum |
| **Electrical Life** | DPDT | 500,000 operations minimum (120V AC, 10A) |
| | SPDT<br>3PDT<br>4PDT | 200,000 operations minimum (120V AC, 10A) |
| **Operating Temperature** [4] | SPDT | –25 to +50°C (no freezing) |
| | DPDT<br>3PDT<br>4PDT | –25 to +40°C (no freezing) |
| Operating Humidity | | 45 to 85% RH (no condensation) |
| Weight (approx.) | | SPDT: 24g, DPDT: 37g, 3PDT: 50g, 4PDT: 74g |

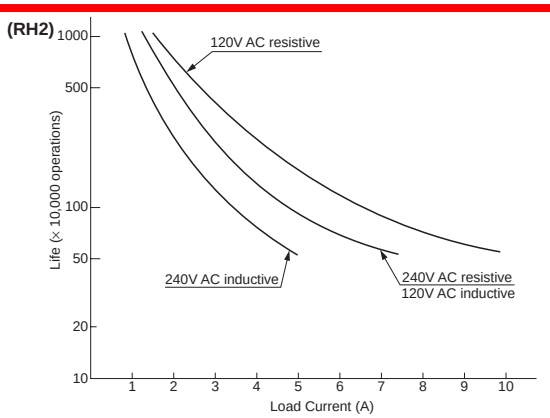
Note: Above values are initial values.
1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
   Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000V AC, 1 minute
4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is –25 to +40°C.

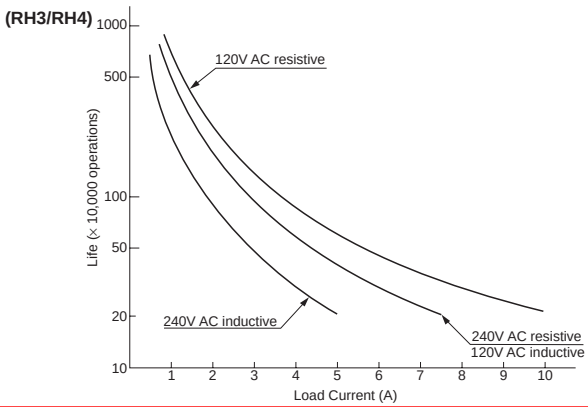
# Characteristics (Reference Data)

## Electrical Life Curves

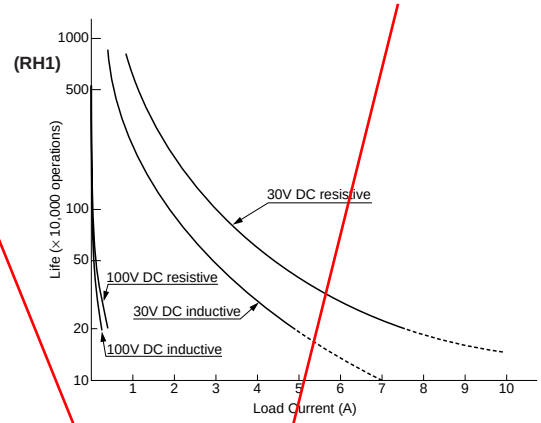
### AC Load

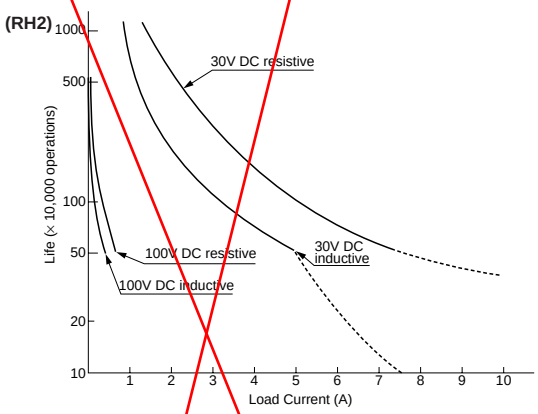


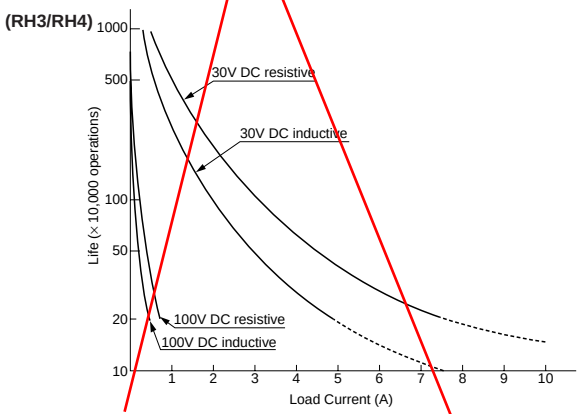



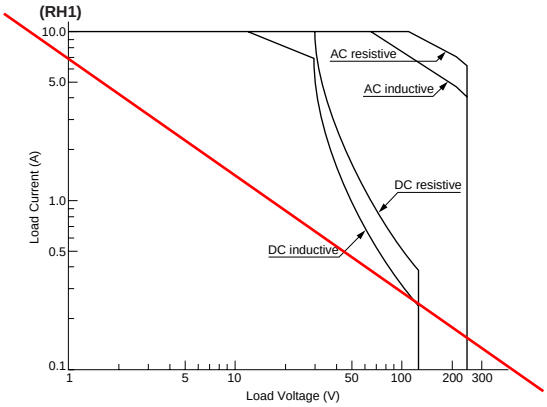

### DC Load

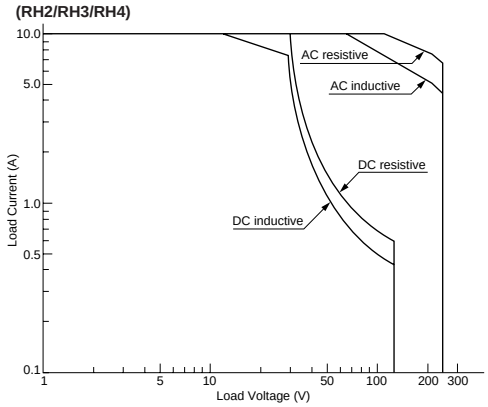


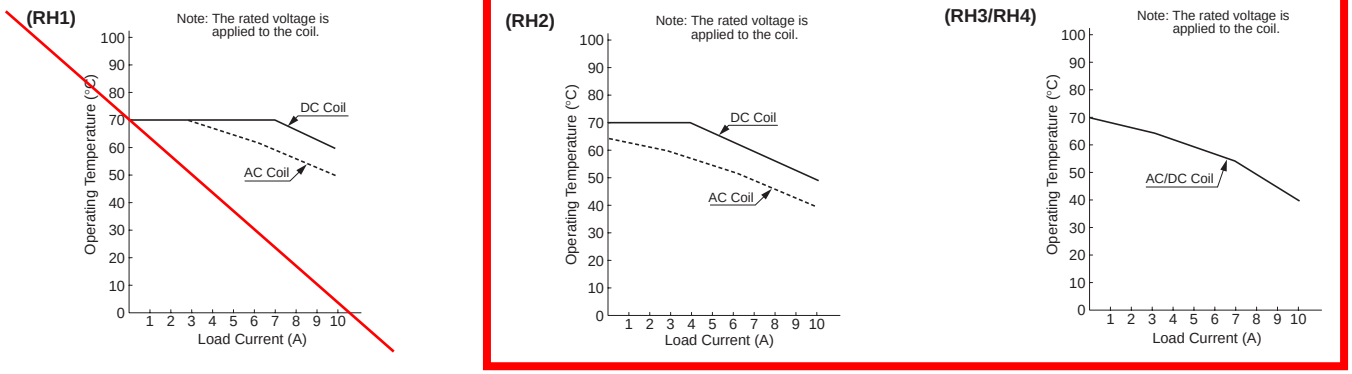




## Maximum Switching Capacity



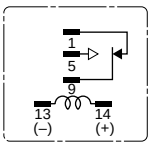
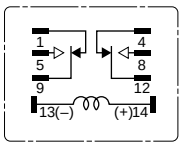
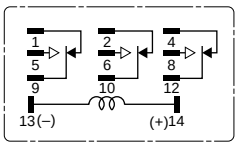
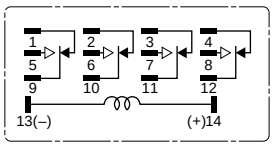
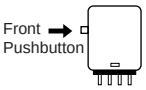



## Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)



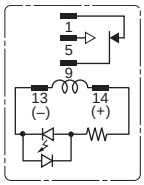
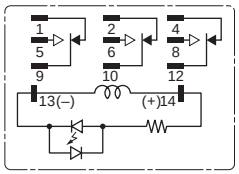
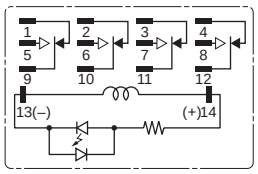
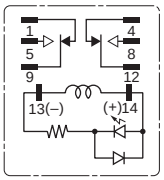
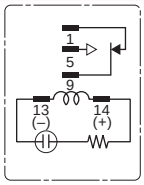
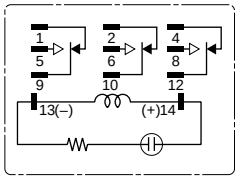
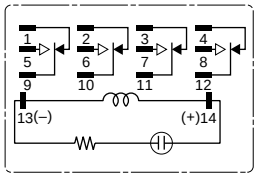
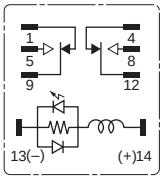

## Internal Connection (View from Bottom)

### Basic Type

| SPDT | DPDT | 3PDT | 4PDT | With Check Button |
|---|---|---|---|---|
|  |  |  |  |  Contacts can be operated by pressing the check button. |



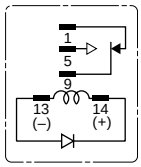
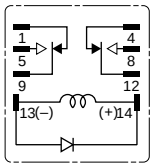
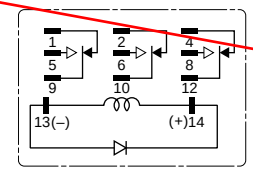
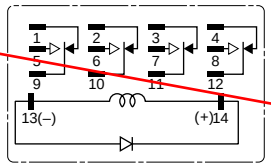
### With Indicator (-L type)

| | SPDT | 3PDT | 4PDT | DPDT |
|---|---|---|---|---|
| Below 100V AC/DC |  |  |  |  |
| 100V AC/DC and over |  |  |  |  |

| Below 24V AC/DC | 24V AC/DC and over |
|---|---|

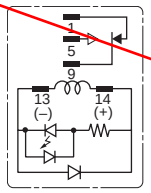
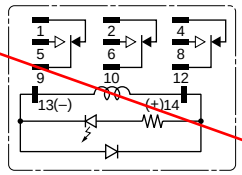
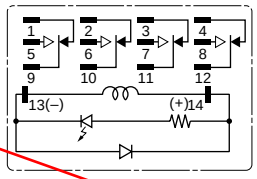
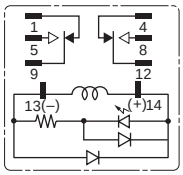
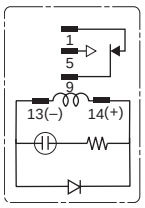
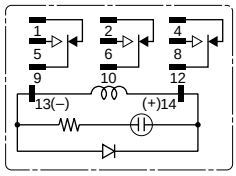
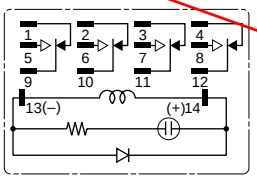
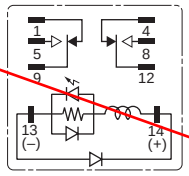
When the relay is energized, the indicator goes on.
- Relay coils less than 100V DC do not contain a protection diode (except DPDT).
- Relay coils below 100V use LED indicator, coils above 100V use neon lamp indicator.

### With Diode (-D type)

| SPDT | DPDT | 3PDT | 4PDT |
|---|---|---|---|
|  |  |  |  |

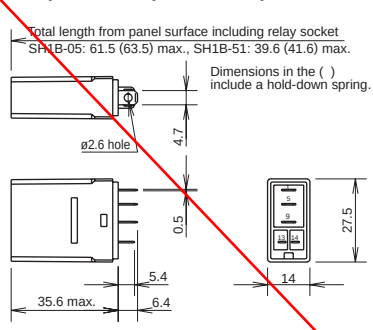
Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC coil only.
- Diode Characteristics
  Reverse withstand voltage: 1,000V
  Forward current: 1A

## With Indicator LED & Diode (-LD type)

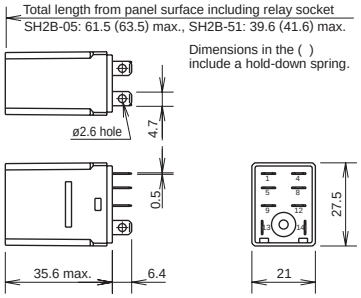
| | SPDT | 3PDT | 4PDT | | DPDT | |
|---|---|---|---|---|---|---|
| Below 100V DC |  |  |  | Below 24V AC/DC |  | Contains an LED indicator and a surge absorber, and has the same height as the basic type. |
| 100V DC and over |  |  |  | 24V AC/DC and over |  | |

## Dimensions (mm)

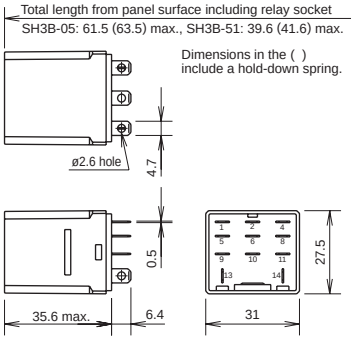
### RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD



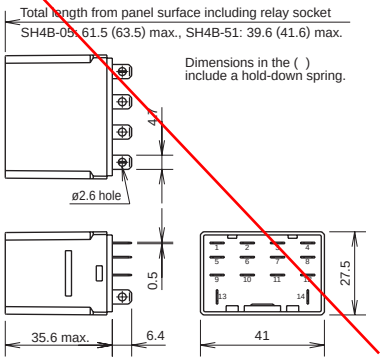

### RH2B-U/RH2B-UL/RH2B-UD/RH2B-ULD



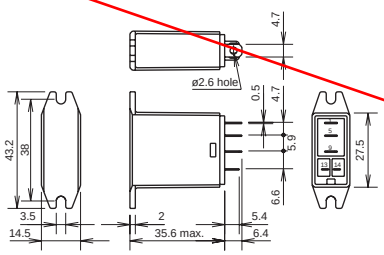

### RH3B-U/RH3B-UL/RH3B-D/RH3B-LD



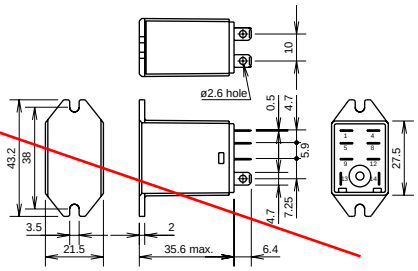

### RH4B-U/RH4B-UL/RH4B-UD/RH4B-LD



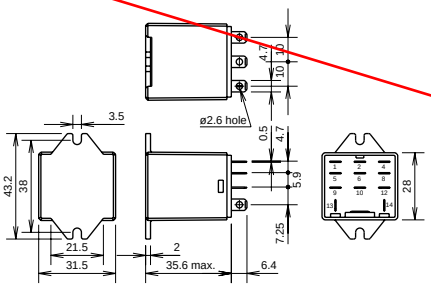

### RH1B-UT



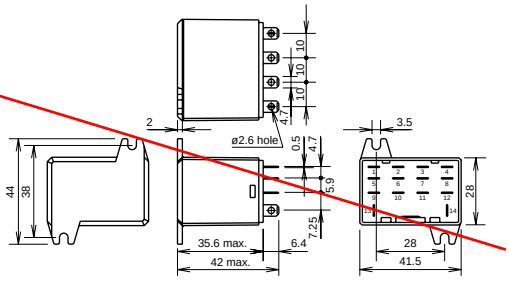

### RH2B-UT




### RH3B-UT

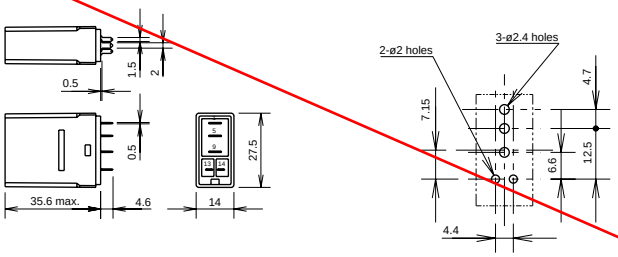



### RH4B-UT

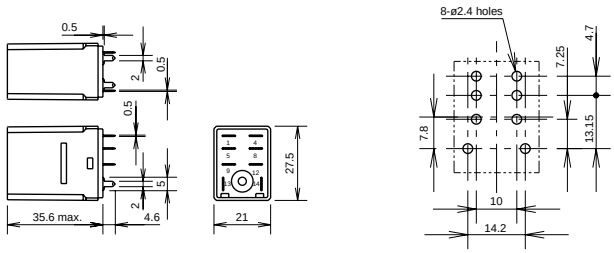


## Dimensions con't (mm)

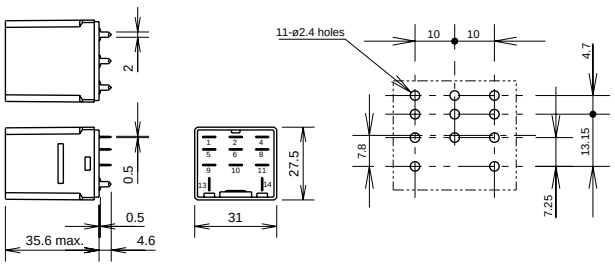
### RH1V2-U/RH1V2-UD




### RH2V2-U/RH2V2-UL/RH2V2-UD




### RH3V2-U/RH3V2-UL/RH3V2-D

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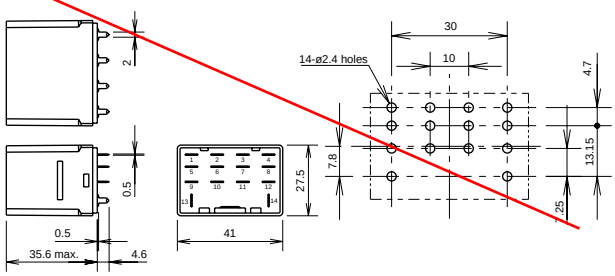
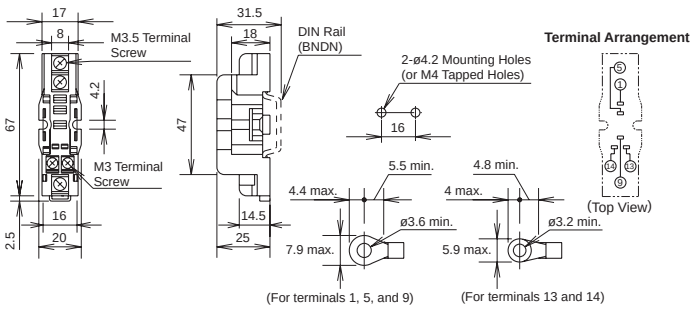
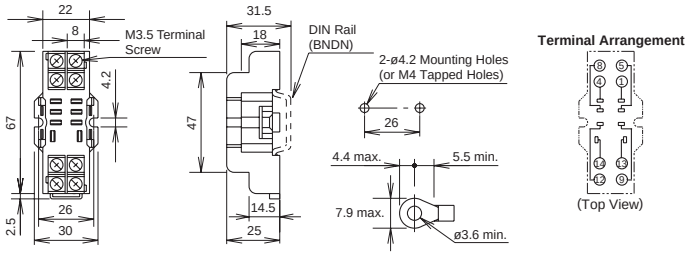



## Standard DIN Rail Mount Sockets

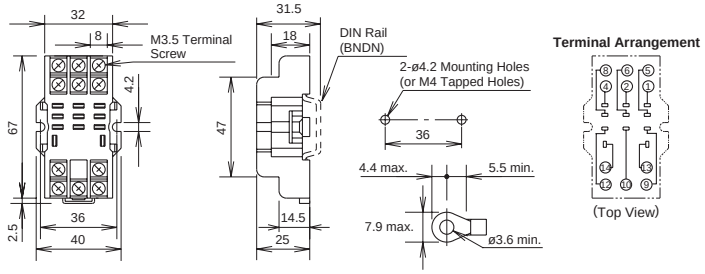
### SH1B-05



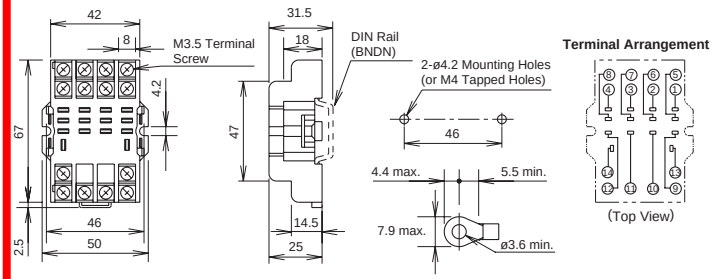

### SH2B-05




### SH3B-05




### SH4B-05

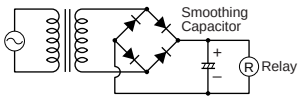


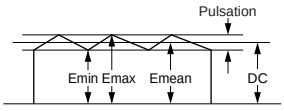
# Operating Instructions

## Driving Circuit for Relays

1. To ensure correct relay operation, apply rated voltage to the relay coil.

2. Input voltage for the DC coil:
   A complete DC voltage is best for the coil power to make sure of stable relay operation. When using a power supply containing a ripple voltage, suppress the ripple factor within 5%. When power is supplied through a rectification circuit, the relay operating characteristics, such as pickup voltage and dropout voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.



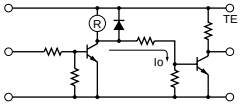




$$\text{Ripple Factor (\%)} \quad \frac{\text{Emax} - \text{Emin}}{\text{Emean}} \times 100\%$$

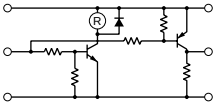
Emax = Maximum of pulsating current
Emin = Minimum of pulsating current
Emean = DC mean value

3. Leakage current while relay is off:
   When driving an element at the same time as the relay operation, special consideration is needed for the circuit design. As shown in the incorrect circuit below, leakage current (Io) flows through the relay coil while the relay is off. Leakage current causes coil release failure or adversely affects the vibration resistance and shock resistance. Design a circuit as shown in the correct example.

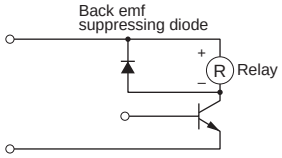
**Incorrect**




**Correct**



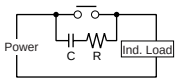
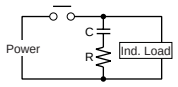
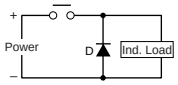
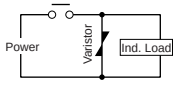

4. Surge suppression for transistor driving circuits:
   When the relay coil is turned off, a high-voltage pulse is generated, causing a transistor to deteriorate and sometimes to break. Be sure to connect a diode to suppress the back electromotive force. Then, the coil release time becomes slightly longer. To shorten the coil release time, connect a Zener diode between the collector and emitter of the transistor. Select a Zener diode with a Zener voltage slightly higher than the power voltage.



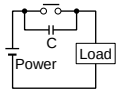
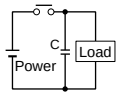

## Protection for Relay Contacts

1. The contact ratings show maximum values. Make sure that these values are not exceeded. When an inrush current flows through the load, the contact may become welded. If this is the case, connect a contact protection circuit, such as a current limiting resistor.

2. Contact protection circuit:
   When switching an inductive load, arcing causes carbides to form on the contacts, resulting in increased contact resistance. In consideration of contact reliability, contact life, and noise suppression, use of a surge absorbing circuit is recommended. Note that the release time of the load becomes slightly longer. Check the operation using the actual load. Incorrect use of a contact protection circuit will adversely affect switching characteristics. Four typical examples of contact protection circuits are shown in the following table:

| | | |
|---|---|---|
| RC |  | This protection circuit can be used when the load impedance is smaller than the RC impedance in an AC load power circuit.<br>• R: Resistor of approximately the same resistance value as the load<br>• C:0.1 to 1 µF |
| |  | This protection circuit can be used for both AC and DC load power circuits.<br>R: Resistor of approximately the same resistance value as the load<br>C: 0.1 to 1 µF |
| Diode |  | This protection circuit can be used for DC load power circuits. Use a diode with the following ratings.<br>Reverse withstand voltage: Power voltage of the load circuit x 10<br>Forward current: More than the load current |
| Varistor |  | This protection circuit can be used for both AC and DC load power circuits.<br>For a best result, when using a power voltage of 24 to 48V AC/DC, connect a varistor across the load.<br>When using a power voltage of 100 to 240V AC/DC, connect a varistor across the contacts. |

3. Do not use a contact protection circuit as shown below:

| | |
|---|---|
|  | This protection circuit is very effective in arc suppression when opening the contacts. But, the capacitor is charged while the contacts are opened. When the contacts are closed, the capacitor is discharged through the contacts, increasing the possibility of contact welding. |
|  | This protection circuit is very effective in arc suppression when opening the contacts. But, when the contacts are closed, a current flows to charge the capacitor, causing contact welding. |

Generally, switching a DC inductive load is more difficult than switching a DC resistive load. Using an appropriate arc suppressor, however, will improve the switching characteristics of a DC inductive load.

## Soldering

1. When soldering the relay terminals, use a soldering iron of 30 to 60W, and quickly complete soldering (within approximately 3 seconds).

2. Use a non-corrosive rosin flux.

## Operating Instructions con't

### Other Precautions

1. General notice:
   To maintain the initial characteristics, do not drop or shock the relay.

   The relay cover cannot be removed from the base during normal operation. To maintain the initial characteristics, do not remove the relay cover.

   Use the relay in environments free from condensation, dust, sulfur dioxide ($SO_2$), and hydrogen sulfide ($H_2S$).

   Make sure that the coil voltage does not exceed applicable coil voltage range.

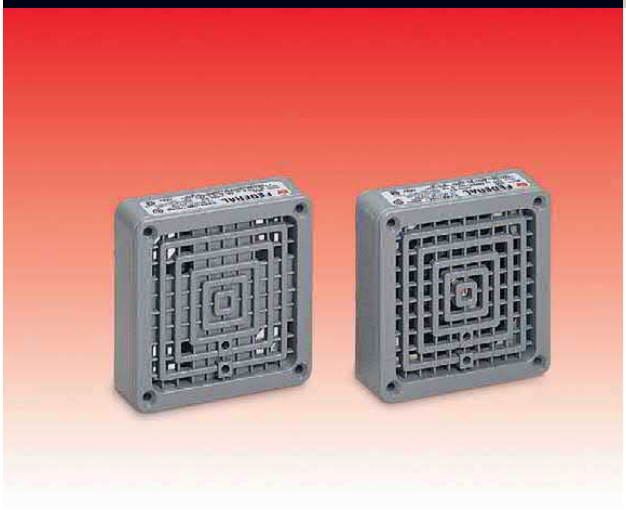
2. UL and CSA ratings may differ from product rated values determined by IDEC.
3. Do not use relays in the vicinity of strong magnetic field, as this may affect relay operation.

## Safety Precautions

- Turn off the power to the relay before starting installation, removal, wiring, maintenance, and inspection of the relays. Failure to turn power off may cause electrical shock or fire hazard.
- Observe specifications and rated values, otherwise electrical shock or fire hazard may be caused.
- Use wires of the proper size to meet voltage and current requirements. Tighten the terminal screws on the relay socket to the proper tightening torque.
- Surge absorbing elements on AC relays with RC or DC relays with diode are provided to absorb the back electromotive force generated by the coil. When the relay is subject to an excessive external surge voltage, the surge absorbing element may be damaged. Add another surge absorbing provision to the relay to prevent damage.

### Precautions for the RU Relays

- Before operating the latching lever of the RU relay, turn off the power to the RU relay. After checking the circuit, return the latching lever to the original position.
- Do not use the latching lever as a switch. The durability of the latching lever is a minimum of 100 operations.
- When using DC loads on 4PDT relays, apply a positive voltage to terminals of neighboring poles and a negative voltage to the other terminals of neighboring poles to prevent the possibility of short circuits.
- DC relays with a diode have a polarity in the coil terminals. Apply the DC voltage to the correct terminals.



# Vibratone® Horns

## Models 350 and 450

The Models 350 and 450 Vibratone Horns produce a very loud horn tone by the electro-mechanical vibration of a diaphragm. Capable of reproducing coded blasts or sustained tones through the use of a number of control devices from a push button to a PLC. Federal Signal's Vibratone horn is excellent for general alarm, start and dismissal, coded paging, and process control signaling in areas of high ambient noise levels.

The Vibratone Model 350 is available in AC voltages; 12VAC, 24VAC, 120VAC and 240VAC. The Model 350 produces 100dBa @ 10', except the 12VAC model, which produces 94dBa @ 10'.

The Model 450 is available in DC voltages; 12VDC, 24VDC, 125VDC and 250VDC. The Model 450 produces 99dBa @ 10'.

Vibratone mounting options provide for surface, flush or semi-flush mounting on walls, panels, in cabinets, on 4-inch square outlet boxes, or in concrete and deep wall constructions.

Installed on the front of a Vibratone Horn, the optional Model PR Projector or Model PR2 Double Projector direct sound output straight ahead or to the sides, optimizing sound output for long, narrow rooms or corridors.

Vibratone horns are UL and cUL Listed, CSA Certified and FM Approved. They are designed and approved for use in Type 4X applications when installed with the Panel Mount Gasket Kit or Weatherproof Backbox (Model WB). They are approved for Type 4X and Type 12 applications when installed with the Surface Mount Trim Ring (Model TR, illustrated on page 124).

Each Vibratone horn is enclosed in a zinc die-cast housing and sealed with grey powder-coat paint. The Model 350 features a stainless steel diaphragm. The Model 450 utilizes an aluminum diaphragm and heavy duty contacts. The rugged construction of the Vibratone horns resists vandalism and the effects of harsh industrial environments.

Compact size, loud output and heavy-duty construction make the VibraTone horns ideal for industrial and institutional signaling applications.

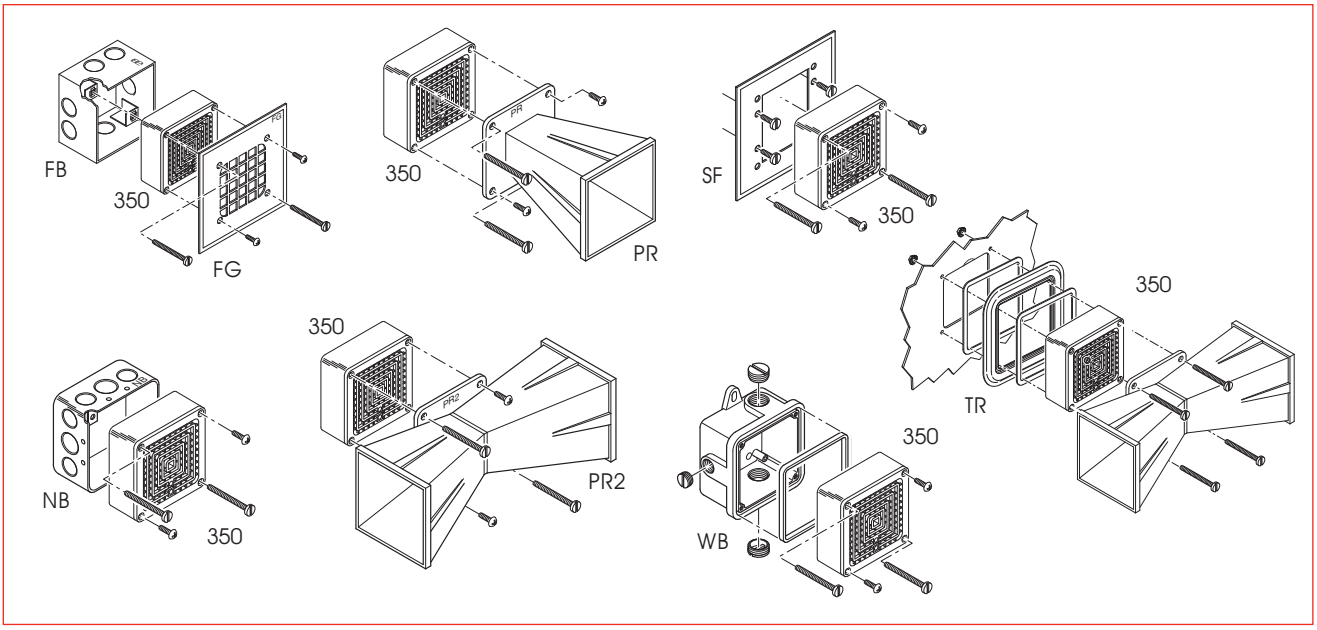
## DESIGNED FOR ROUTINE SIGNALING

- Range of up to 200 feet
- Coded or sustained tones
- Model 350 – 12, 24, 120 and 240VAC; Model 450 – 12, 24, 125 and 250VDC
- Model 350 produces 100dBa at 10'
- Model 450 produces 99dBa at 10'
- Type 4X when installed with Panel Mount Gasket Kit or Weatherproof Backbox (Model WB); Type 4X and Type 12 when installed with Surface Mount Trim Ring (Model TR)
- UL and cUL Listed, CSA Certified and FM Approved

| Model | Voltage | Operating Current | Decibels @ 10' | 1m |
|---|---|---|---|---|
| **350** | 12VAC 50/60Hz | 0.90 amps | 94 | 104 |
| **350** | 24VAC 50/60Hz | 0.90 amps | 100 | 110 |
| **350** | 120VAC 50/60Hz | 0.18 amps | 100 | 110 |
| **350** | 240VAC 50/60Hz | 0.09 amps | 100 | 110 |
| **450** | 12VDC | 0.50 amps | 99 | 109 |
| **450** | 24VDC | 0.25 amps | 99 | 109 |
| **450** | 125VDC | 0.05 amps | 99 | 109 |
| **450** | 250VDC | 0.03 amps | 99 | 109 |

5yr FEDERAL SIGNAL WARRANTY

## VIBRATONE® HORNS (350/450)




## OPTIONS

| | |
|---|---|
| **FB** | Wall box for flush mounting the Vibratone® horn in stud, 4" block, or other shallow wall construction; 4 3/8" square box; 2 7/8" deep; shipping weight 2 lbs. (0.91 kg) |
| **FBL** | Same as FB, but 3 13/16" deep for 6" x 8" concrete block, cinder block or other deep wall construction; shipping wt. 3 lbs. (1.36 kg) |
| **FG** | Flush grille which attaches to the basic unit and serves as the cover of the plastered-in FB flush box; 8" H x 8" W x 1/8" D; shipping wt. 1 lb. (0.45 kg) |
| **K8435666A** | Optional Panel Mounting Gasket Kit includes a gasket and hardware for surface or flush mounting the horn for NEMA Type 4 applications. |
| **NB** | 4" square box with 1/2" & 3/4" knockouts for interior mountings; 1 1/2" deep; shipping weight 1 lb. (0.45 kg) |
| **PR** | Projector which concentrates sound into a basic area when attached to the basic model 350/450 units; 4" H x 4" W x 6" D; shipping weight 1 lb. (0.45 kg) |
| **PR2** | Double projector directs sounds to both sides when attached to the basic model 350/450 units; ideal for use in hallways; 4" H x 11 1/2" W x 4" D; shipping weight 2 lbs. (0,91 kg) |
| **SF** | Stamped surface plate used for installations on plastered-in 4" outlet switch boxes for semi-flush mountings; 6"H x 6" W x 1/2" D; shipping weight 1 lb. (0.45 kg) |
| **TR** | Gasketed trim ring allowing surface mount installations of 350/450 units while maintaining Type12 and Type4X rating of enclosure. |
| **WB** | Cast aluminum neoprene-gasketed weatherproof housing for outside use, complete with mounting lugs; tapped for 1/2", 3/4" conduit; 4 3/8" square box; 2" deep mounting lugs on 4 1/2" centers; shipping weight 1 lb. (0.45 kg) |

## SPECIFICATIONS

| | | |
|---|---|---|
| Operating Temperature: | -65°F to 150°F | -54°C to 66°C |
| Net Weight: | 1.4 lbs. | 0.6 kg |
| Shipping Weight: | 1.5 lbs. | 0.7 kg |
| Height: | 4.0" | 102.0 mm |
| Width: | 4.0" | 102.0 mm |
| Depth: | 2.5" | 64.0 mm |

## HOW TO ORDER

- Specify model and voltage
- Specify options from list
- Please refer to Model Number Index 350/450 beginning on page 377

## REPLACEMENT PARTS

| ***Description*** | ***Part Number*** |
|---|---|
| Panel Mount Gasket Kit | K8435666A |
| Coil (120VAC only) | KFC1516C |
| Volume Control Kit | K8435663B |
| Gasket for WB | K8435696A |

# Feed-through terminal block - UT 4 - 3044102

Please be informed that the data shown in this PDF Document is generated from our Online Catalog. Please find the complete data in the user's documentation. Our General Terms of Use for Downloads are valid (http://phoenixcontact.com/download)

Feed-through terminal block, connection method: Screw connection, number of connections: 2, cross section:0.14 mm² - 6 mm², AWG: 26 - 10, width: 6.2 mm, height: 46.9 mm, color: gray, mounting type: NS 35/7,5, NS 35/15

## Why buy this product

- The large wiring space enables the connection of solid and stranded conductors without ferrules, even above the nominal cross section
- As well as saving space, the compact design enables user-friendly wiring in a small amount of space
- Optimum screwdriver guidance through closed screw shafts
- Tested for railway applications
- The cable entry funnel enables the use of conductors with ferrules and plastic collars within the nominal cross section

## Key Commercial Data

| | |
|---|---|
| Packing unit | 1 STK |
| Minimum order quantity | 50 STK |
| GTIN | 4 017918 960391 |
| GTIN | 4017918960391 |
| Weight per Piece (excluding packing) | 9.600 g |
| Custom tariff number | 85369010 |
| Country of origin | Germany |

## Technical data

### General

| | |
|---|---|
| Number of levels | 1 |
| Number of connections | 2 |
| Potentials | 1 |

# Feed-through terminal block - UT 4 - 3044102

## Technical data

### General

| | |
|---|---|
| Nominal cross section | 4 mm² |
| Color | gray |
| Insulating material | PA |
| Flammability rating according to UL 94 | V0 |
| Area of application | Railway industry |
| | Machine building |
| | Plant engineering |
| | Process industry |
| Rated surge voltage | 8 kV |
| Degree of pollution | 3 |
| Overvoltage category | III |
| Insulating material group | I |
| Maximum power dissipation for nominal condition | 1.02 W |
| Maximum load current | 41 A (with 6 mm² conductor cross section) |
| Nominal current $I_N$ | 32 A (with 4 mm² conductor cross section) |
| Nominal voltage $U_N$ | 1000 V |
| Open side panel | Yes |
| Shock protection test specification | DIN EN 50274 (VDE 0660-514):2002-11 |
| Back of the hand protection | guaranteed |
| Finger protection | guaranteed |
| Result of surge voltage test | Test passed |
| Surge voltage test setpoint | 9.8 kV |
| Result of power-frequency withstand voltage test | Test passed |
| Power frequency withstand voltage setpoint | 2.2 kV |
| Result of the test for mechanical stability of terminal points (5 x conductor connection) | Test passed |
| Result of bending test | Test passed |
| Bending test rotation speed | 10 rpm |
| Bending test turns | 135 |
| Bending test conductor cross section/weight | 0.14 mm² / 0.2 kg |
| | 4 mm² / 0.9 kg |
| | 6 $mm^2$ / 1.4 kg |
| Tensile test result | Test passed |
| Conductor cross section tensile test | 0.14 mm² |
| Tractive force setpoint | 10 N |
| Conductor cross section tensile test | 4 mm² |
| Tractive force setpoint | 60 N |

# Feed-through terminal block - UT 4 - 3044102

## Technical data

### General

| | |
|---|---|
| Conductor cross section tensile test | 6 mm² |
| Tractive force setpoint | 80 N |
| Result of tight fit on support | Test passed |
| Tight fit on carrier | NS 35 |
| Setpoint | 1 N |
| Result of voltage-drop test | Test passed |
| Requirements, voltage drop | ≤ 3.2 mV |
| Result of temperature-rise test | Test passed |
| Short circuit stability result | Test passed |
| Conductor cross section short circuit testing | 4 mm² |
| Short-time current | 0.48 kA |
| Conductor cross section short circuit testing | 6 mm² |
| Short-time current | 0.72 kA |
| Result of thermal test | Test passed |
| Proof of thermal characteristics (needle flame) effective duration | 30 s |
| Oscillation, broadband noise test result | Test passed |
| Test specification, oscillation, broadband noise | DIN EN 50155 (VDE 0115-200):2008-03 |
| Test spectrum | Service life test category 1, class B, body mounted |
| Test frequency | $f_1$ = 5 Hz to $f_2$ = 150 Hz |
| ASD level | 1.857 $(m/s^2)^2/Hz$ |
| Acceleration | 0,8 g |
| Test duration per axis | 5 h |
| Test directions | X-, Y- and Z-axis |
| Shock test result | Test passed |
| Test specification, shock test | DIN EN 50155 (VDE 0115-200):2008-03 |
| Shock form | Half-sine |
| Acceleration | 5 g |
| Shock duration | 30 ms |
| Number of shocks per direction | 3 |
| Test directions | X-, Y- and Z-axis (pos. and neg.) |
| Relative insulation material temperature index (Elec., UL 746 B) | 130 °C |
| Temperature index of insulation material (DIN EN 60216-1 (VDE 0304-21)) | 125 °C |
| Static insulating material application in cold | -60 °C |
| Behavior in fire for rail vehicles (DIN 5510-2) | Test passed |
| Flame test method (DIN EN 60695-11-10) | V0 |
| Oxygen index (DIN EN ISO 4589-2) | >32 % |
| NF F16-101, NF F10-102 Class I | 2 |

# Feed-through terminal block - UT 4 - 3044102

## Technical data

### General

| | |
|---|---|
| NF F16-101, NF F10-102 Class F | 2 |
| Surface flammability NFPA 130 (ASTM E 162) | passed |
| Specific optical density of smoke NFPA 130 (ASTM E 662) | passed |
| Smoke gas toxicity NFPA 130 (SMP 800C) | passed |
| Calorimetric heat release NFPA 130 (ASTM E 1354) | 27,5 MJ/kg |
| Fire protection for rail vehicles (DIN EN 45545-2) R22 | HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R23 | HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R24 | HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R26 | HL 1 - HL 3 |

### Dimensions

| | |
|---|---|
| Width | 6.2 mm |
| End cover width | 2.2 mm |
| Length | 47.7 mm |
| Height | 46.9 mm |
| Height NS 35/7,5 | 47.5 mm |
| Height NS 35/15 | 55 mm |

### Connection data

| | |
|---|---|
| Connection method | Screw connection |
| Connection in acc. with standard | IEC 60947-7-1 |
| Note | Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area. |
| Conductor cross section solid min. | 0.14 mm² |
| Conductor cross section solid max. | 6 mm² |
| Conductor cross section AWG min. | 26 |
| Conductor cross section AWG max. | 10 |
| Conductor cross section flexible min. | 0.14 mm² |
| Conductor cross section flexible max. | 6 mm² |
| Min. AWG conductor cross section, flexible | 26 |
| Max. AWG conductor cross section, flexible | 10 |
| Conductor cross section flexible, with ferrule without plastic sleeve min. | 0.14 mm² |
| Conductor cross section flexible, with ferrule without plastic sleeve max. | 4 mm² |
| Conductor cross section flexible, with ferrule with plastic sleeve min. | 0.14 mm² |
| Conductor cross section flexible, with ferrule with plastic sleeve max. | 4 mm² |
| 2 conductors with same cross section, solid min. | 0.14 mm² |
| 2 conductors with same cross section, solid max. | 1.5 mm² |
| 2 conductors with same cross section, stranded min. | 0.14 mm² |
| 2 conductors with same cross section, stranded max. | 1.5 mm² |

# Feed-through terminal block - UT 4 - 3044102

## Technical data

### Connection data

| | |
|---|---|
| 2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min. | 0.5 mm² |
| 2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max. | 2.5 mm² |
| 2 conductors with same cross section, stranded, ferrules without plastic sleeve, min. | 0.14 mm² |
| 2 conductors with same cross section, stranded, ferrules without plastic sleeve, max. | 1.5 mm² |
| Connection in acc. with standard | IEC/EN 60079-7 |
| Conductor cross section solid min. | 0.14 mm² |
| Conductor cross section solid max. | 6 mm² |
| Conductor cross section AWG min. | 26 |
| Conductor cross section AWG max. | 10 |
| Conductor cross section flexible min. | 0.14 mm² |
| Conductor cross section flexible max. | 4 mm² |
| Stripping length | 9 mm |
| Internal cylindrical gage | A4 |
| Screw thread | M3 |
| Tightening torque, min | 0.6 Nm |
| Tightening torque max | 0.8 Nm |

### Standards and Regulations

| | |
|---|---|
| Connection in acc. with standard | CSA |
| | IEC 60947-7-1 |
| Flammability rating according to UL 94 | V0 |
| Fire protection for rail vehicles (DIN EN 45545-2) R22 | HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R23 | HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R24 | HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 |
| Fire protection for rail vehicles (DIN EN 45545-2) R26 | HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 HL 1 - HL 3 |

### Environmental Product Compliance

| | |
|---|---|
| China RoHS | Environmentally Friendly Use Period = 50 |
| | For details about hazardous substances go to tab “Downloads”, Category “Manufacturer's declaration” |

## Drawings

Circuit diagram

Extract from the online catalog

# SFP 1-20/120AC

Order No.: 2856702

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2856702

DIN rail module with device surge protection type 3 and mains suppression filter against high-frequency interference voltages. Integrated power display switches off automatically when there is a malfunction due to overload. Mounting on NS 35.

| Commercial data | |
|---|---|
| EAN | 4017918952648 |
| sales group | J041 |
| Pack | 1 pcs. |
| Customs tariff | 85363010 |
| Weight/Piece | 0.6275 KG |
| Catalog page information | Page 46 (TT-2007) |

Product notes

WEEE/RoHS-compliant since: 07/14/2006

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

## Product description

Device protection with interference filter

## Technical data

### Standards

| | |
|---|---|
| Housing material | ABS, V0(UL-94) |
| Inflammability class acc. to UL 94 | V0 |
| Color | aluminum |
| Standards for air and creepage distances | DIN VDE 0110-1 |
| | IEC 60664-1: 1992-10 |
| | IEC 61643-1 |
| Surge voltage category | III |
| Pollution degree | 2 |
| Degree of protection | IP20 |
| Design | Rail-mountable module, one-piece |
| Mounting type | DIN rail 35 mm |
| Number of positions | 2 |
| Ambient temperature (operation) | -40 °C ... 85 °C |
| For country-specific use in | USA, CN, BR |
| Direction of action | L-N & L(N)-PE |
| Width | 112.00 mm |
| Height | 79.00 mm |
| Length | 93.00 mm |

### Protective circuit

| | |
|---|---|
| IEC category | III |
| EN type | T3 |
| Nominal voltage $U_N$ | 120 V AC |
| Arrester rated voltage $U_C$ (L-N) | 200 V DC |
| | 150 V AC |
| Arrester rated voltage $U_C$ (L-PE) | 200 V DC |
| | 150 V AC |
| Nominal frequency $f_N$ | 50 Hz |
| | 60 Hz |
| Nominal current $I_N$ | 20 A (≤ 40°C) |
| Operating effective current $I_C$ at $U_C$ | ≤ 10 mA |
| Discharge current to PE at $U_C$ | ≤ 0.5 mA |
| Nominal discharge surge current $I_n$ (8/20) µs (L-N) | 3 kA |

| | |
|---|---|
| Nominal discharge surge current In (8/20) µs (L-PE) | 3 kA |
| Max. discharge surge current Imax (8/20) µs maximum (L-N) | 10 kA |
| Max. discharge surge current Imax (8/20) µs maximum (L-PE) | 10 kA |
| Combined surge $U_{OC}$ | 6 kV (3 kA) |
| Energy absorption symmetrical | 170 J |
| Enery absorption, asymmetrical | 2x 170 J |
| Protection level $U_P$ (L-N) | ≤ 450 V (at 6 kV/3 kA) |
| Protection level $U_P$ (L-PE) | ≤ 450 V (at 6 kV/3 kA) |
| Protection level $U_P$ (N-PE) | ≤ 450 V (at 6 kV/3 kA) |
| Residual voltage at In, (L-N) | ≤ 450 V |
| Residual voltage at In, (L-PE) | ≤ 450 V |
| Residual voltage at In, (N-PE) | ≤ 450 V |
| Clamping voltage SVR (L-N) | ≤ 400 V (at 6 kV/500 A) |
| Clamping voltage SVR (L-PE) | ≤ 400 V (at 6 kV/500 A) |
| Response time tA (L-N) | ≤ 25 ns |
| Response time tA (L-PE) | ≤ 25 ns |
| Response time tA (N-PE) | ≤ 25 ns |
| Inductivity in series | 2x 1 mH ±30 % (with current compensation) |
| Capacity (L-N) | 2 µF ±10 % (X2, FOW X2-250V) |
| Capacity (L-PE) | 2.2 nF ±20 % (Y, FOW X2-250V) |
| Capacity (L-PEN) | 2.2 nF ±20 % (Y, FOW X2-250V) |
| Max. required back-up fuse | 20 A (gL / gG) |
| Input attenuation aE, sym. | 40 dB (≥ 500 kHz / 50 Ω) |
| Input attenuation aE, asym. | 30 dB (≥ 1 MHz / 50 Ω) |
| Message surge protection faulty | Remote indicator contact |

**Non-heating apparatus connection, power supply**

| | |
|---|---|
| Connection name | Input/output |
| Type of connection | Screw terminal blocks |
| Connection type IN | Screw terminal blocks |
| Connection type OUT | Screw terminal blocks |
| Connection method | 3-conductor (shielded) |
| Screw thread | M3 |
| Tightening torque | 0.5 Nm |

| | |
|---|---|
| Conductor cross section stranded min. | 0.2 mm² |
| Conductor cross section stranded max. | 4 mm² |
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 6 mm² |
| Conductor cross section AWG/kcmil min. | 24 |
| Conductor cross section AWG/kcmil max | 10 |

**Remote indicator contact**

| | |
|---|---|
| Connection name | Remote fault indicator contact |
| Switching function | PDT contact |
| Type of connection | Pluggable screw connection |
| Screw thread | M2 |
| Tightening torque | 0.25 Nm |
| Conductor cross section stranded min. | 0.14 mm² |
| Conductor cross section stranded max. | 1.5 mm² |
| Conductor cross section solid min. | 0.14 mm² |
| Conductor cross section solid max. | 1.5 mm² |
| Conductor cross section AWG/kcmil min. | 28 |
| Conductor cross section AWG/kcmil max | 16 |
| Maximum operating voltage $U_{max.}$ AC | 250 V AC |
| Maximum operating voltage $U_{max}$ DC | 300 V DC |
| Max. operating current $I_{max}$ | 1 A (for 48 V DC) |
| | 1 A (for 250 V AC) |
| | 0.25 A (For 250 V DC) |
| Min. permissible switching capacity | (1.00 A / 48 V DC) |
| | (100 mA/ 12 V AC) |
| Switching capacity max. perm. | (0.25 A / 250 V DC) |
| | (1.0 A / 48 V AC) |

**Connection, protective circuit**

| | |
|---|---|
| Standards/regulations | IEC 61643-1 |
| | IEC 61643-11 |
| | UL 1449 |
| | UL 1283 |

**Protective circuit, filter**

| | |
|---|---|
| Discharge resistor | ≤ 390 kΩ |

| | |
|---|---|
| Clamping voltage ringwave (L-N) | 100 V (category A 100 kHz 6 kV/200 A) |
| | 195 V (category B 100 kHz 6 kV/500 A) |
| Clamping voltage ringwave (L-PE) | 390 V (category A 100 kHz 6 kV/200 A) |
| | 390 V (category B 100 kHz 6 kV/500 A) |

## Certificates / Approvals

| | |
|---|---|
| Certification | CSA, CUL, GOST, UCSA, UL |

**CUL**

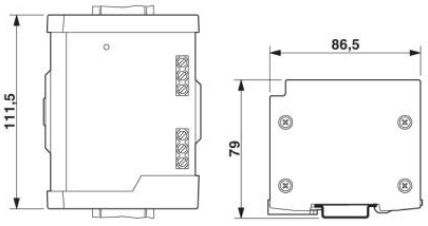
| | |
|---|---|
| Nominal voltage $U_N$ | 120 V |
| Nominal current $I_N$ | 20 A |
| AWG/kcmil | 12-10 |

**UL**

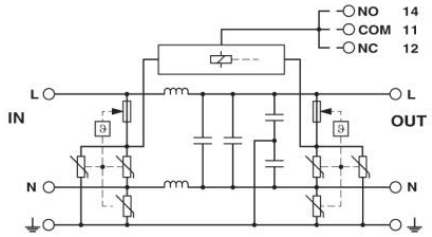
| | |
|---|---|
| Nominal voltage $U_N$ | 120 V |
| Nominal current $I_N$ | 20 A |
| AWG/kcmil | 12-10 |

## Diagrams/Drawings

Dimensioned drawing



Circuit diagram



## Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

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**Extract from the online catalog**

# SD-US/SC/LA/GY

Order No.: 2963860

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2963860

Rail-mountable socket, with light indicator, housing color: gray, with screw connection, national version: USA, housing width 45 mm

| Commercial data | |
|---|---|
| GTIN (EAN) | 4017918859138 |
| sales group | H070 |
| Pack | 10 pcs. |
| Customs tariff | 85366990 |
| Weight/Piece | 0.07641 KG |
| Catalog page information | Page 603 (IF-2009) |

Product notes

WEEE/RoHS-compliant since: 07/20/2006

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## Technical data

### General data

| | |
|---|---|
| Nominal voltage $U_N$ | 125 V AC |
| Nominal current $I_N$ | 15000 A AC |
| Status display | Glow lamp or LED with preresistor |

| | |
|---|---|
| Contact material | CuZn37 |
| For country-specific use in | USA |
| Color | gray |
| Insulating material | PA |
| Ambient temperature (operation) | -20 °C ... 60 °C |
| Ambient temperature (storage/transport) | -20 °C ... 60 °C |
| Standards/regulations | IEC 83 |
| | DIN 49440-1 |
| | UL 498 |
| Width | 45 mm |
| Height | 75 mm |
| Depth | 70.5 mm |

**Connection data**

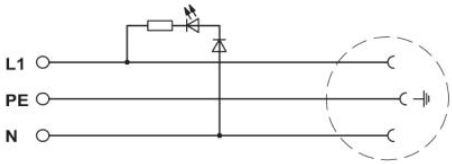
| | |
|---|---|
| Conductor cross section solid min. | 0.2 mm² |
| Conductor cross section solid max. | 4 mm² |
| Conductor cross section stranded min. | 0.2 mm² |
| Conductor cross section stranded max. | 2.5 mm² |
| Conductor cross section AWG/kcmil min. | 30 |
| Conductor cross section AWG/kcmil max | 12 |
| Type of connection | Screw connection |
| Stripping length | 8 mm |
| Screw thread | M3 |

## Certificates / Approvals

| | |
|---|---|
| Certification | CUL Listed, GOST, UL Listed |

## Diagrams/Drawings

Circuit diagram



## Address

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# UNO-PS/1AC/24DC/ 90W/C2LPS

## Primary-switched power supply unit

Data sheet
105950_en_00

© PHOENIX CONTACT 2014-03-14

## 1 Description

**UNO POWER power supply unit - for NEC Class 2 applications**

The UNO POWER power supply unit impresses in worldwide use thanks to maximum energy efficiency. Low no-load losses and the high degree of efficiency save energy.

Thanks to its high power density, the UNO POWER power supply unit is the ideal solution, particularly in compact control boxes.

**Features**

- Worldwide use thanks to input voltage range of 85 V AC ... 264 V AC
- Superior system availability through reliable power supply with 24 V DC
- Maximum energy efficiency thanks to optimized efficiency over the entire operating range of the power supply unit and low no-load losses
- Particularly compact: 90 W of power from this narrow power supply, which is just 55 mm wide
- Output power limited < 100 W according to UL 1310 for NEC Class 2 applications

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

# 3 Ordering data

| Description | Type | Order No. | Pcs. / Pkt. |
|---|---|---|---|
| Primary-switched UNO power supply for DIN rail mounting, input: 2-phase, output: 24 V DC/90 W/C2LPS, for NEC Class 2 applications | UNO-PS/1AC/24DC/ 90W/C2LPS | 2902994 | 1 |

# 4 Technical data

| Input data | |
|---|---|
| Nominal input voltage | 100 V AC ... 240 V AC |
| Input voltage range | 85 V AC ... 264 V AC |
| AC frequency range | 45 Hz ... 65 Hz |
| Current consumption | 1.5 A (120 V AC)<br>1 A (230 V AC) |
| Inrush current limitation | < 40 A (typical) |
| $I^2t$ | < 1.5 $A^2s$ |
| Typical response time | < 1 s |
| Power failure bypass | > 25 ms (120 V AC)<br>> 100 ms (230 V AC) |
| Protective circuit | Transient surge protection Varistor |
| Input fuse, integrated | 3.15 A (slow-blow, internal) |
| Choice of suitable fuses | 6 A ... 16 A (Characteristics B, C, D, K) |

| Input connection data | |
|---|---|
| Connection method | Screw connection |
| Conductor cross section, solid | 0.2 $mm^2$ ... 2.5 $mm^2$ |
| Conductor cross section, stranded | 0.2 $mm^2$ ... 2.5 $mm^2$ |
| Conductor cross section AWG/kcmil | 24 ... 14 |
| Stripping length | 8 mm |
| Screw thread | M3 |
| Tightening torque | 0.5 Nm ... 0.6 Nm |

| Output data | |
|---|---|
| Nominal output voltage | 24 V DC ±1% |
| Output current | 3.75 A (-25°C ... 55°C) |
| Derating | 55 °C ... 70 °C (2.5%/K) |
| Control deviation | < 1 % (change in load, static 10 % ... 90 %)<br>< 3 % (Dynamic load change 10 % ... 90 %, 10 Hz)<br>< 0.1 % (change in input voltage ±10 %) |
| Ascent time | < 0.5 s ($U_{OUT}$ (10 % ... 90 %)) |
| Residual ripple | < 45 $mV_{PP}$ (with nominal values) |
| Connection in parallel | No |
| Connection in series | No |
| Protection against surge voltage on the output | ≤ 35 V DC |
| Resistance to reverse feed | ≤ 35 V DC |

| Output connection data | |
|---|---|
| Connection method | Screw connection |
| Conductor cross section, solid | 0.2 $mm^2$ ... 2.5 $mm^2$ |
| Conductor cross section, stranded | 0.2 $mm^2$ ... 2.5 $mm^2$ |
| Conductor cross section AWG/kcmil | 24 ... 14 |
| Stripping length | 8 mm |
| Screw thread | M3 |
| Tightening torque | 0.5 Nm ... 0.6 Nm |

| Power consumption | |
|---|---|
| Efficiency | > 88.5 % (for 230 V AC and nominal values) |
| Maximum power dissipation NO-Load | < 0.5 W |
| Power loss nominal load max. | < 12 W |

| General data | |
|---|---|
| Insulation voltage input/output | 4 kV AC (type test)<br>3 kV AC (routine test) |
| MTBF | > 1159000 h |
| Housing material | polycarbonate |
| Foot latch material | Plastic POM |
| Dimensions W / H / D | 55 mm / 90 mm / 84 mm |
| Weight | 0.34 kg |

| Security | |
|---|---|
| Degree of protection | IP20 |
| Protection class | II ( in closed control cabinet ) |
| SELV | IEC 60950-1 (SELV) and EN 60204 (PELV) |

| Ambient conditions | |
|---|---|
| Ambient temperature (operation) | -25 °C ... 70 °C (> 55° C derating) |
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
| Max. permissible relative humidity (operation) | ≤ 95 % (at 25 °C, non-condensing) |
| Vibration (operation) | < 15 Hz, amplitude ±2.5 mm (according to IEC 60068-2-6)<br>15 Hz ... 150 Hz, 2.3g, 90 min. |
| Shock | 30 g in each direction, according to IEC 60068-2-27 |
| Pollution degree | 2 |
| Climatic class | 3K3 (in acc. with EN 60721) |
| Inflammability class in acc. with UL 94 (housing) | V0 |

| Standards | |
|---|---|
| Electrical Equipment for Machinery | EN 60204-1 |
| Electrical safety (of information technology equipment - Safety - Part 1) | IEC 60950-1/VDE 0805 (SELV) |
| Electronic equipment for use in electrical power installations | EN 50178/VDE 0160 (PELV) |
| SELV | IEC 60950-1 (SELV) and EN 60204 (PELV) |
| Safe isolation | DIN VDE 0100-410 |
| Protection against electric shock | DIN 57100-410 |
| Limitation of mains harmonic currents | EN 61000-3-2 |
| Network version/undervoltage | EN 61000-4-11 |
| Information technology equipment - Safety (CB Scheme) | CB Scheme |

| Approvals | |
|---|---|
| UL approvals | UL/C-UL listed UL 508<br>UL/C-UL Recognized UL 60950<br>NEC Class 2 as per UL 1310 |
| CSA | CAN/CSA-C22.2 No. 60950-1-07<br>CSA-C22.2 No. 107.1-01 |

Current approvals/permissions for the product can be found in the download area under phoenixcontact.net/products.

| Conformance with EMC Directive 2004/108/EC | | |
|---|---|---|
| **Noise immunity according to EN 61000-6-2** | | |
| | **EN 61000-6-2 requirement** | **Tested** |
| Electrostatic discharge EN 61000-4-2 | | |
| Housing contact discharge | 4 kV (Test intensity 2) | 6 kV (Test intensity 3) |
| Housing air discharge | 8 kV (Test intensity 3) | 8 kV (Test intensity 3) |
| Comments | Criterion B | Criterion B |
| Electromagnetic HF field EN 61000-4-3 | | |
| Frequency range | 80 MHz ... 1 GHz | 80 MHz ... 1 GHz |
| Test field strength | 10 V/m | 10 V/m |
| Frequency range | 1.4 GHz ... 2 GHz | 1 GHz ... 2 GHz |
| Test field strength | 3 V/m | 10 V/m |
| Frequency range | 2 GHz ... 2.7 GHz | 2 GHz ... 3 GHz |
| Test field strength | 1 V/m | 10 V/m |
| Comments | Criterion A | Criterion A |
| Fast transients (burst) EN 61000-4-4 | | |
| Input | 2 kV (Test intensity 3 - asymmetrical) | 4 kV (Test intensity 4 - asymmetrical) |
| Output | 2 kV (Test intensity 3 - asymmetrical) | 2 kV (Test intensity 3 - asymmetrical) |
| Comments | Criterion B | Criterion B |
| Surge current loads (surge) EN 61000-4-5 | | |
| Input | 1 kV (Test intensity 2 - symmetrical)<br>2 kV (Test intensity 3 - asymmetrical) | 2 kV (Test intensity 3 - symmetrical)<br>4 kV (Test intensity 4 - asymmetrical) |
| Output | 0.5 kV (Test intensity 1 - symmetrical)<br>0.5 kV (Test intensity 1 - asymmetrical) | 1 kV (Test intensity 2 - symmetrical)<br>2 kV (Test intensity 3 - asymmetrical) |
| Comments | Criterion B | Criterion B |
| Conducted interference EN 61000-4-6 | | |
| Frequency range | 10 kHz ... 80 MHz | 10 kHz ... 80 MHz |
| Voltage | 10 V (Test intensity 3) | 10 V (Test intensity 3) |
| Comments | Criterion A | Criterion A |

| | |
|---|---|
| Criterion A | Normal operating behavior within the specified limits. |
| Criterion B | Temporary impairment to operational behavior that is corrected by the device itself. |

| Emitted interference in acc. with EN 61000-6-3 | |
|---|---|
| Radio interference voltage in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |
| Emitted radio interference in acc. with EN 55011 | EN 55011 (EN 55022) Class B, area of application: Industry and residential |

All technical specifications are nominal values and refer to a room temperature of 25 °C and 70 % relative humidity at 100 m above sea level.

# 5 Intended use

This power supply unit features IP20 protection and is intended for installation in housing. It is suitable for use in industrial applications.

# 6 Structure

## 6.1 Device elements

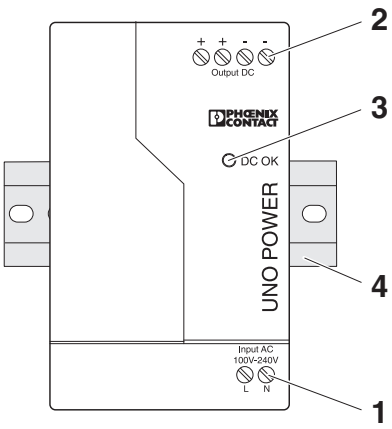
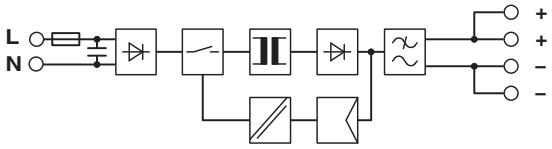



Figure 1 Device elements

1. Input voltage: Input AC L/N
2. Output voltage: Output DC+/-
3. Green LED: DC OK
4. Universal snap-on foot: 35 mm DIN rail according to EN 60715

## 6.2 Block diagram




| Element | Meaning |
|---|---|
| | Fuse |
| | Decoupling |
| | Switch |
| | Transmitter |
| | Filter |
| | Disconnect transducer |
| | Controller |

**Extract from the online catalog**

# FL SWITCH SFN 8TX

Order No.: 2891929

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2891929

Ethernet switch, 8 TP RJ45 ports, automatic detection of data transmission rate of 10/100 mbps (RJ45), autocrossing function

| Commercial data | |
|---|---|
| EAN | 4046356100823 |
| Pack | 1 Pcs. |
| Customs tariff | 85176200 |
| Weight/Piece | 0.5035 KG |
| Catalog page information | Page 222 (AX-2007) |

Product notes

WEEE/RoHS-compliant since: 01/10/2007

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

## Technical data

### Interfaces

| | |
|---|---|
| Interface | Ethernet (RJ45) |
| No. of ports | 8 RJ45 ports |
| Type of connection | RJ45 socket, autonegotiation and autocrossing |
| Transmission physics | Ethernet in RJ45 twisted pair |
| Transmission speed | 10/100 MBit/s (RJ45) |

| | |
|---|---|
| **Function** | |
| Basic functionality | Unmanaged switch / autonegotiation, complies with IEEE 802.3, store and forward switching mode |
| Status and diagnostics displays | LEDs: $U_{S1}$, link and activity per port |
| **Network extension parameters** | |
| Cascading depth | Network, line and star structure: any |
| Maximum conductor length ((twisted pair) | 100 m |
| **Supply voltage** | |
| Supply voltage | 24 V DC |
| Residual ripple | 3.6 $V_{PP}$ (within the permitted voltage range) |
| Range of supply voltages | 18.5 V DC ... 30.2 V DC |
| Typical current consumption | Typ. 140 mA |
| **General data** | |
| Weight | 365 g |
| Width | 50 mm |
| Height | 120 mm |
| Depth | 70 mm |
| Degree of protection | IP20 in acc. with DIN 40050/IEC 60529 |
| Ambient temperature (operation) | 0 °C ... 60 °C |
| Ambient temperature (storage/transport) | -20 °C ... 70 °C |
| Permissible humidity (operation) | 10 % ... 95 % (non-condensing) |
| Housing material | Aluminum |
| Electromagnetic compatibility | Conformance with EMC directive 89/336/EEC |
| Emitted interference | EN 61000-6-4 |
| Immunity to interference | EN 61000-6-2 |

## Address

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# TMC 7 and TMC 8 series overcurrent protection

Thermal-magnetic supplementary protectors and circuit breakers

PHOENIX CONTACT
INSPIRING INNOVATIONS

# TMC 7 and TMC 8 series

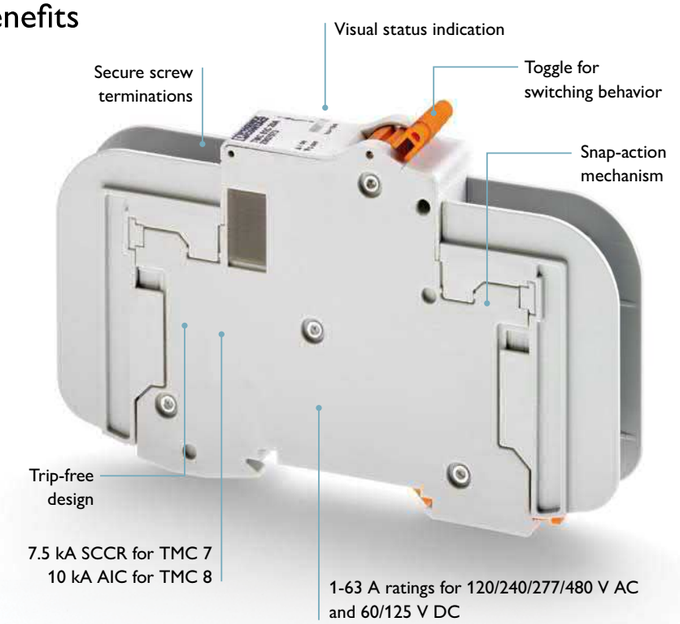
## Thermal-magnetic overcurrent protection

The TMC 7 series supplementary protectors and TMC 8 series circuit breakers are composed of 1-pole, 2-pole, and 3-pole thermal-magnetic miniature circuit breakers (MCBs) available in industry standard B-, C-, and D-trip curves for DIN rail-mounted applications. The breakers comply with UL 1077, UL 489, and EN 60947-2 accordingly, and are marked with the appropriate approvals.

These dual-rated breakers are equipped with toggle actuation and visual status indication, and are ideal for overcurrent protection of circuits and loads. A trip-free, snap-action mechanism ensures reliable switching behavior for use in switchgear, panel boards, and electrical equipment.

Phoenix Contact's TMC 7 series supplementary protectors and TMC 8 series circuit breakers are rated for use in systems up to 277/480 V AC and 60/125 V DC.

## Features and benefits

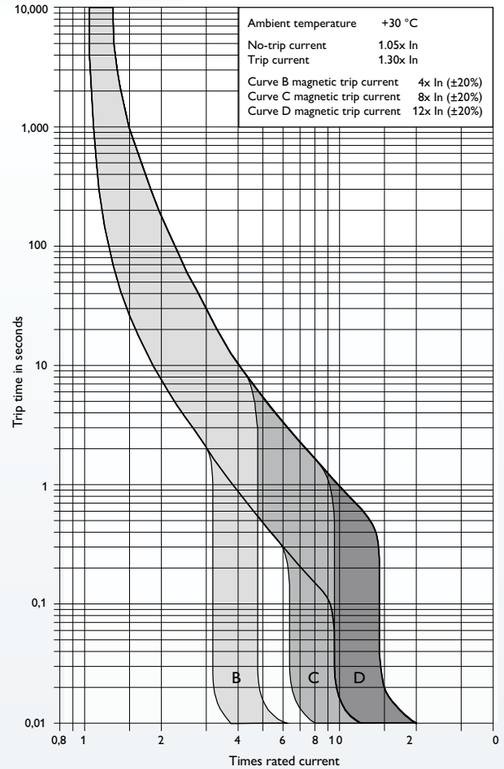



| Features | Benefits |
|---|---|
| **Visual status indication** | **Easily identify circuit status** |
| **A wide range of currents** | **1-63 A versions for optimizing system reliability** |
| **1-, 2-, and 3-pole versions** | **Configurations for all applications** |
| **B-, C-, and D-curves** | **A single product line with trip curves for all load types** |
| **Dual rated (AC/DC)** | **Single part number with both AC and DC ratings, reducing inventory requirements** |
| **Snap-action mechanism** | **Eliminates contact welding and reduces contact wear** |
| **Trip-free design** | **Increased safety against closing during an overcurrent event** |
| **UL 508 Listed cuttable busbar** | **Flexible, easy bridging of power and accessories** |
| **Multiple accessories** | **Provide added functionality and system status information** |

## Trip characteristics

The TMC 7 and TMC 8 series includes a range of trip characteristics for a variety of applications: B-, C-, and D-curves.

| Curve | Application |
|---|---|
| **B** | • Heaters<br>• Sensitive equipment |
| **C** | • Small transformers<br>• Lighting<br>• Pilot devices<br>• Control circuits and coils |
| **D** | • Motors<br>• Generators |




**Magnetic tripping currents are increased by 30% on DC supplies**

# TMC 8 series circuit breakers

The TMC 8 series is composed of 1-pole, 2-pole, and 3-pole thermal-magnetic miniature circuit breakers (MCBs) in accordance with UL 489 and EN 60947-2 for DIN rail-mounted applications.

These dual-rated breakers are equipped with toggle actuation, visual status indication, and high-rated interrupting capacity and are meant to protect branch circuit conductors. A trip-free snap-action mechanism ensures reliable switching behavior for use in switchgear, panel boards, and electrical equipment.

Phoenix Contact's TMC 8 breakers are rated for use in systems up to 277/480 V AC and 60/125 V DC with a 10 kA short-circuit current rating.

c UL us LISTED

| Ampere rating (A) | B Curve | | | | | | C Curve | | | | | | D Curve | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Pole | | 2 Pole | | 3 Pole | | 1 Pole | | 2 Pole | | 3 Pole | | 1 Pole | | 2 Pole | | 3 Pole | |
| 1 | TMC 81B 01A | 2907478 | TMC 82B 01A | 2907502 | TMC 83B 01A | 2907539 | TMC 81C 01A | 2907558 | TMC 82C 01A | 2907582 | TMC 83C 01A | 2907607 | TMC 81D 01A | 2907626 | TMC 82D 01A | 2907650 | TMC 83D 01A | 2907674 |
| 2 | TMC 81B 02A | 2907479 | TMC 82B 02A | 2907503 | TMC 83B 02A | 2907540 | TMC 81C 02A | 2907559 | TMC 82C 02A | 2907584 | TMC 83C 02A | 2907608 | TMC 81D 02A | 2907627 | TMC 82D 02A | 2907652 | TMC 83D 02A | 2907675 |
| 3 | TMC 81B 03A | 2907480 | TMC 82B 03A | 2907504 | TMC 83B 03A | 2907542 | TMC 81C 03A | 2907560 | TMC 82C 03A | 2907585 | TMC 83C 03A | 2907609 | TMC 81D 03A | 2907628 | TMC 82D 03A | 2907653 | TMC 83D 03A | 2907676 |
| 4 | TMC 81B 04A | 2907481 | TMC 82B 04A | 2907505 | TMC 83B 04A | 2907543 | TMC 81C 04A | 2907561 | TMC 82C 04A | 2907586 | TMC 83C 04A | 2907610 | TMC 81D 04A | 2907629 | TMC 82D 04A | 2907654 | TMC 83D 04A | 2907678 |
| 5 | TMC 81B 05A | 2907482 | TMC 82B 05A | 2907506 | TMC 83B 05A | 2907544 | TMC 81C 05A | 2907562 | TMC 82C 05A | 2907587 | TMC 83C 05A | 2907611 | TMC 81D 05A | 2907630 | TMC 82D 05A | 2907655 | TMC 83D 05A | 2907679 |
| 6 | TMC 81B 06A | 2907483 | TMC 82B 06A | 2907507 | TMC 83B 06A | 2907545 | TMC 81C 06A | 2907563 | TMC 82C 06A | 2907588 | TMC 83C 06A | 2907612 | TMC 81D 06A | 2907631 | TMC 82D 06A | 2907656 | TMC 83D 06A | 2907681 |
| 7 | TMC 81B 07A | 2907484 | TMC 82B 07A | 2907508 | TMC 83B 07A | 2907546 | TMC 81C 07A | 2907564 | TMC 82C 07A | 2907589 | TMC 83C 07A | 2907613 | TMC 81D 07A | 2907632 | TMC 82D 07A | 2907657 | TMC 83D 07A | 2907682 |
| 8 | TMC 81B 08A | 2907485 | TMC 82B 08A | 2907510 | TMC 83B 08A | 2907547 | TMC 81C 08A | 2907565 | TMC 82C 08A | 2907590 | TMC 83C 08A | 2907614 | TMC 81D 08A | 2907633 | TMC 82D 08A | 2907658 | TMC 83D 08A | 2907683 |
| 10 | TMC 81B 10A | 2907487 | TMC 82B 10A | 2907511 | TMC 83B 10A | 2907548 | TMC 81C 10A | 2907566 | TMC 82C 10A | 2907591 | TMC 83C 10A | 2907615 | TMC 81D 10A | 2907634 | TMC 82D 10A | 2907659 | TMC 83D 10A | 2907684 |
| 12 | TMC 81B 12A | 2907488 | TMC 82B 12A | 2907512 | TMC 83B 12A | 2907549 | TMC 81C 12A | 2907568 | TMC 82C 12A | 2907592 | TMC 83C 12A | 2907616 | TMC 81D 12A | 2907636 | TMC 82D 12A | 2907660 | TMC 83D 12A | 2907685 |
| 13 | TMC 81B 13A | 2907489 | TMC 82B 13A | 2907513 | TMC 83B 13A | 2907550 | TMC 81C 13A | 2907569 | TMC 82C 13A | 2907593 | TMC 83C 13A | 2907617 | TMC 81D 13A | 2907637 | TMC 82D 13A | 2907661 | TMC 83D 13A | 2907686 |
| 15 | TMC 81B 15A | 2907490 | TMC 82B 15A | 2907514 | TMC 83B 15A | 2907551 | TMC 81C 15A | 2907571 | TMC 82C 15A | 2907594 | TMC 83C 15A | 2907618 | TMC 81D 15A | 2907638 | TMC 82D 15A | 2907662 | TMC 83D 15A | 2907687 |
| 16 | TMC 81B 16A | 2907491 | TMC 82B 16A | 2907515 | TMC 83B 16A | 2907552 | TMC 81C 16A | 2907572 | TMC 82C 16A | 2907595 | TMC 83C 16A | 2907620 | TMC 81D 16A | 2907639 | TMC 82D 16A | 2907663 | TMC 83D 16A | 2907688 |
| 20 | TMC 81B 20A | 2907492 | TMC 82B 20A | 2907516 | TMC 83B 20A | 2907553 | TMC 81C 20A | 2907573 | TMC 82C 20A | 2907597 | TMC 83C 20A | 2907621 | TMC 81D 20A | 2907640 | TMC 82D 20A | 2907665 | TMC 83D 20A | 2907689 |
| 25 | TMC 81B 25A | 2907493 | TMC 82B 25A | 2907530 | TMC 83B 25A | 2907555 | TMC 81C 25A | 2907574 | TMC 82C 25A | 2907598 | TMC 83C 25A | 2907623 | TMC 81D 25A | 2907641 | TMC 82D 25A | 2907666 | TMC 83D 25A | 2907690 |
| 30 | TMC 81B 30A | 2907494 | TMC 82B 30A | 2907531 | TMC 83B 30A | 2907556 | TMC 81C 30A | 2907575 | TMC 82C 30A | 2907599 | TMC 83C 30A | 2907624 | TMC 81D 30A | 2907642 | TMC 82D 30A | 2907667 | TMC 83D 30A | 2907691 |
| 32 | TMC 81B 32A | 2907495 | TMC 82B 32A | 2907532 | TMC 83B 32A | 2907557 | TMC 81C 32A | 2907576 | TMC 82C 32A | 2907600 | TMC 83C 32A | 2907625 | TMC 81D 32A | 2907643 | TMC 82D 32A | 2907668 | TMC 83D 32A | 2907692 |
| 35 | TMC 81B 35A | 2907496 | TMC 82B 35A | 2907533 | TMC 83B 35A | 1010309 | TMC 81C 35A | 2907577 | TMC 82C 35A | 2907601 | TMC 83C 35A | 1010303 | TMC 81D 35A | 2907644 | TMC 82D 35A | 2907669 | TMC 83D 35A | 1010290 |
| 40 | TMC 81B 40A | 2907497 | TMC 82B 40A | 2907534 | TMC 83B 40A | 1010308 | TMC 81C 40A | 2907578 | TMC 82C 40A | 2907602 | TMC 83C 40A | 1010305 | TMC 81D 40A | 2907645 | TMC 82D 40A | 2907670 | TMC 83D 40A | 1010289 |
| 50 | TMC 81B 50A | 2907498 | TMC 82B 50A | 2907535 | TMC 83B 50A | 1010307 | TMC 81C 50A | 2907579 | TMC 82C 50A | 2907603 | TMC 83C 50A | 1010302 | TMC 81D 50A | 2907646 | TMC 82D 50A | 2907671 | TMC 83D 50A | 1010284 |
| 60 | TMC 81B 60A | 2907500 | TMC 82B 60A | 2907536 | TMC 83B 60A | 1010306 | TMC 81C 60A | 2907580 | TMC 82C 60A | 2907604 | TMC 83C 60A | 1010301 | TMC 81D 60A | 2907647 | TMC 82D 60A | 2907672 | TMC 83D 60A | 1010288 |
| 63 | TMC 81B 63A | 2907501 | TMC 82B 63A | 2907537 | TMC 83B 63A | 1010286 | TMC 81C 63A | 2907581 | TMC 82C 63A | 2907605 | TMC 83C 63A | 1010291 | TMC 81D 63A | 2907649 | TMC 82D 63A | 2907673 | TMC 83D 63A | 1010287 |

## Product description breakdown

TMC 8 1 C 01A

- 01A — Current rating
- C — Trip curve (B, C, or D)
- 1 — Number of poles
- 8 — Design criteria (UL 489)
- TMC — Thermal-magnetic trip technology

## Accessories

| Part number | PN description | Description |
|---|---|---|
| 2907991 | TMC 8 B1 80 57 C | Single-pole, 57-position cuttable busbar |
| 2907992 | TMC 8 B1 80 37 CA | Single pole with accessory, 37-position cuttable busbar |
| 2907993 | TMC 8 B2 80 56 C | Double-pole, 56-position cuttable busbar |
| 2907995 | TMC 8 B2 80 46 CA | Double pole with accessory, 46-position cuttable busbar |
| 2907996 | TMC 8 B3 80 57 C | Three-pole, 57-position cuttable busbar |
| 2907997 | TMC 8 B3 80 48 CA | Three pole with accessory, 48-position cuttable busbar |
| 2907998 | TMC 8 B TERM PIN | Wiring termination |
| 2907999 | TMC 8 B END CAP | Insulating end cap for busbar after cutting to length |
| 2908000 | TMC 8 B BUS CAP | Touch-safe cap for busbar terminations |
| 2908219 | TMC 7/8 AUX | Contact for notification of breaker actuation |
| 2908220 | TMC 7/8 ALARM | Contact for indicating overcurrent trip |
| 2908221 | TMC 7/8 12VDC SHNT | 12 V DC input for remote trip |
| 2908222 | TMC 7/8 24VDC SHNT | 24 V DC input for remote trip |
| 2908224 | TMC 7/8 48VDC SHNT | 48 V DC input for remote trip |
| 2908225 | TMC 7/8 125VDC SHNT | 125 V DC input for remote trip |
| 2908226 | TMC 7/8 120VAC SHNT | 120 V AC input for remote trip |
| 2908227 | TMC 7/8 240VAC SHNT | 240 V AC input for remote trip |
| 2908228 | TMC 7/8 277VAC SHNT | 277 V AC input for remote trip |
| 2908227 | TMC 7/8 240VAC SHNT | 240 V AC input for remote trip |
| 2908228 | TMC 7/8 277VAC SHNT | 277 V AC input for remote trip |



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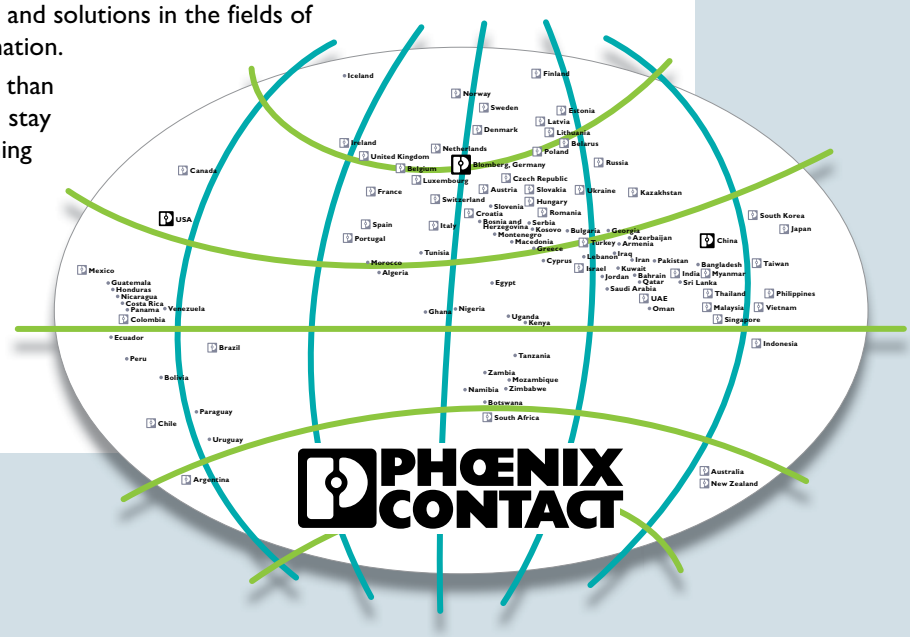


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## TeSys™ D Non-Reversing Contactors

LC1D09

LC1D093

LC1D40A

LC1D115

LRD22

LRD3

### Table 18.22: TeSys D Contactors—3 or 4 Pole, Screw Terminal Connections

| Maximum Horsepower Ratings | | | | | | Maximum Current Utilization Categories | | Continuous Current Rating (A) | No. of Poles | | Instantaneous Auxiliary Contacts | | Catalog Number *[39]* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single-Phase | | Three-Phase | | | | Inductive AC3 (A) | Resistive AC1 (A) | | N.O. | N.C. | N.O. | N.C. | |
| 115 V hp | 230 V hp | 200 V hp | 230 V hp | 460 V hp | 575 V hp | | | | | | | | |
| 1/3 | 1 | 2 | 2 | 5 | 7.5 | 9 | 20 | 25 | 3 | 0 | 1 | 1 | LC1D09 *[40][41][42]* |
| — | — | — | — | — | — | — | | | 4 | | | | LC1DT20 *[40]* |
| — | — | — | — | — | — | — | | | 2 | 2 | | | LC1D098 *[40]* |
| 1/2 | 2 | 3 | 3 | 7.5 | 10 | 12 | 25 | 25 | 3 | 0 | 1 | 1 | LC1D12 *[40][41][42]* |
| — | — | — | — | — | — | — | | | 4 | | | | LC1D125 *[40]* |
| — | — | — | — | — | — | — | | | 2 | 2 | | | LC1D128 *[40]* |
| 1 | 3 | 5 | 5 | 10 | 15 | 18 | 32 | 32 | 3 | 0 | 1 | 1 | LC1D18 *[40][41]* |
| — | — | — | — | — | — | — | | | 4 | | | | LC1DT32 *[40]* |
| — | — | — | — | — | — | — | | | 2 | 2 | | | LC1D188 *[40]* |
| 2 | 3 | 7.5 | 7.5 | 15 | 20 | 25 | 40 | 40 | 3 | 0 | 1 | 1 | LC1D25 *[40][40]* |
| — | — | — | — | — | — | — | | | 4 | | | | LC1DT40 *[40]* |
| — | — | — | — | — | — | — | | | 2 | 2 | | | LC1D258 *[40]* |
| 2 | 5 | 10 | 10 | 20 | 25 | 32 | 50 | 50 | 3 | 0 | 1 | 1 | LC1D32 *[40][41]* |
| 2 | 5 | 10 | 10 | 20 | 25 | 38 | | | 3 | 0 | 1 | 1 | LC1D38*[40][41]* |
| 3 | 5 | 10 | 10 | 30 | 30 | 40 | 60 | 60 | 3 | 0 | 1 | 1 | LC1D40A *[40]* |
| — | — | — | — | — | — | — | | | 4 | | 0 | 0 | LC1DT60A*[40]* |
| 3 | 7.5 | 15 | 15 | 40 | 40 | 50 | 80 | 70 | 3 | 0 | 1 | 1 | LC1D50A *[40]* |
| 5 | 10 | 20 | 20 | 40 | 50 | 65 | | 80 | 3 | | | | LC1D65A *[40]* |
| — | — | — | — | — | — | — | | | 4 | 0 | 0 | 0 | LC1DT80A*[40]* |
| 7.5 | 15 | 25 | 30 | 60 | 60 | 80 | 125 | 110 | 3 | 0 | 1 | 1 | LC1D80 |
| — | — | — | — | — | — | — | | | 4 | | 0 | 0 | LC1D80004 *[43]* |
| — | — | — | — | — | — | — | | | 2 | 2 | | | LC1D80008 *[43]* |
| 7.5 | 15 | 25 | 30 | 60 | 60 | 95 | | | 3 | 0 | 1 | 1 | LC1D95 |
| — | — | 30 | 40 | 75 | 100 | 115 | 200 | 160 | 3 | 0 | 1 | 1 | LC1D115 |
| — | — | 40 | 50 | 100 | 125 | 150 | | | 3 | | | | LC1D150 |
| — | — | — | — | — | — | — | | | 4 | | 0 | 0 | LC1D115004 |

### Table 18.23: TeSys D Coil Voltage Codes*[44]*

| Contactor | Hz | 24 V | 48 V | 110 V | 120 V | 125 V | 208 V | 220 V | 240 V | 250 V | 440 V | 480 V | 600 V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AC | | | | | | | | | | | | | |
| D09–D150 | 50/60 | B7 | E7 | F7 | G7 | — | LE7 | M7 | U7 | — | — | T7 *[45]* | X7 *[45]* |
| LC1D80–LC1D150 | 50 | B5 | E5 | F5 | — | — | — | M5 *[45]* | U5 | — | — | — | — |
| | 60 | B6 | E6 | F6 | G6 | — | L6 | M6 | U6 | — | — | T6 | X6 *[45]* |
| DC | | | | | | | | | | | | | |
| D09-D38, DT20-D258 Low Consumption | — | BL | EL | FL | — | — | — | ML | — | UL | — | — | — |
| D09–D150 | — | BD | ED | FD | — | GD | — | MD | — | UD | RD | — | — |

*[39]* Complete the catalog number by adding the coil voltage code from Table 18.23 TeSys D Coil Voltage Codes, page 18-8 for example, LC1D09**G7**).

*[40]* For ring tongue versions of LC1D09–LC1D65A and LC1DT20–LC1DT80A, add **6** to the catalog number prior to adding the voltage code (for example, LC1D09G7 becomes LC1D09**6**G7 and LC1D50AG7 becomes LC1D50A**6**G7).

*[41]* For spring terminals versions of LC1D09–LC1D65A, add **3** to the catalog number prior to adding the voltage code (for example, LC1D12G7 becomes LC1D12**3**G7 and LC1D40AG7 becomes LC1D40A**3**G7. Note that 40–65 A spring terminals are only on the control terminations and not on power terminations).

*[42]* For slip-on connector versions of LC1D09 and LC1D12 only, add **9** to the catalog number prior to adding the voltage code (for example, LC1D09G7 becomes LC1D09**9**G7).

*[43]* For DC version of these devices, replace the **C** with a **P** (for example, L**C**1D80004•• becomes L**P**1D80004••). This applies only to 80 A, 4-pole devices.

*[44]* For additional voltage codes refer to the Control and Protection Components Catalog MKTED210011EN.

*[45]* Not available for LC1D80–LC1D150.



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# TeSys™ D Overload Relays

## Table 18.24: TeSys D Overload Relays—Ambient Compensated, Bimetallic, Direct Mounting

| Current Setting Range (A) | For Direct Mounting to LC1... | Class 10 with Single-Phase Sensitivity | Class 10 without Single-Phase Sensitivity | Class 20 with Single-Phase Sensitivity | Class 20 without Single-Phase Sensitivity |
|---|---|---|---|---|---|
| 0.10–0.16 | D09–D38 | LRD01 | LR3D01 | — | — |
| 0.16–0.25 | | LRD02 | LR3D02 | — | — |
| 0.25–0.40 | | LRD03 | LR3D03 | — | — |
| 0.40–0.63 | | LRD04 | LR3D04 | LRD04L | LR3D04L |
| 0.63–1 | | LRD05 | LR3D05 | LRD05L | LR3D05L |
| 1–1.6 | | LRD06 | LR3D06 | LRD06L | LR3D06L |
| 1.6–2.5 | | LRD07 | LR3D07 | LRD07L | LR3D07L |
| 2.5–4 | | LRD08 | LR3D08 | LRD08L | LR3D08L |
| 4–6 | | LRD10 | LR3D10 | LRD10L | LR3D10L |
| 5.5–8 | | LRD12 | LR3D12 | LRD12L | LR3D12L |
| 7–10 | | LRD14 | LR3D14 | LRD14L | LR3D14L |
| 9–13 | D12–D38 | LRD16 | LR3D16 | LRD16L | LR3D21L |
| 12–18 | D18–D38 | LRD21 | LR3D21 | LRD21L | LR3D21L |
| 16–24 | | LRD22 | LR3D22 | — | — |
| 17–24 | | — | — | LRD22L | LR3D22L |
| 23–32 | D25–D38 | LRD32 | LR3D32 | LRD32L | LR3D32L |
| 30–38 | D32–D38 | LRD35 | LR3D35 | — | — |
| 9-13 | D40A–D65A | LRD313 | LR3D313 | LRD313L | — |
| 12-18 | D40A–D65A | LRD318 | LR3D318 | LRD318L | — |
| 17-25 | D40A–D65A | LRD325 | LR3D325 | LRD325L | — |
| 23-32 | D40A–D65A | LRD332 | LR3D332 | LRD332L | — |
| 30-40 | D40A–D65A | LRD340 | LR3D340 | LRD340L | — |
| 37-50 | D40A–D65A | LRD350 | LR3D350 | LRD350L | — |
| 48-65 | D40A–D65A | LRD365 | LR3D365 | LRD365L | — |
| 17-25 | D40–D95 | LRD3322 | LR3D3322 | LR2D3522 | LR3D3522 |
| 23-32 | D40–D95*[46]* | LRD3353 | LR3D3353 | LR2D3553 | LR3D3553 |
| 30-40 | D40–D95*[46]* | LRD3355 | LR3D3355 | LR2D3555 | LR3D3555 |
| 37-50 | D50–D95*[46]* | LRD3357 | LR3D3357 | LR2D3557 | LR3D3557 |
| 48-65 | D50–D95*[46]* | LRD3359 | LR3D3359 | LR2D3559 | LR3D3559 |
| 55–70 | D65–D95 | LRD3361 | LR3D3361 | LR2D3561 | LR3D3561 |
| 63–80 | D65–D95 | LRD3363 | LR3D3363 | LR2D3563 | LR3D3563 |
| 80–104 | D95 | LRD3365 | — | — | — |
| 80–104 | D115–D150 | LRD4365 | — | — | — |
| 95–120 | D115–D150 | LRD4367 | — | — | — |
| 110–140 | D150 | LRD4369 | — | — | — |

## Table 18.25: TeSys LR9D Electronic Overload Relays *New!*

| Current Setting Range (A) | For Direct Mounting Beneath Contactor LC1D/ LC2D | Class 5/10/20/30 Selectable |
|---|---|---|
| 0.1–0.5 | D09–D38 | LR9D01 |
| 0.4–2 | D09–D38 | LR9D02 |
| 1.6–8 | D09–D38 | LR9D08 |
| 6.4–32 | D09–D38 | LR9D32 |
| 22–110 | N/A (Separate mounting only) | LR9D110S |

## Table 18.26: TeSys D Overload Relays—Solid State

| Current Setting Range (A) | For Direct Mounting Beneath Contactor LC1 | Class 10 | Class 20 | Class 10/20 Selectable |
|---|---|---|---|---|
| 60–100 | D115–D150 | LR9D5367 | LR9D5567 | LR9D67 |
| 90–150 | D115–D150 | LR9D5369 | LR9D5569 | LR9D69 |

TeSys D contactor accessories: TeSys™ D & F Auxiliary Contacts, Time Delay, Mechanical Latch, page 18-15
TeSys D overload relay accessories: TeSys D Overload Relay Accessories, page 18-22
TeSys D replacement coils: TeSys™ D AC Coils, page 18-43
Dimensions: TeSys™ D Contactors, AC and DC Coil, page 18-51 to TeSys™ D Thermal Overload Relay Dimensions, page 18-59
TeSys T: see TeSys™ T Motor Management System, page 16-102

E164862
CCN NLDX

LR43364
Class 3211 04

*[46]* Direct mount to old D2 style D40 to D65 (no Everlink terminations) and to D80 and D95 only.



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# Product data sheet
## Characteristics

# HJL36015
## PowerPact H Circuit Breaker,ThermMagn,15A,3P,600V,25kA

Product availability : Stock - Normally stocked in distribution facility

## Main

| | |
|---|---|
| Product or component type | Circuit breaker |
| Range of product | PowerPact H |
| Trip Unit Type | Thermal-magnetic |
| Breaking capacity code | J |

## Complementary

| | |
|---|---|
| Line Rated Current | 15 A |
| Number of Poles | 3P |
| Interrupt Rating | 65 kA at 480 V AC<br>25 kA at 600 V AC<br>100 kA at 240 V AC<br>20 kA at 250 V DC |
| System Voltage | 250 V DC<br>600 V AC |
| Continuous current rating | 80 % |
| Mounting mode | Unit mount |
| Electrical connection | Lugs load<br>Lugs line |
| Wire Gauge | AWG 14...AWG 3/0 (aluminium/copper) |
| Magnetic hold current | 350 A |
| Magnetic tripping current | 750 A |
| Height | 6.4 in |
| Width | 4.12 in |
| Depth | 4.36 in |
| Tightening torque | 5 N.m for 2.5...95 mm² (AWG 14...AWG 3/0) |

Disclaimer: This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications

## Environment

| | |
|---|---|
| Product certifications | CE<br>CSA<br>IEC<br>UL listed |
| Ambient air temperature for operation | 104 °F (40 °C) |

## Ordering and shipping details

| | |
|---|---|
| Category | 01115 - HG,HJ,JG,JJ UNIT MT BREAKER/SWITCH |
| Discount Schedule | DE2 |
| GTIN | 00785901577904 |
| Nbr. of units in pkg. | 1 |
| Package weight(Lbs) | 4.1399999999999997 |
| Returnability | Y |
| Country of origin | MX |

## Offer Sustainability

| | |
|---|---|
| Sustainable offer status | Green Premium product |
| RoHS (date code: YYWW) | Compliant - since 0832 - Schneider Electric declaration of conformity<br>Schneider Electric declaration of conformity |
| REACh | Reference not containing SVHC above the threshold<br>Reference not containing SVHC above the threshold |
| Product environmental profile | Available |
| Product end of life instructions | Need no specific recycling operations |
| California proposition 65 | WARNING: This product can expose you to chemicals including: |
| - - - - - - - Substance 1 | DINP, which is known to the State of California to cause cancer, and |
| - - - - - - - Substance 2 | DIDP, which is known to the State of California to cause Birth Defects or other reproductive harm. |
| - - - - - - - More information | For more information go to www.p65warnings.ca.gov |

## Contractual warranty

| | |
|---|---|
| Warranty period | 18 months |

# 30.5 mm Push Buttons

## Pilot Lights

### Pilot Light Devices∗

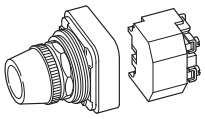
*Transformer Type Pilot Light*
***Cat. No. 800T-P16R***

*Push-to-Test Pilot Light*
***Cat. No. 800T-PT16R***

| Type | Lamp Type | Volts | Color | Type 4/13 Pilot Light Cat. No. | Type 4/13 Push-to-Test∗ Cat. No. | Type 4/4X/13 Pilot Light Cat. No. | Type 4/4X/13 Push-to-Test∗ Cat. No. |
|---|---|---|---|---|---|---|---|
| Operator Only❄ | | | | 800T-S00 | **800T-SB00XX** | 800H-SR00 | 800H-SRB00XX |
| Full Voltage‡ | Incandescent | 24V AC/DC | Red | **800T-Q24R** | **800T-QT24R** | **800H-QR24R** | **800H-QRT24R** |
| | | | Green | **800T-Q24G** | **800T-QT24G** | **800H-QR24G** | 800H-QRT24G |
| | | | Amber | **800T-Q24A** | **800T-QT24A** | **800H-QR24A** | 800H-QRT24A |
| | No Lamp | 0…250V AC/DC | No Lens | 800T-QN25 | 800T-QTN25 | — | — |
| Universal‡ | LED | 12…130 V AC/DC | Red | **800T-QH2R** | **800T-QTH2R** | **800H-QRH2R** | **800H-QRTH2R** |
| | | | Green | **800T-QH2G** | **800T-QTH2G** | **800H-QRH2G** | **800H-QRTH2G** |
| | | | Amber | **800T-QH2A** | **800T-QTH2A** | **800H-QRH2A** | **800H-QRTH2A** |
| Transformer‡ | Incandescent | 120V AC, 50/60 Hz | Red | **800T-P16R** | **800T-PT16R** | **800H-PR16R** | **800H-PRT16R** |
| | | | Green | **800T-P16G** | **800T-PT16G** | **800H-PR16G** | **800H-PRT16G** |
| | | | Amber | **800T-P16A** | **800T-PT16A** | **800H-PR16A** | **800H-PRT16A** |
| | LED | | Red | **800T-PH16R** | **800T-PTH16R** | **800H-PRH16R** | **800H-PRTH16R** |
| | | | Green | **800T-PH16G** | **800T-PTH16G** | **800H-PRH16G** | **800H-PRTH16G** |
| | | | Amber | **800T-PH16A** | **800T-PTH16A** | **800H-PRH16A** | **800H-PRTH16A** |
| | No Lamp | | No Lens | 800T-PN16 | 800T-PTN16 | — | — |

∗ Includes one standard Cat. No. 800T-XA (1 N.O. - 1 N.C.) contact block. For typical pilot light wiring diagrams, see page 10-65.
❄ Operator only supplied without power module, lamp, lens cap, or contact blocks.
‡ All pilot lights except push-to-test without sealed contacts and dual input transformer relay, are rated for Class 1, Division 2 applications.

| 800 | T | | – | P | T | | 16 | G | AR (Push-to-Test) |
|---|---|---|---|---|---|---|---|---|---|
| | *a* | *b* | | *c* | *d* | *e* | *f* | *g* | *h* |



#### *a*

| Protection Rating | |
|---|---|
| Code | Description |
| T | Metal, Type 4/13 |
| H | Plastic, Type 4/4X/13 |

#### *b*

| Finger-Safe Guards | |
|---|---|
| Code | Description |
| Blank | No guards |
| C | Guards on terminals |

#### *c*

| Power Module Type | | |
|---|---|---|
| 800T Type 4/13 Code | Description | 800H Type 4/4X/13 Code |
| P | Transformer (or dual input) | PR |
| Q | Full voltage/ Universal | QR |

#### *d*

| Lamp Test Options | |
|---|---|
| Code | Description |
| Blank | No test option |
| T | Push-to-test |
| D | Dual input — diode♣ |
| DT | Dual input — transformer relay |
| **Note:** Push-to-test supplied with factory jumpered contact block. | |

#### *e*

| Illumination Options | |
|---|---|
| Code | Description |
| Blank | Incandescent |
| H | LED∗ |

#### *f*

| Voltage | |
|---|---|
| Transformer | |
| Code | Description |
| 16 | 120V AC 50/60 Hz |
| 26 | 240V AC 50/60 Hz |
| 46 | 480V AC 50/60 Hz |
| 56 | 600V AC 50/60 Hz |
| Full Voltage — Incandescent | |
| 12 | 12V AC/DC |
| 24 | 24V AC/DC |
| 48 | 48V AC/DC |
| 10 | 120V AC/DC |
| 20 | 240V AC/DC |
| Universal — LED | |
| 2 | 12…130V AC/DC |
| Dual Input | |
| 16 | 120V AC |
| 24 | 24V AC/DC (Dual input diode only) |

#### *g*

| Lens Color | | |
|---|---|---|
| Code | Color | Glass Code ♠ |
| Blank | No lens | Blank |
| A | Amber | D |
| B | Blue | E |
| C | Clear | F |
| G | Green | H |
| R | Red | J |
| W | White | K |

#### *h*

| Contact Blocks (Push-to-test units only) | |
|---|---|
| Code | Description |
| Standard | |
| Blank | 1 N.O. - 1 N.C. |
| Pen*TUFF* (Low Voltage) | |
| AV | 1 N.O. - 1 N.C. |
| Class 1, Div. 2/Zone 2 | |
| Logic Reed | |
| AR | 1 N.O. - 1 N.C. |
| Sealed Switch | |
| AP | 1 N.O. - 1 N.C. |
| Stackable Sealed Switch | |
| AY | 1 N.O. - 1 N.C. |

∗ LED illumination option is not available with diode type dual input.
♣ Diode type dual input provides circuit isolation via opposing diodes. Not recommended for use with solid-state outputs.
♠ Glass lens available on 800T pilot lights only. Not available on push-to-test units.

## Momentary Contact Push Button Devices, Non-Illuminated

*Flush Head Unit*
***Cat. No. 800T-A1A***

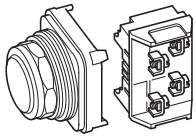
*Extended Head Unit*
***Cat. No. 800T-B6A***

*Booted Unit*
***Cat. No. 800H-R2A***

*Bootless Flush Head Unit*
***Cat. No. 800H-AR1A***

| Contact Type | Button Color | Type 4/13 | | Type 4/4X/13 | |
|---|---|---|---|---|---|
| | | Flush Head | Extended Head | Booted∗ | Bootless Flush Head |
| | | Cat. No. | Cat. No. | Cat. No. | Cat. No. |
| No Contact | Green | **800T-A1** | **800T-B1** | **800H-R1** | **800H-AR1** |
| | Black | **800T-A2** | **800T-B2** | **800H-R2** | **800H-AR2** |
| | Red | **800T-A6** | **800T-B6** | **800H-R6** | **800H-AR6** |
| 1 N.O. | Green | **800T-A1D1** | **800T-B1D1** | **800H-R1D1** | **800H-AR1D1** |
| | Black | **800T-A2D1** | **800T-B2D1** | **800H-R2D1** | **800H-AR2D1** |
| | Red | **800T-A6D1** | **800T-B6D1** | **800H-R6D1** | **800H-AR6D1** |
| 1 N.C. | Green | **800T-A1D2** | **800T-B1D2** | 800H-R1D2 | 800H-AR1D2 |
| | Black | **800T-A2D2** | **800T-B2D2** | 800H-R2D2 | **800H-AR2D2** |
| | Red | **800T-A6D2** | **800T-B6D2** | **800H-R6D2** | **800H-AR6D2** |
| 1 N.O. - 1 N.C. | Green | **800T-A1A** | **800T-B1A** | **800H-R1A** | **800H-AR1A** |
| | Black | **800T-A2A** | **800T-B2A** | **800H-R2A** | **800H-AR2A** |
| | Red | **800T-A6A** | **800T-B6A** | **800H-R6A** | **800H-AR6A** |

**800 T ___ – A 1 ___ A**
*a b c d e f*



### a

| Protection Rating | |
|---|---|
| Code | Description |
| T | Metal, Type 4/13 |
| H | Plastic, Type 4/4X/13 |

### b

| Finger-Safe Guards | |
|---|---|
| Code | Description |
| Blank | No guards |
| C | Guards on terminals |

### c

| Operator Type | | |
|---|---|---|
| 800T Type 4/13 | Description | 800H Type 4/4X/13 |
| Code | | Code |
| A | Flush head | AR |
| B | Extended head | BR |
| D | Mushroom head | DR |
| DX | Mushroom head less color cap | DRX |
| — | Bootless guarded head | GR |
| — | Booted head | R∗ |

### d

| Color Cap | |
|---|---|
| Code | Description |
| Blank | Used only when ordering Operator Type DX/DRX |
| 1 | Green |
| 2 | Black |
| 3 | Orange❄ |

### d (cont'd)

| Color Cap | |
|---|---|
| Code | Description |
| 4 | Grey❄ |
| 5 | White❄ |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow |

### e

| Special Mushroom Head | |
|---|---|
| Code | Description |
| J§ | Jumbo mushroom head — plastic |
| L§ | Jumbo mushroom head — metal |

**Note:** Special mushroom head options only apply to mushroom head operator type code D/DR (Table c).

### f

| Contact Block(s) | |
|---|---|
| Code | Description |
| Blank | No contacts |
| **Standard** | |
| D1 | 1 N.O. |
| D2 | 1 N.C. |
| D3 | 1 N.O.E.M. |
| D4 | 1 N.C.L.B. |
| D5 | 1 N.O. (Mini) |
| D6 | 1 N.C. (Mini) |
| A1 | 1 N.C.L.B. - 1 N.O. |
| A2 | 2 N.O.‡ |
| A4 | 2 N.C. |
| A7 | 1 N.C.L.B. - 1 N.C. |
| A | 1 N.O. - 1 N.C. |
| B | 2 N.O. - 2 N.C. |

### f (cont'd)

| Contact Block(s) | |
|---|---|
| Code | Description |
| **Pen*TUFF* (Low Voltage)** | |
| D1V | 1 N.O. |
| D2V | 1 N.C. |
| D3V | 1 N.O.E.M. |
| D4V | 1 N.C.L.B. |
| AV | 1 N.O. - 1 N.C. |
| BV | 2 N.O. - 2 N.C. |
| **Time Delay** | |
| T | 1 N.O. Depress close, delayed opening |
| S | 1 N.C. Depress open, delayed closure |
| **Snap Action** | |
| M | 1 N.O. - 1 N.C. |
| N | 2 N.O. - 2 N.C. |
| **Class 1, Div. 2/Zone 2** | |
| **Logic Reed** | |
| D1R | 1 N.O. |
| D2R | 1 N.C. |
| A2R | 2 N.O.‡ |
| A4R | 2 N.C. |
| AR | 1 N.O. - 1 N.C. |
| BR | 2 N.O. - 2 N.C. |

### f (cont'd)

| Contact Block(s) | |
|---|---|
| Code | Description |
| **Class 1, Div. 2/Zone 2** | |
| **Sealed Switch** | |
| D1P | 1 N.O. |
| D2P | 1 N.C. |
| AP | 1 N.O. - 1 N.C. |
| BP | 2 N.O. - 2 N.C |
| **Stackable Sealed Switch** | |
| D1Y | 1 N.O. |
| D2Y | 1 N.C. |
| A2Y | 2 N.O. |
| A4Y | 2 N.C. |
| AY | 1 N.O. - 1 N.C. |
| BY | 2 N.O. - 2 N.C |

**Time Delay Contacts**

Series C field installable kits can only be used with Series T or later operators. Adjustable range of 0.5 to 15 s + 25%. Maximum continuous current Ith 5 A.

**Snap Action Contacts**

Snap-action contacts feature a quick make, quick break snap-action mechanism that is only available on factory assembled units. Maximum continuous current $I_{th}$ 10 A.

∗ Underlying operators are "flush head" type, except red which are "extended head". Boot material is chlorosulfonated polyethylene.
❄ Not available for booted operators.
‡ A2 and A2R contact blocks cannot be stacked upon, but can stack on other contact blocks.
§ Jumbo mushroom heads not available in white color.

## 2-Position Red Push-Pull and Push-Pull/Twist Release Devices, Non-Illuminated

**Note:** A jumbo or large legend plate is recommended, if space allows.

*2-Position Push-Pull*
***Cat. No. 800T-FX6D4***

*2-Position Metal Push-Pull*
***Cat. No. 800T-FXLE6D4S***

*2-Position Push-Pull / Twist*
***Cat. No. 800T-FXT6D4***

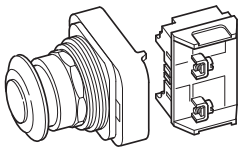
*2-Position Push-Pull / Twist*
***Cat. No. 800H-FRXT6D4***

| Contact Type | Operator Position: Out | Operator Position: In | Type 4/13: Push-Pull — 40 mm | Type 4/13: Push-Pull — 63 mm Metal | Type 4/13: Push-Pull/Twist Release | Type 4/4X/13: Push-Pull/Twist Release |
|---|---|---|---|---|---|---|
| | | | Cat. No. | Cat. No. | Cat. No. | Cat. No. |
| N.C.L.B.∗ | X | O | **800T-FX6D4** | **800T-FXLE6D4** | **800T-FXT6D4** | **800H-FRXT6D4** |
| N.O. - N.C.L.B.∗ | O<br>X | X<br>O | **800T-FX6A1** | 800T-FXLE6A1 | **800T-FXT6A1** | **800H-FRXT6A1** |
| N.C.L.B. - N.C.L.B.∗ | X<br>X | O<br>O | **800T-FX6A5** | 800T-FXLE6A5 | **800T-FXT6A5** | **800H-FRXT6A5** |
| S.M.C.B.∗❄ | X | O | **800TC-FX6D4S** | 800TC-FXLE6D4S | 800TC-FXT6D4S | 800HC-FRXT6D4S |
| N.O. - S.M.C.B.∗❄ | O<br>X | X<br>O | 800TC-FX6A1S | 800TC-FXLE6A1S | 800TC-FXT6A1S | 800HC-FRXT6A1S |
| S.M.C.B. - S.M.C.B∗❄ | X<br>X | O<br>O | **800TC-FX6A5S** | **800TC-FXLE6A5S** | **800TC-FXT6A5S** | **800HC-FRXT6A5S** |

**Note:** X = Closed/O = Open **Note:** These caps are only available in plastic.

**Note:** Emergency stop push buttons are compliant with EN ISO 13850 and EN/IEC 60947-5-5 Standards when using N.C.L.B. contact blocks.

❄ The Self Monitoring Contact Block (S.M.C.B.) is composed of a N.C.L.B. contact wired in series with a N.O. monitoring contact. The N.O. monitoring contact automatically closes when the S.M.C.B. is properly installed onto the E-stop operator. If the S.M.C.B. is separated from the E-stop operator, the N.O. monitoring contact will automatically open.



**800 T – FX 1 A1**
*a b c d e*

### a

| Protection Rating | |
|---|---|
| Code | Description |
| T | Metal, Type 4/13 |
| H | Plastic, Type 4/4X/13 |

### b

| Finger-Safe Guards | |
|---|---|
| Code | Description |
| Blank | No guards |
| C | Guards on terminals |

### c

| Head Type‡ | | |
|---|---|---|
| 800T Type 4/13 Code | Description | 800H Type 4/4X/13 Code |
| FX | Mushroom head (push-pull) | — |
| FXC | 90 mm anodized aluminum head (push-pull) | — |
| FXJ | Jumbo mushroom head (push-pull) | — |
| FXJE | Jumbo mushroom head (push-pull) with "E-Stop" | — |
| FXL | 63 mm anodized aluminum head (push-pull) | — |
| FXLE | 63 mm anodized aluminum head (push-pull) with "E-Stop" | — |
| FXT | Push-pull/twist-to-release | FRXT |
| FXJT | Jumbo head push-pull with twist-to-release | FRXJT |

### d

| Color Cap | |
|---|---|
| Code | Color |
| Blank | No cap§ |
| 1 | Green |
| 2 | Black |
| 3 | Orange |
| 4 | Grey |
| 5 | White |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow |

### e

| Contact Block(s) | | | |
|---|---|---|---|
| Code | Operator Position: Out | Operator Position: In | Description |
| Blank | — | — | No contacts on operator |
| **Standard** | | | |
| D1 | O | X | 1 N.O. |
| D2 | X | O | 1 N.C. |
| D4 | X | O | 1 N.C.L.B. |
| A | O<br>X | X<br>O | 1 N.O. - 1 N.C. |
| A1 | O<br>X | X<br>O | 1 N.O. - 1 N.C.L.B. |
| A5 | X<br>X | O<br>O | 2 N.C.L.B. |

### e (cont'd)

| Contact Block(s) | | | |
|---|---|---|---|
| Code | Operator Position: Out | Operator Position: In | Description |
| Blank | — | — | No contacts |
| **PenTUFF (Low Voltage)** | | | |
| D1V | O | X | 1 N.O. |
| D2V | X | O | 1 N.C. |
| D4V | X | O | 1 N.C.L.B. |
| AV | O<br>X | X<br>O | 1 N.O. - 1 N.C. |
| **Class 1, Div. 2/Zone 2** | | | |
| **Logic Reed** | | | |
| D1R | O | X | 1 N.O. |
| D2R | X | O | 1 N.C. |
| AR | O<br>X | X<br>O | 1 N.O. - 1 N.C. |
| **Sealed Switch** | | | |
| D1P | O | X | 1 N.O. |
| D2P | X | O | 1 N.C. |
| AP | O<br>X | X<br>O | 1 N.O.<br>1 N.C. |
| **Stackable Sealed Switch** | | | |
| D1Y | O | X | 1 N.O. |
| D2Y | X | O | 1 N.C. |
| AY | O<br>X | X<br>O | 1 N.O. - 1 N.C. |

**Note:** X = Closed/O = Open

∗ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN in the OUT position, the electrical contacts change state before the mechanical detent occurs.

‡ Devices with N.C.L.B. contacts meet EN ISO 13850 and IEC 60947-5-5 standards for emergency stop applications.

§ Not valid with head Type J or JT.

Allen-Bradley

# PowerFlex 520-Series AC Drive Specifications

Original Instructions

| Topic | Page |
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LISTEN. THINK. SOLVE.®

# Product Overview

The PowerFlex® 520-Series AC drive delivers an innovative design that is remarkably versatile and can accommodate systems ranging from standalone machines to simple system integration. The PowerFlex 523 drive provides general purpose control for applications ranging up to 30 HP and 22 kW. The PowerFlex 525 drive provides maximum flexibility and performance ranging up to 30 HP and 22 kW.

By combining a variety of motor control options, communications, energy savings and standard safety features in a cost-effective drive, the PowerFlex 520-Series drive is suitable for a wide array of applications.

Maximize your system performance and productivity by taking advantage of the following key features offered in a PowerFlex 520-Series drive.

# PowerFlex 520-Series AC Drives Feature

## Modular Design

- Detachable control module and power module allow **simultaneous configuration and installation**.
- Each drive has **a standard control module** used across the entire power range.
- **MainsFree™ configuration** allows you to simply connect your control module to a PC with a standard USB cable and quickly upload, download, and flash the drive with new settings.
- **Support for accessory cards** without affecting footprint.
  (PowerFlex 523 drives support one, PowerFlex 525 drives support two)

## Packaging and Mounting

- Installation can be quick and easy using the **DIN rail mounting** feature on A, B, and C frame drives. Panel mounting is also available, providing added flexibility.
- **Zero Stacking™** is allowed for ambient temperatures up to 45 °C, saving valuable panel space.
- **Integral filtering** is available on all 200V and 400V ratings, providing a cost-effective means of meeting EN61800-3 Category C2 and C3 EMC requirements. External filters provide compliance to EN61800-3 Category C1, C2, and C3 EMC requirements for all PowerFlex 520-Series ratings.
- An optional **IP 30, NEMA/UL Type 1 conduit box** is easily adapted to the standard IP 20 (NEMA Type Open) product, providing increased environmental ratings.

## Optimized Performance

- **Removable MOV** to ground provides trouble-free operation when used on ungrounded distribution systems.
- A **relay pre-charge** limits inrush current.
- **Integral brake transistor**, available on all ratings, provides dynamic braking capability with simple low cost brake resistors.
- A jumper to switch between **24V DC sink or source control** for control wiring flexibility.
- **Dual Overload Rating** available for drives above 15 HP/11 kW. Normal duty: 110% overload for 60 seconds or 150% for 3 seconds. Heavy duty: 150% overload for 60 seconds or 180% overload (200% programmable) for 3 seconds provides robust overload protection.
- **Adjustable PWM frequency up to 16 kHz** ensures quiet operation.

# PowerFlex 520-Series AC Drive Advanced Features

## Control Performance

- **Variety of motor control options, including:**
  - Volts per hertz (V/Hz)
  - Sensorless Vector Control (SVC)
  - Closed loop velocity vector control (PowerFlex 525 drives only)
- **Variety of Positioning Control, including:**
  - PointStop™ stops motor load in a consistent position without encoder feedback
  - Closed loop feedback with an optional encoder card (PowerFlex 525 drives only)
  - Point-to-point positioning mode (PowerFlex 525 drives only)
- **Integral PID** functionality enhances application flexibility (PowerFlex 523 drives have one PID loop, PowerFlex 525 drives have two PID loops)

## I/O Wiring

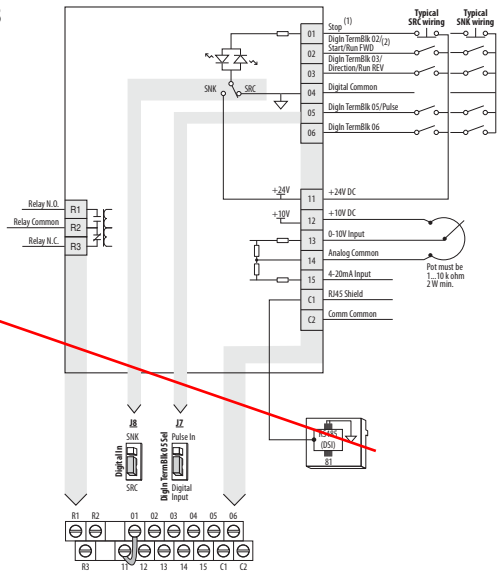
### *PowerFlex 523*

- **Two (2) Analog Inputs** (two unipolar) are independently isolated from the rest of the drive I/O.
- **Five (5) Digital Inputs** (four programmable) provide application versatility.
- **One (1) Relay Output** (form C) can be used to indicate various drive, motor or logic conditions.

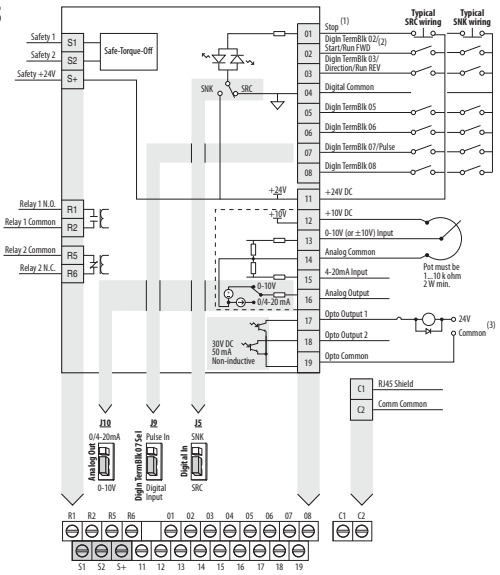
### *PowerFlex 525*

- **Two (2) Analog Inputs** (one unipolar and one bipolar) are independently isolated from the rest of the drive I/O. These inputs can be toggled via a digital input.
- **Seven (7) Digital Inputs** (six programmable) provide application versatility.
- **One (1) Analog Output** is jumper selectable between either 0-10V or 0-20 mA. This scalable, 10-bit output is suitable for metering or as a speed reference for another drive.
- **Two (2) Opto Outputs and two (2) Relay Outputs** (one form A and one form B) can be used to indicate various drive, motor or logic conditions.

**PowerFlex 523 Control I/O Wiring Block Diagram**




**PowerFlex 525 Control I/O Wiring Block Diagram**



## Communications

- **Embedded EtherNet/IP™ port** allows easy configuration, control, and collection of drive data over the network. (PowerFlex 525 drives only)
- **Dual port EtherNet/IP option card** supports Device Level Ring (DLR) topologies, providing **fault-tolerant connectivity** for optimum drive availability.
- **Integral RS485/DSI communications** enable the drives to be used in a multi-drop network configuration.
- Optional communication cards such as **DeviceNet™**, and **PROFIBUS DP™** can improve machine performance.
- **Online EDS file creation** with RSNetWorx™ providing ease of set-up on a network.

## Optimized for Common DC Bus Installations

### Enhanced Control of Internal Pre-charge

**Common DC Bus** offers additional inherent breaking capabilities by utilizing all the drives/loads on the bus for energy absorption offering higher efficiency and cost savings. The PowerFlex 520-Series drive has been optimized for use in **Common DC Bus** or **Shared DC Bus installation**s.

- Configurable pre-charge control using digital inputs.
- Direct DC Bus connection to power terminal blocks.

## Improved Ride Through

### Operation Down to 1/2 Line Voltage

The PowerFlex 520-Series drive allows for the selection of **1/2 DC Bus operation**, for use in critical applications where continued drive output is desired even in the event of brown out or low voltage conditions. The PowerFlex 520-Series drive also supports **enhanced inertia ride through** for additional low voltage mitigation.

- Selectable 1/2 line voltage operation.
- Increased power loss ride through.

*Additional Features of PowerFlex 525 Drives*

## Closed Loop Feedback

### Encoder/Pulse Train Input

The PowerFlex 525 drive allows for configurable closed loop control with an optional encoder card for either speed or position feedback for improved speed regulation, basic position control, or other pulse inputs for motor control.

- Improved speed regulation
- Basic position control

## Basic Position Control

### Local Position Control

- Position regulator with StepLogic™
  - 8 positions (local logic)

### Outer Position Control Loop

- **Analog input bipolar mode** offers improved zero-cross performance.
- **Simple motion control** applications with more complex position profiles.
- **Speed reference** supplied to drive via Analog Input or multiple field bus network options.
- **Speed ratio** available for simple draw applications.

## Feedback Details

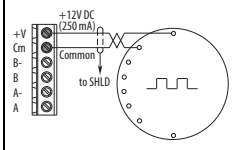
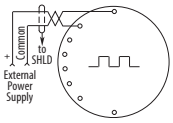
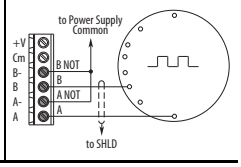
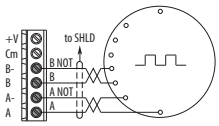
### Line Driver Type Incremental Encoder Option Card

- Quadrature (dual channel) or Single Channel
- 5V/12V DC supply, 10 mA min per channel
- Single Ended or Differential (A, B Channel)
- Duty Cycle of 50%, +10%
- Input Frequency up to 250 kHz

### Pulse Train Input

- Configurable Input Voltage 5V/12V/24V DC autodetect
- Input Frequency up to 100 kHz

**Encoder Wiring Examples**

| I/O | Connection Example | I/O | Connection Example |
|---|---|---|---|
| **Encoder Power – Internal Drive Power** Internal (drive) 12V DC, 250 mA |  | **Encoder Power – External Power Source** |  |
| **Encoder Signal – Single-Ended, Dual Channel** |  | **Encoder Signal – Differential, Dual Channel** |  |

## Safety Inside using Safe-Torque-Off Function

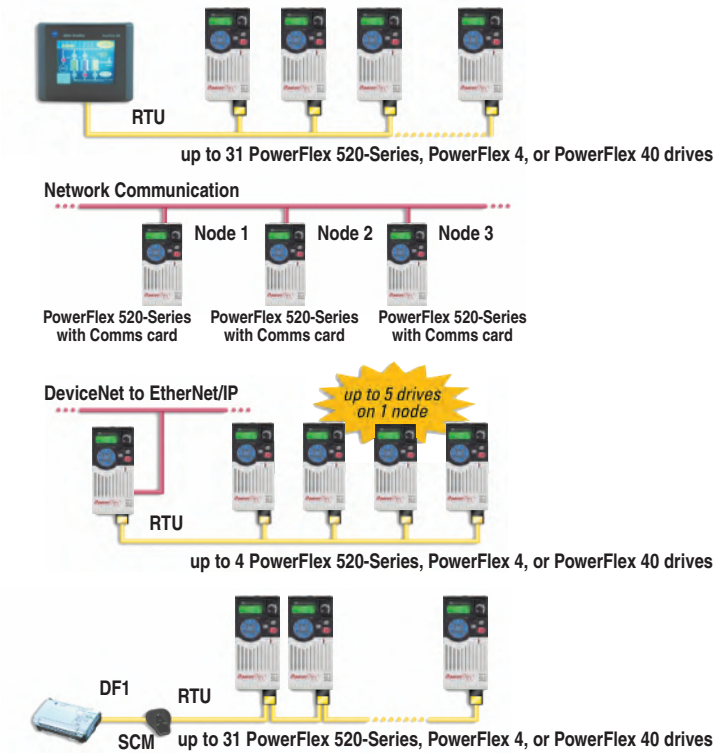
Safe Torque-Off is a standard safety feature of the PowerFlex 525 drive to help protect personnel and equipment. Safe Torque-off allows you to restart your application faster after a safety-related situation.

- Safe Torque-Off functionality **removes rotational power without powering down the drive**.
- Embedded safety **reduces wiring and saves on installation space**.
- Meets ISO 13849-1 standards and provides safety ratings up to and including **SIL 2/PLd**.

# Communications and Software

## Versatile Programming and Network Solutions

- PowerFlex 520-Series drives are compatible with any device that acts as a **RTU Master** and supports standard 03 and 06 RTU commands.
- A network can be configured using PowerFlex 520-Series drives for **high performance and flexible configuration** capabilities.
  - Embedded port for EtherNet/IP (PowerFlex 525 drives only)
  - EtherNet/IP dual-port option card
  - DeviceNet option card
  - PROFIBUS DP option card
- A **multi-drive solution** can be reached using a single PowerFlex 520-Series drive, with the ability for up to five (5) drives to reside on one (1) node.
- **Integral RS485** communications enable the drives to be used in a multi-drop network configuration. A serial converter module (SCM) provides connectivity to any controller with a DF1 port. The SCM can be eliminated if the controller acts as a RTU Master.




## PC Programming Software

### Connected Components Workbench™

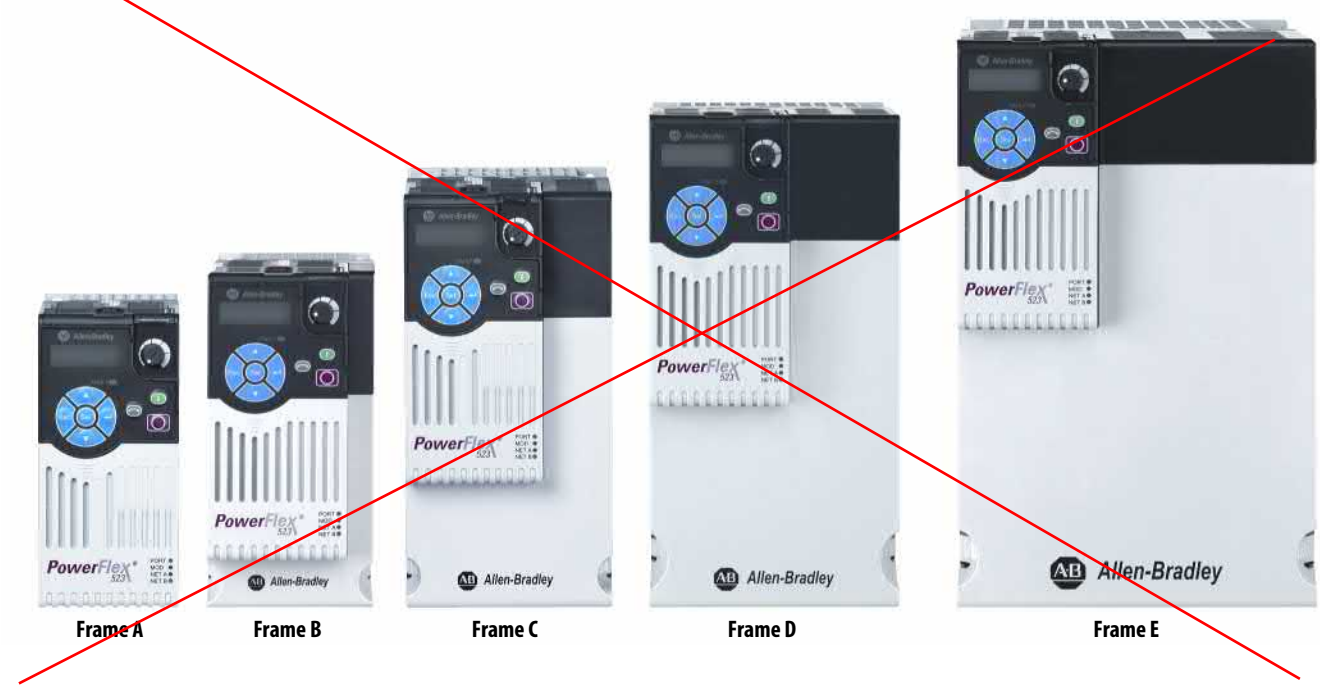
- Supports plug-and-play connectivity through a standard USB connection.
- AppView™ tool provides parameter groups for several of the most common applications.
- Create and save custom parameter groups using the CustomView™ tool.
- Supports PowerFlex drives, Micro800™ controllers and PanelView™ component graphic terminals.

### Studio 5000™ Logix Designer

- Add-on profiles (AOPs) for PowerFlex 520-seriers AC drives provide seamless integration into the Logix environment.
- Configuration files from Studio 5000 Logix Designer(1) can be transferred directly to the PowerFlex 520-Series drive over EtherNet/IP.
- Automatic Device Configuration (ADC) uploads configuration parameters to a replaced drive, minimizing the need for a manual reconfiguration.

(1) The Logix Designer application is the rebranding of RSLogix 5000 software. You can also use RSLogix 5000 version 17 or greater.

## PowerFlex 523 Drive Family




Frame A Frame B Frame C Frame D Frame E

## PowerFlex 525 Drive Family

Frame A Frame B Frame C Frame D Frame E

# Catalog Number Explanation

| 1-3 | 4 | 5 | 6-8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| **25B** | **–** | **B** | **2P3** | **N** | **1** | **1** | **4** | **–** | **–** |
| Drive | Dash | Voltage Rating | Rating | Enclosure | Reserved | Emission Class | Reserved | Dash | Dash |

| Code | Type |
|---|---|
| 25A | PowerFlex 523 |
| 25B | PowerFlex 525 |

| Code | Voltage | Phase |
|---|---|---|
| V | 120V AC | 1 |
| A | 240V AC | 1 |
| B | 240V AC | 3 |
| D | 480V AC | 3 |
| E | 600V AC | 3 |

| Code | Enclosure |
|---|---|
| N | IP20 NEMA / Open |

| Code | Interface Module |
|---|---|
| 1 | Standard |

| Code | EMC Filter |
|---|---|
| 0 | No Filter |
| 1 | Filter |

| Code | Braking |
|---|---|
| 4 | Standard |

**Output Current @ 1 Phase, 100...120V Input**

| Code | Amps | Frame | ND | | HD | |
|---|---|---|---|---|---|---|
| | | | HP | kW | HP | kW |
| 1P6[1] | 1.6 | A | 0.25 | 0.2 | 0.25 | 0.2 |
| 2P5 | 2.5 | A | 0.5 | 0.4 | 0.5 | 0.4 |
| 4P8 | 4.8 | B | 1.0 | 0.75 | 1.0 | 0.75 |
| 6P0 | 6.0 | B | 1.5 | 1.1 | 1.5 | 1.1 |

**Output Current @ 1 Phase, 200...240V Input**

| Code | Amps | Frame | ND | | HD | |
|---|---|---|---|---|---|---|
| | | | HP | kW | HP | kW |
| 1P6[1] | 1.6 | A | 0.25 | 0.2 | 0.25 | 0.2 |
| 2P5 | 2.5 | A | 0.5 | 0.4 | 0.5 | 0.4 |
| 4P8 | 4.8 | A | 1.0 | 0.75 | 1.0 | 0.75 |
| 8P0 | 8.0 | B | 2.0 | 1.5 | 2.0 | 1.5 |
| 011 | 11.0 | B | 3.0 | 2.2 | 3.0 | 2.2 |

**Output Current @ 3Phase, 200...240V Input**

| Code | Amps | Frame | ND | | HD | |
|---|---|---|---|---|---|---|
| | | | HP | kW | HP | kW |
| 1P6[1] | 1.6 | A | 0.25 | 0.2 | 0.25 | 0.2 |
| 2P5 | 2.5 | A | 0.5 | 0.4 | 0.5 | 0.4 |
| 5P0 | 5.0 | A | 1.0 | 0.75 | 1.0 | 0.75 |
| 8P0 | 8.0 | A | 2.0 | 1.5 | 2.0 | 1.5 |
| 011 | 11.0 | A | 3.0 | 2.2 | 3.0 | 2.2 |
| 017 | 17.5 | B | 5.0 | 4.0 | 5.0 | 4.0 |
| 024 | 24.0 | C | 7.5 | 5.5 | 7.5 | 5.5 |
| 032 | 32.2 | D | 10.0 | 7.5 | 10.0 | 7.5 |
| 048[2] | 48.3 | E | 15.0 | 11.0 | 10.0 | 7.5 |
| 062[2] | 62.1 | E | 20.0 | 15.0 | 15.0 | 11.0 |

**Output Current @ 3 Phase, 380...480V Input**

| Code | Amps | Frame | ND | | HD | |
|---|---|---|---|---|---|---|
| | | | HP | kW | HP | kW |
| 1P4 | 1.4 | A | 0.5 | 0.4 | 0.5 | 0.4 |
| 2P3 | 2.3 | A | 1.0 | 0.75 | 1.0 | 0.75 |
| 4P0 | 4.0 | A | 2.0 | 1.5 | 2.0 | 1.5 |
| 6P0 | 6.0 | A | 3.0 | 2.2 | 3.0 | 2.2 |
| 010 | 10.5 | B | 5.0 | 4.0 | 5.0 | 4.0 |
| 013 | 13.0 | C | 7.5 | 5.5 | 7.5 | 5.5 |
| 017 | 17.0 | C | 10.0 | 7.5 | 10.0 | 7.5 |
| 024 | 24.0 | D | 15.0 | 11.0 | 15.0 | 11.0 |
| 030[2] | 30.0 | D | 20.0 | 15.0 | 15.0 | 11.0 |
| 037[2] | 37.0 | E | 25.0 | 18.5 | 20.0 | 15.0 |
| 043[2] | 43.0 | E | 30.0 | 22.0 | 25.0 | 18.5 |

**Output Current @ 3 Phase, 525...600V Input**

| Code | Amps | Frame | ND | | HD | |
|---|---|---|---|---|---|---|
| | | | HP | kW | HP | kW |
| 0P9 | 0.9 | A | 0.5 | 0.4 | 0.5 | 0.4 |
| 1P7 | 1.7 | A | 1.0 | 0.75 | 1.0 | 0.75 |
| 3P0 | 3.0 | A | 2.0 | 1.5 | 2.0 | 1.5 |
| 4P2 | 4.2 | A | 3.0 | 2.2 | 3.0 | 2.2 |
| 6P6 | 6.6 | B | 5.0 | 4.0 | 5.0 | 4.0 |
| 9P9 | 9.9 | C | 7.5 | 5.5 | 7.5 | 5.5 |
| 012 | 12.0 | C | 10.0 | 7.5 | 10.0 | 7.5 |
| 019 | 19.0 | D | 15.0 | 11.0 | 15.0 | 11.0 |
| 022[2] | 22.0 | D | 20.0 | 15.0 | 15.0 | 11.0 |
| 027[2] | 27.0 | E | 25.0 | 18.5 | 20.0 | 15.0 |
| 032[2] | 32.0 | E | 30.0 | 22.0 | 25.0 | 18.5 |

(1) This rating is only available for PowerFlex 523 drives.

(2) Normal and Heavy Duty ratings are available for this drive.

# Technical Specifications

## *Protection*

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Bus Overvoltage Trip | | |
| 100...120V AC Input: | 405V DC bus (equivalent to 150V AC incoming line) | |
| 200...240V AC Input: | 405V DC bus (equivalent to 290V AC incoming line) | |
| 380...480V AC Input: | 810V DC bus (equivalent to 575V AC incoming line) | |
| 525...600V AC Input: | 1005V DC bus (equivalent to 711V AC incoming line) | |
| Bus Undervoltage Trip | | |
| 100...120V AC Input: | 190V DC bus (equivalent to 75V AC incoming line) | |
| 200...240V AC Input: | 190V DC bus (equivalent to 150V AC incoming line) | |
| 380...480V AC Input: | 390V DC bus (equivalent to 275V AC incoming line) | |
| 525...600V AC Input | | |
| P038 = 3 "600V": | 487V DC bus (equivalent to 344V AC incoming line) | |
| P038 = 2 "480V": | 390V DC bus (equivalent to 275V AC incoming line) | |
| Power Ride-Thru: | 100 ms | |
| Logic Control Ride-Thru: | 0.5 s minimum, 2 s typical | |
| Electronic Motor Overload Protection: | Provides class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A) (2). UL 508C File 29572. | |
| Overcurrent: | 200% hardware limit, 300% instantaneous fault | |
| Ground Fault Trip: | Phase-to-ground on drive output | |
| Short Circuit Trip: | Phase-to-phase on drive output | |

## *Electrical*

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Voltage Tolerance: | -15% / +10% | |
| Frequency Tolerance: | 47...63 Hz | |
| Input Phases: | Three-phase input provides full rating. Single-phase input provides 35% rating on three-phase drives. | |
| Displacement Power Factor: | 0.98 across entire speed range | |
| Maximum Short Circuit Rating: | 100,000 Amps Symmetrical | |
| Actual Short Circuit Rating: | Determined by AIC Rating of installed fuse/circuit breaker | |
| Transistor Type: | Isolated Gate Bipolar Transistor (IGBT) | |
| Internal DC Bus Choke | Only for Frame E drive ratings | |
| 200...240V AC Input: | 11 kW (15 HP) | |
| 380...480V AC Input: | 15...18.5 kW (20...25 HP) – Heavy Duty | |
| 525...600V AC Input: | 15...18.5 kW (20...25 HP) – Heavy Duty | |

## *Control*

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Method | Sinusoidal PWM, Volts/Hertz, Sensorless Vector Control, Economizer SVC motor control, and Closed Loop Velocity Vector Control (Closed Loop Velocity Vector Control is not applicable to PowerFlex 523 drives) | |
| Carrier Frequency | 2...16 kHz, Drive rating based on 4 kHz | |
| Frequency Accuracy | | |
| Digital Input: | Within ±0.05% of set output frequency | |
| Analog Input: | Within 0.5% of maximum output frequency, 10-Bit resolution | |
| Analog Output: | – | ±2% of full scale, 10-Bit resolution |

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Performance | | |
| V/Hz (Volts per Hertz): | ±1% of base speed across a 60:1 speed range | |
| SVC (Sensorless Vector): | ±0.5% of base speed across a 100:1 speed range | |
| SVC Economizer: | ±0.5% of base speed across a 100:1 speed range | |
| VVC (Velocity Vector Control): | ±0.5% of base speed across a 60:1 speed range – Not applicable to PowerFlex 523 drives | |
| Performance with Encoder | – | |
| SVC (Sensorless Vector): | | ±0.1% of base speed across a 100:1 speed range |
| SVC Economizer: | | ±0.1% of base speed across a 100:1 speed range |
| VVC (Velocity Vector Control): | | ±0.1% of base speed across a 1000:1 speed range |
| Output Voltage Range: | 0V to rated motor voltage | |
| Output Frequency Range: | 0...500 Hz (programmable) | |
| Efficiency: | 97.5% (typical) | |
| Stop Modes: | Multiple programmable stop modes including – Ramp, Coast, DC-Brake, and Ramp-to-Stop | |
| Accel/Decel: | Four independently programmable accel and decel times. Each time may be programmed from 0...600 s in 0.01 s increments. | |
| Intermittent Overload | | |
| Normal Duty: | – | 110% Overload capability for up to 60 s, 150% for up to 3 s<br>Applies for power rating above 15 kW (20 HP) only. Based on 480V drive rating. |
| Heavy Duty: | 150% Overload capability for up to 60 s, 180% for up to 3 s (200% programmable) | |

## *Control Inputs*

| Specifications | | PowerFlex 523 | PowerFlex 525 |
|---|---|---|---|
| Digital | Bandwidth: | 10 Rad/s for open and closed loop | |
| | Quantity: | (1) Dedicated for stop<br>(4) Programmable | (1) Dedicated for stop<br>(6) Programmable |
| | Current: | 6 mA | |
| | Type | | |
| | Source Mode (SRC): | 18...24V = ON, 0...6V = OFF | |
| | Sink Mode (SNK): | 0...6V = ON, 18...24V = OFF | |
| | Pulse Train | | |
| | Quantity: | (1) Shared with one of the programmable digital input terminals. | |
| | Input Signal: | Transistor contact (open collector) | |
| | Input Frequency: | 0...100 kHz | |
| | Current Consumption: | 7 mA @ 24V DC maximum | |
| Analog | Quantity: | (2) Isolated, 0-10V and 4-20 mA | (2) Isolated, -10-10V and 4-20 mA |
| | Specification | | |
| | Resolution: | 10-bit | |
| | 0-10V DC Analog: | 100k ohm input impedance | |
| | 4-20 mA Analog: | 250 ohm input impedance | |
| | External Pot: | 1...10k ohm, 2 W minimum | |

## *Control Outputs*

| Specifications | | PowerFlex 523 | PowerFlex 525 |
|---|---|---|---|
| Relay | Quantity: | (1) Programmable Form C | (2) 1 Programmable Form A and 1 Programmable Form B |
| | Specification | | |
| | Resistive Rating: | 3.0 A @ 30V DC, 3.0 A @ 125V, 3.0 A @ 240V AC | |
| | Inductive Rating: | 0.5 A @ 30V DC, 0.5 A @ 125V, 0.5 A @ 240V AC | |

| Specifications | | PowerFlex 523 | PowerFlex 525 |
|---|---|---|---|
| Opto | Quantity: | – | (2) Programmable |
| | Specification: | | 30V DC, 50 mA Non-inductive |
| Analog | Quantity: | – | (1) Non-Isolated 0-10V or 4-20 mA |
| | Specification<br>Resolution:<br>0-10V DC Analog:<br>4-20 mA Analog: | | <br>10-bit<br>1 k ohm minimum<br>525 ohm maximum |

## *Encoder*

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Type: | – | Incremental, dual channel |
| Supply: | | 12V, 250 mA |
| Quadrature: | | 90°, ±27° @ 25 °C |
| Duty Cycle: | | 50%, +10% |
| Requirements: | | Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 3.5...26V DC output, single-ended or differential and capable of supplying a minimum of 10 mA per channel.<br>Allowable input is DC up to a maximum frequency of 250 kHz. The encoder I/O automatically scales to allow 5V, 12V and 24V DC nominal voltages. |

# Environmental Specifications

| Specifications | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| Altitude<br>Without derating:<br>With derating: | See Current Derating Curves on page 18 for derating guidelines.<br>1000 m (3300 ft) max.<br>Up to 4000 m (13,200 ft) max., with the exception of 600V drives at 2000 m (6600 ft) max. | |
| Surrounding Air Temperature, max.<br>Without derating:<br>With derating: | See Current Derating Curves on page 18 for derating guidelines.<br>-20...50 °C (-4...122 °F)<br>-20...60 °C (-4...140 °F) or -20...70 °C (-4...158 °F) with optional Control Module Fan kit. | |
| Storage Temperature<br>Frame A...D:<br>Frame E: | <br>-40...85 °C (-40...185 °F)<br>-40...70 °C (-40...158 °F) | |
| Atmosphere: | **IMPORTANT** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere. | |
| Relative Humidity: | 0...95% noncondensing | |
| Shock:<br>Vibration: | Complies with IEC 60068-2-27<br>Complies with IEC 60068-2-6:1995 | |

| Frame Size | Operating and Nonoperating | | Nonoperating (Transportation) | |
|---|---|---|---|---|
| | Force (Shock/Vibration) | Mounting Type | Force (Shock/Vibration) | Mounting Type |
| A | 15 g / 2 g | DIN rail or screw | 30 g/ 2.5 g | Screw only |
| B | 15 g / 2 g | DIN rail or screw | 30 g/ 2.5 g | Screw only |
| C | 15 g / 2 g | DIN rail or screw | 30 g/ 2.5 g | Screw only |
| D | 15 g / 2 g | Screw only | 30 g/ 2.5 g | Screw only |
| E | 15 g / 1.5 g | Screw only | 30 g/ 2.5 g | Screw only |

| | |
|---|---|
| Conformal Coating: | Complies with:<br>IEC 60721-3-3 to level 3C2 (chemical and gases only) |
| Surrounding Environment Pollution Degree<br>Pollution Degree 1 & 2: | <br>All enclosures acceptable. |
| Sound Pressure Level (A-weighted)<br>Frame A & B:<br>Frame C:<br>Frame D:<br>Frame E: | Measurements are taken 1 m from the drive.<br>Maximum 53 dBA<br>Maximum 57 dBA<br>Maximum 64 dBA<br>Maximum 68 dBA |

# Certifications

| Certification | PowerFlex 523 | PowerFlex 525 |
|---|---|---|
| **c-UL-us** | Listed to UL508C and CAN/CSA-C22.2 No. 14-05. | |
| **C-Tick**<br>N223 | Australian Communications and Media Authority<br>In conformity with the following:<br>Radiocommunications Act: 1992<br>Radiocommunications Standard: 2008<br>Radiocommunications Labelling Notice: 2008<br>Standards applied:<br>EN 61800-3:2004 | |
| **CE** | In conformity with the following European Directives:<br>EMC Directive (2004/108/EC)<br>Low Voltage Directive (2006/95/EC)<br>Standards applied:<br>EN 61800-3:2004<br>EN 61800-5-1:2007 | |
| **TUV** | Not applicable | TÜV Rheinland<br>Standards applied:<br>EN ISO 13849-1:2008<br>EN 61800-5-2:2007<br>EN 61508 PARTS 1-7:2010<br>EN 62061:2005<br>EN 60204-1:2009<br>Certified to ISO 13849-1 SIL2/PLd with embedded Safe-Torque-Off function<br>Meets Functional Safety (FS) when used with embedded Safe-Torque-Off function |
| **ATEX**<br>II (2) G D | Not applicable | Certified to ATEX directive 94/9/EC<br>Group II Category (2) GD Applications with ATEX Approved Motors |
| **KCC** | Korean Registration of Broadcasting and Communications Equipment<br>Compliant with the following standards:<br>Article 58-2 of Radio Waves Act, Clause 3 | |
| **GOST-R** | Russian GOST-R Certificate no.<br>POCC US.ME92.H00040 | |
| **AC 156** | Tested by Trentec to be compliant with AC156 Acceptance Criteria for Seismic Qualification Testing of Nonstructural Components and 2003 International Building Code for worst-case seismic level for USA excluding site class F | |
| **EPRI** | Electric Power Research Institute<br>Certified compliant with the following standards:<br>SEMI F47<br>IEC 61000-4-34 | |
| **Lloyds Register** | Not applicable | Lloyd's Register Type Approval Certificate 12/10068(E1) |
| **RoHS** | Compliant with the European "Restriction of Hazardous Substances" Directive | |
| The drive is also designed to meet the appropriate portions of the following specifications:<br>NFPA 70 - US National Electrical Code<br>NEMA ICS 7.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. | | |

# Dimensions and Weights

## *Frame/Rating Cross-Reference*

### Catalog Number Description

| 25B | - | V | 2P5 | N | 1 | 0 | 4 |
|---|---|---|---|---|---|---|---|
| Drive | | Voltage Rating | Rating | Enclosure | HIM | Emission Class | Version |

### PowerFlex 520-Series Drive Ratings

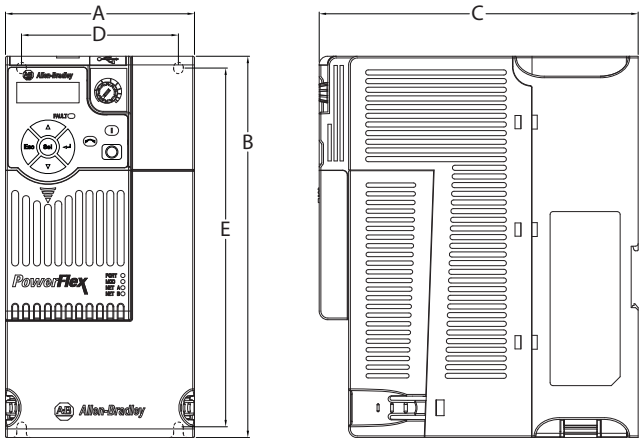
| PowerFlex 523 | PowerFlex 525 | Output Ratings | | | | | Input | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Normal Duty | | Heavy Duty | | Output | | | |
| Catalog No. | Catalog No. | HP | kW | HP | kW | Current (A) | Voltage Range | Total Watts Loss | Frame Size |
| **100...120V AC (-15%, +10%) – 1-Phase Input, 0...230V 3-Phase Output** | | | | | | | | | |
| 25A-V1P6N104 | – | 0.25 | 0.2 | 0.25 | 0.2 | 1.6 | 85...132 | 20.0 | A |
| 25A-V2P5N104 | 25B-V2P5N104 | 0.5 | 0.4 | 0.5 | 0.4 | 2.5 | 85...132 | 27.0 | A |
| 25A-V4P8N104 | 25B-V4P8N104 | 1.0 | 0.75 | 1.0 | 0.75 | 4.8 | 85...132 | 53.0 | B |
| 25A-V6P0N104 | 25B-V6P0N104 | 1.5 | 1.1 | 1.5 | 1.1 | 6.0 | 85...132 | 67.0 | B |
| **200...240V AC (-15%, +10%) – 1-Phase Input, 0...230V 3-Phase Output** | | | | | | | | | |
| 25A-A1P6N104 | – | 0.25 | 0.2 | 0.25 | 0.2 | 1.6 | 85...132 | 20.0 | A |
| 25A-A2P5N104 | 25B-A2P5N104 | 0.5 | 0.4 | 0.5 | 0.4 | 2.5 | 170...264 | 29.0 | A |
| 25A-A4P8N104 | 25B-A4P8N104 | 1.0 | 0.75 | 1.0 | 0.75 | 4.8 | 170...264 | 50.0 | A |
| 25A-A8P0N104 | 25B-A8P0N104 | 2.0 | 1.5 | 2.0 | 1.5 | 8.0 | 170...264 | 81.0 | B |
| 25A-A011N104 | 25B-A011N104 | 3.0 | 2.2 | 3.0 | 2.2 | 11.0 | 170...264 | 111.0 | B |
| **200...240V AC (-15%, +10%) – 1-Phase Input with EMC Filter, 0...230V 3-Phase Output** | | | | | | | | | |
| 25A-A1P6N114 | – | 0.25 | 0.2 | 0.25 | 0.2 | 1.6 | 85...132 | 20.0 | A |
| 25A-A2P5N114 | 25B-A2P5N114 | 0.5 | 0.4 | 0.5 | 0.4 | 2.5 | 170...264 | 29.0 | A |
| 25A-A4P8N114 | 25B-A4P8N114 | 1.0 | 0.75 | 1.0 | 0.75 | 4.8 | 170...264 | 53.0 | A |
| 25A-A8P0N114 | 25B-A8P0N114 | 2.0 | 1.5 | 2.0 | 1.5 | 8.0 | 170...264 | 84.0 | B |
| 25A-A011N114 | 25B-A011N114 | 3.0 | 2.2 | 3.0 | 2.2 | 11.0 | 170...264 | 116.0 | B |
| **200...240V AC (-15%, +10%) – 3-Phase Input, 0...230V 3-Phase Output** | | | | | | | | | |
| 25A-B1P6N104 | – | 0.25 | 0.2 | 0.25 | 0.2 | 1.6 | 85...132 | 20.0 | A |
| 25A-B2P5N104 | 25B-B2P5N104 | 0.5 | 0.4 | 0.5 | 0.4 | 2.5 | 170...264 | 29.0 | A |
| 25A-B5P0N104 | 25B-B5P0N104 | 1.0 | 0.75 | 1.0 | 0.75 | 5.0 | 170...264 | 50.0 | A |
| 25A-B8P0N104 | 25B-B8P0N104 | 2.0 | 1.5 | 2.0 | 1.5 | 8.0 | 170...264 | 79.0 | A |
| 25A-B011N104 | 25B-B011N104 | 3.0 | 2.2 | 3.0 | 2.2 | 11.0 | 170...264 | 107.0 | A |
| 25A-B017N104 | 25B-B017N104 | 5.0 | 4.0 | 5.0 | 4.0 | 17.5 | 170...264 | 148.0 | B |
| 25A-B024N104 | 25B-B024N104 | 7.5 | 5.5 | 7.5 | 5.5 | 24.0 | 170...264 | 259.0 | C |
| 25A-B032N104 | 25B-B032N104 | 10.0 | 7.5 | 10.0 | 7.5 | 32.2 | 170...264 | 323.0 | D |
| 25A-B048N104 | 25B-B048N104 | 15.0 | 11.0 | 10.0 | 7.5 | 48.3 | 170...264 | 584.0 | E |
| 25A-B062N104 | 25B-B062N104 | 20.0 | 15.0 | 15.0 | 11.0 | 62.1 | 170...264 | 708.0 | E |
| **380...480V AC (-15%, +10%) – 3-Phase Input, 0...460V 3-Phase Output[1]** | | | | | | | | | |
| 25A-D1P4N104 | 25B-D1P4N104 | 0.5 | 0.4 | 0.5 | 0.4 | 1.4 | 323...528 | 27.0 | A |
| 25A-D2P3N104 | 25B-D2P3N104 | 1.0 | 0.75 | 1.0 | 0.75 | 2.3 | 323...528 | 37.0 | A |
| 25A-D4P0N104 | 25B-D4P0N104 | 2.0 | 1.5 | 2.0 | 1.5 | 4.0 | 323...528 | 80.0 | A |
| 25A-D6P0N104 | 25B-D6P0N104 | 3.0 | 2.2 | 3.0 | 2.2 | 6.0 | 323...528 | 86.0 | A |
| 25A-D010N104 | 25B-D010N104 | 5.0 | 4.0 | 5.0 | 4.0 | 10.5 | 323...528 | 129.0 | B |
| 25A-D013N104 | 25B-D013N104 | 7.5 | 5.5 | 7.5 | 5.5 | 13.0 | 323...528 | 170.0 | C |
| 25A-D017N104 | 25B-D017N104 | 10.0 | 7.5 | 10.0 | 7.5 | 17.0 | 323...528 | 221.0 | C |
| 25A-D024N104 | 25B-D024N104 | 15.0 | 11.0 | 15.0 | 11.0 | 24.0 | 323...528 | 303.0 | D |
| 25A-D030N104 | 25B-D030N104 | 20.0 | 15.0 | 15.0 | 11.0 | 30.0 | 323...528 | 387.0 | D |

| PowerFlex 523 | PowerFlex 525 | Output Ratings | | | | | Input | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Normal Duty | | Heavy Duty | | Output | | | |
| Catalog No. | Catalog No. | HP | kW | HP | kW | Current (A) | Voltage Range | Total Watts Loss | Frame Size |
| **380...480V AC (-15%, +10%) – 3-Phase Input with EMC Filter, 0...460V 3-Phase Output** | | | | | | | | | |
| 25A-D1P4N114 | 25B-D1P4N114 | 0.5 | 0.4 | 0.5 | 0.4 | 1.4 | 323...528 | 27.0 | A |
| 25A-D2P3N114 | 25B-D2P3N114 | 1.0 | 0.75 | 1.0 | 0.75 | 2.3 | 323...528 | 37.0 | A |
| 25A-D4P0N114 | 25B-D4P0N114 | 2.0 | 1.5 | 2.0 | 1.5 | 4.0 | 323...528 | 81.0 | A |
| 25A-D6P0N114 | 25B-D6P0N114 | 3.0 | 2.2 | 3.0 | 2.2 | 6.0 | 323...528 | 88.0 | A |
| 25A-D010N114 | 25B-D010N114 | 5.0 | 4.0 | 5.0 | 4.0 | 10.5 | 323...528 | 133.0 | B |
| 25A-D013N114 | 25B-D013N114 | 7.5 | 5.5 | 7.5 | 5.5 | 13.0 | 323...528 | 175.0 | C |
| 25A-D017N114 | 25B-D017N114 | 10.0 | 7.5 | 10.0 | 7.5 | 17.0 | 323...528 | 230.0 | C |
| 25A-D024N114 | 25B-D024N114 | 15.0 | 11.0 | 15.0 | 11.0 | 24.0 | 323...528 | 313.0 | D |
| 25A-D030N114 | 25B-D030N114 | 20.0 | 15.0 | 15.0 | 11.0 | 30.0 | 323...528 | 402.0 | D |
| 25A-D037N114 | 25B-D037N114 | 25.0 | 18.5 | 20.0 | 15.0 | 37.0 | 323...528 | 602.0 | E |
| 25A-D043N114 | 25B-D043N114 | 30.0 | 22.0 | 25.0 | 18.5 | 43.0 | 323...528 | 697.0 | E |
| **525...600V AC (-15%, +10%) – 3-Phase Input, 0...575V 3-Phase Output** | | | | | | | | | |
| 25A-E0P9N104 | 25B-E0P9N104 | 0.5 | 0.4 | 0.5 | 0.4 | 0.9 | 446...660 | 22.0 | A |
| 25A-E1P7N104 | 25B-E1P7N104 | 1.0 | 0.75 | 1.0 | 0.75 | 1.7 | 446...660 | 32.0 | A |
| 25A-E3P0N104 | 25B-E3P0N104 | 2.0 | 1.5 | 2.0 | 1.5 | 3.0 | 446...660 | 50.0 | A |
| 25A-E4P2N104 | 25B-E4P2N104 | 3.0 | 2.2 | 3.0 | 2.2 | 4.2 | 446...660 | 65.0 | A |
| 25A-E6P6N104 | 25B-E6P6N104 | 5.0 | 4.0 | 5.0 | 4.0 | 6.6 | 446...660 | 95.0 | B |
| 25A-E9P9N104 | 25B-E9P9N104 | 7.5 | 5.5 | 7.5 | 5.5 | 9.9 | 446...660 | 138.0 | C |
| 25A-E012N104 | 25B-E012N104 | 10.0 | 7.5 | 10.0 | 7.5 | 12.0 | 446...660 | 164.0 | C |
| 25A-E019N104 | 25B-E019N104 | 15.0 | 11.0 | 15.0 | 11.0 | 19.0 | 446...660 | 290.0 | D |
| 25A-E022N104 | 25B-E022N104 | 20.0 | 15.0 | 15.0 | 11.0 | 22.0 | 446...660 | 336.0 | D |
| 25A-E027N104 | 25B-E027N104 | 25.0 | 18.5 | 20.0 | 15.0 | 27.0 | 446...660 | 466.0 | E |
| 25A-E032N104 | 25B-E032N104 | 30.0 | 22.0 | 25.0 | 18.5 | 32.0 | 446...660 | 562.0 | E |

(1) A non-filtered drive is not available for 380...480V AC 25 HP (18.5 kW) and 30 HP (22.0 kW) ratings. Filtered drives are available, however you must verify that the application will support a filtered drive.

### *Drive Dimensions and Weight*

Dimensions are in mm and (in.). Weights are in kg and (lb).




| Frame Size | A | B | C | D | E | Weight |
|---|---|---|---|---|---|---|
| A | 72.0 (2.83) | 152.0 (5.98) | 172.0 (6.77) | 57.5 (2.26) | 140.0 (5.51) | 1.1 (2.4) |
| B | 87.0 (3.43) | 180.0 (7.09) | 172.0 (6.77) | 72.5 (2.85) | 168.0 (6.61) | 1.6 (3.5) |
| C | 109.0 (4.29) | 220.0 (8.66) | 184.0 (7.24) | 90.5 (3.56) | 207.0 (8.15) | 2.3 (5.0) |
| D | 130.0 (5.12) | 260.0 (10.24) | 212.0 (8.35) | 116.0 (4.57) | 247.0 (9.72) | 3.9 (8.6) |
| E | 185.0 (7.28) | 300.0 (11.81) | 279.0 (10.98) | 160.0 (6.30) | 280.0 (11.02) | 12.9 (28.4) |

# Design Considerations

## Mounting Considerations

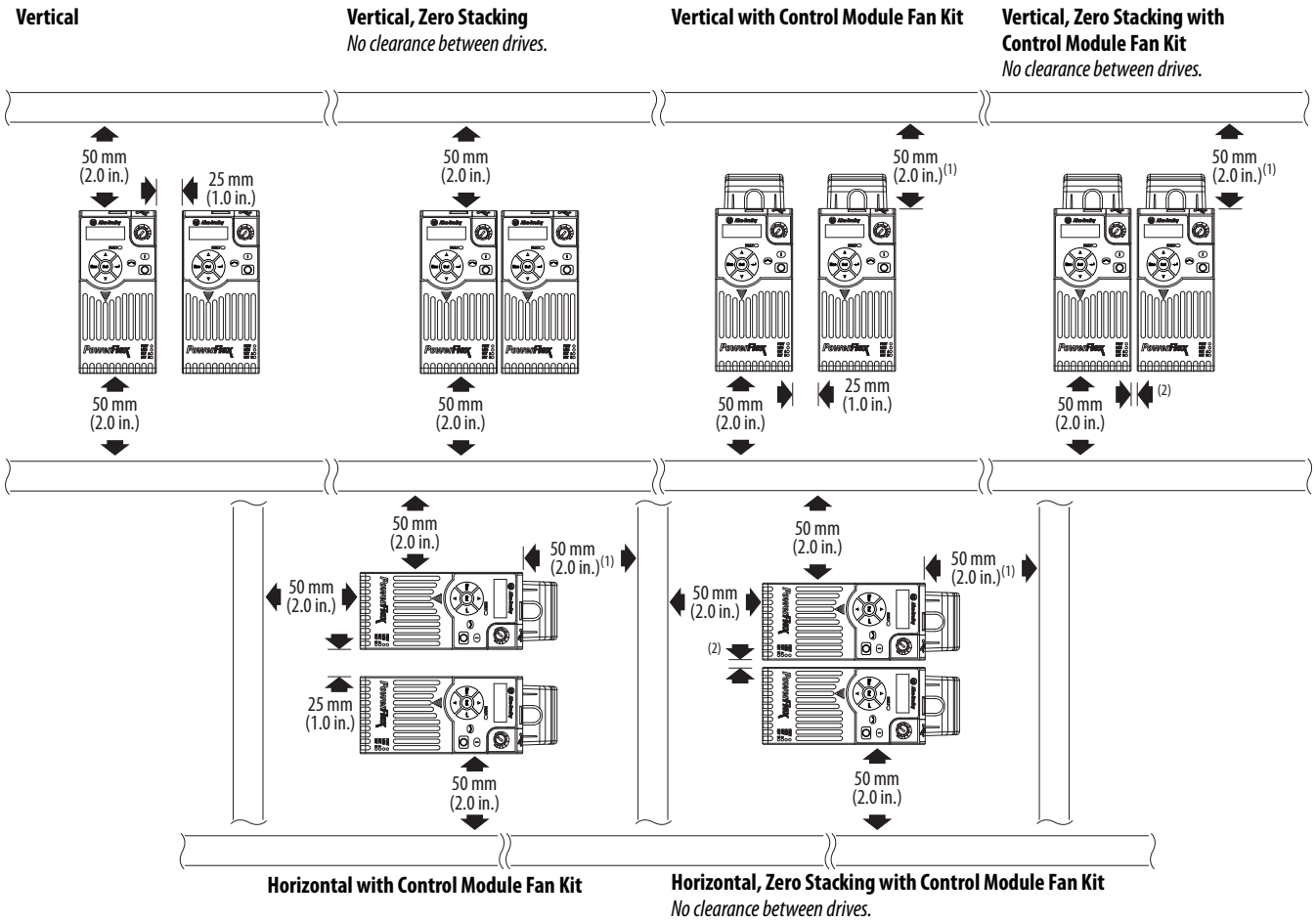
- Mount the drive upright on a flat, vertical and level surface.

| Frame | Screw Size | Screw Torque |
|---|---|---|
| A | M5 (#10...24) | 1.56...1.96 Nm (14...17 lb-in.) |
| B | M5 (#10...24) | 1.56...1.96 Nm (14...17 lb-in.) |
| C | M5 (#10...24) | 1.56...1.96 Nm (14...17 lb-in.) |
| D | M5 (#10...24) | 2.45...2.94 Nm (22...26 lb-in.) |
| E | M8 (5/16 in.) | 6.0...7.4 Nm (53...65 lb-in.) |

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

## *Minimum Mounting Clearances*

See Dimensions and Weights on page 14 for mounting dimensions.




(1) For Frame E with Control Module Fan Kit only, clearance of 95 mm (3.7 in.) is required.

(2) For Frame E with Control Module Fan Kit only, clearance of 12 mm (0.5 in.) is required.

## Ambient Operating Temperatures

See Accessories and Dimensions on page 36 for option kits.

| Mounting | Enclosure Rating[1] | Ambient Temperature | | | |
|---|---|---|---|---|---|
| | | Minimum | Maximum (No Derate) | Maximum (Derate)[2] | Maximum with Control Module Fan Kit (Derate)[3][5] |
| Vertical | IP 20/Open Type | -20 °C (-4 °F) | 50 °C (122 °F) | 60 °C (140 °F) | 70 °C (158 °F) |
| | IP 30/NEMA 1/UL Type 1 | | 45 °C (113 °F) | 55 °C (131 °F) | – |
| Vertical, Zero Stacking | IP 20/Open Type | | 45 °C (113 °F) | 55 °C (131 °F) | 65 °C (149 °F) |
| | IP 30/NEMA 1/UL Type 1 | | 40 °C (104 °F) | 50 °C (122 °F) | – |
| Horizontal with Control Module Fan Kit[4][5] | IP 20/Open Type | | 50 °C (122 °F) | – | 70 °C (158 °F) |
| Horizontal, Zero Stacking with Control Module Fan Kit[4][5] | IP 20/Open Type | | 45 °C (113 °F) | – | 65 °C (149 °F) |

(1) IP 30/NEMA 1/UL Type 1 rating requires installation of the PowerFlex 520-Series IP 30/NEMA 1/UL Type 1 option kit, catalog number 25-JBAx.

(2) For catalogs 25x-D1P4N104 and 25x-E0P9N104, the temperature listed under the Max. (Derate) column is reduced by 5 °C (9 °F) for all mounting methods.

(3) For catalogs 25x-D1P4N104 and 25x-E0P9N104, the temperature listed under the Max. with Control Module Fan Kit (Derate) column is reduced by 10 °C (18 °F) for vertical and vertical with zero stacking mounting methods only.

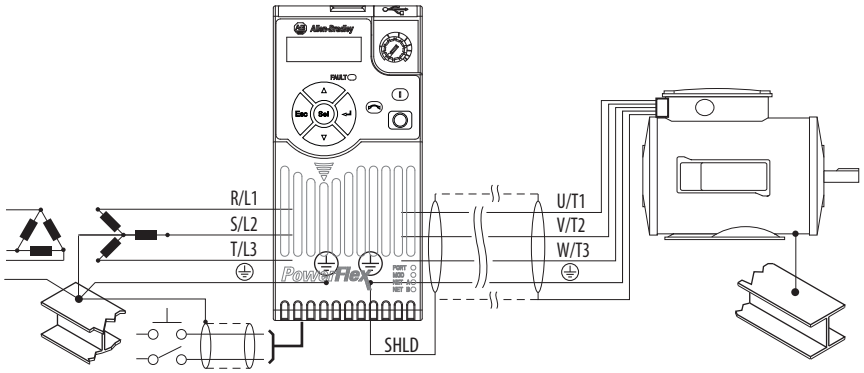
(4) Catalogs 25x-D1P4N104 and 25x-E0P9N104 cannot be mounted using either of the horizontal mounting methods.

(5) Requires installation of the PowerFlex 520-Series Control Module Fan Kit, catalog number 25-FANx-70C.

## General Grounding Requirements

The drive Safety Ground - (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

**Typical Grounding**




### *Ground Fault Monitoring*

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

### *Safety Ground - ⏚ (PE)*

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

### *Motor Ground*

The motor ground must be connected to one of the ground terminals on the drive.

### *Shield Termination - SHLD*

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The earthing plate or conduit box option may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

Allen-Bradley

# CompactLogix Controllers Specifications

### CompactLogix 5370 Controller Catalog Numbers
1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B, 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B, 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM

### 1769 Packaged Controller Catalog Numbers
1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B

### 1769 Modular Controller Catalog Numbers
1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E

### 1768 Controller Catalog Numbers
1768-L43, 1768-L43S, 1768-L45, 1768-L45S

### Memory Card Catalog Numbers
1784-CF128, 1784-SD1, 1784-SD2

| Topic | Page |
|---|---|
| CompactLogix 5370 Controllers | 4 |
| 1769 Packaged CompactLogix Controllers with Embedded I/O | 31 |
| 1769 Modular CompactLogix Controllers | 42 |
| 1768 CompactLogix Controllers | 46 |
| Controller Memory Use | 53 |
| Controller Compatibility | 54 |
| Controller Connections | 57 |
| Determine Total Connection Use | 59 |
| CompactLogix Controller Accessories | 60 |

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**Table 1 - Environmental Specifications - 1768 and 1769 CompactLogix Controllers and CompactLogix 5370 Controllers**

| Attribute | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM | 1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B | 1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E | 1768-L43, 1768-L43S, 1768-L45, 1768-L45S |
|---|---|---|---|---|---|---|
| Temperature, operating<br>IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock) | -20…60 °C<br>(-4…140 °F) | 0…60 °C<br>(32…140 °F) | | | | |
| Temperature, storage<br>IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold),<br>IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat),<br>IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock) | -40…85 °C<br>(-40…185 °F) | | | | | |
| Temperature, surrounding air, max | 60 °C (140 °F) | | | | | |
| Relative humidity<br>IEC 60068-2-30 (Test Db, Unpackaged Damp Heat) | 5...95% noncondensing | | | | | |
| Vibration<br>IEC 60068-2-6 (Test Fc, Operating) | 2 g @ 10…500 Hz[1] | | 5 g @ 10…500 Hz | 2 g @ 10…500 Hz | 5 g @ 10…500 Hz | |
| Shock, operating<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | 30 g[1] | | 20 g - DIN rail<br>30 g - Panel | 30 g | 20 g - DIN rail<br>30 g - Panel | 30 g |
| Shock, nonoperating<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | 50 g[1], [2] | | 30 g - DIN rail<br>40 g - Panel | 50 g | 30 g - DIN rail<br>40 g - Panel | 50 g |
| Emissions<br>CISPR 11 | Group 1, Class A | | | | | |
| ESD immunity<br>IEC 61000-4-2 | 6 kV contact discharges<br>8 kV air discharges | | | 4 kV contact discharges<br>8 kV air discharges | 1769-L31<br>4 kV contact discharges<br>8 kV air discharges<br><br>1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E<br>6 kV contact discharges<br>8 kV air discharges | 6 kV contact discharges<br>8 kV air discharges |

(1) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, you must first adhere a bumper on the back of the controller. Failure to install the bumper before mounting the controller results in the system failing to meet this specification. For more information, see the CompactLogix 5370 Controllers User Manual, publication 1769-UM021.

(2) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, the Shock, nonoperating specification = 30 g.

**Table 1 - Environmental Specifications - 1768 and 1769 CompactLogix Controllers and CompactLogix 5370 Controllers**

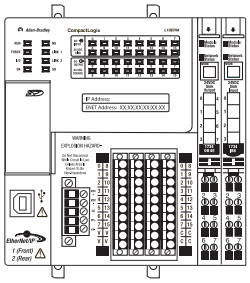
| Attribute | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM | 1769-L23-QBFC1B, 1769-L23E-QB1B, 1769-L23E-QBFC1B | 1769-L31, 1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E | 1768-L43, 1768-L43S, 1768-L45, 1768-L45S |
|---|---|---|---|---|---|---|
| Radiated RF immunity<br>IEC 61000-4-3 | 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz<br>10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz | | | 10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz<br>10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz | 1769-L31, 1769-L32C, 1769-L35CR<br>10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz<br><br>1769-L32E, 1769-L35E<br>10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz<br>3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz | 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz<br>3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz |
| EFT/B immunity<br>IEC 61000-4-4 | ±3 kV at 5 kHz on power ports<br>±3 kV at 5 kHz on signal ports<br>±3 kV at 5 kHz on communication ports | | ±3 kV at 5 kHz on communication ports | ±2 kV at 5 kHz on power ports<br>±2 kV at 5 kHz on signal ports<br>±2 kV at 5 kHz on communication ports | 1769-L31, 1769-L32C, 1769-L35CR<br>±2 kV at 5 kHz on communication ports<br>1769-L32E, 1769-L35E<br>±3 kV at 5 kHz on power ports<br>±3 kV at 5 kHz on communications ports | ±4 kV at 5 kHz on communication ports |
| Surge transient immunity<br>IEC 61000-4-5 | ± 1 kV line-line (DM) and ± 2 kV line-earth (CM) on power ports<br>± 1 kV line-line (DM) and ± 2 kV line-earth (CM) on signal ports<br>±2 kV line-earth (CM) on communication ports | ±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports<br>±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports<br>±2 kV line-earth (CM) on shielded ports<br>±2 kV line-earth (CM) on communication ports | ±2 kV line-earth (CM) on communication ports | ±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports<br>±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports<br>±2 kV line-earth (CM) on shielded ports<br>±2 kV line-earth (CM) on communication ports | 1769-L31<br>Channel 0: ±2 kV line-earth (CM) on shielded ports<br>Channel 1: ±1 kV line-earth (CM) on shielded ports<br><br>1769-L32C, 1769-L35CR, 1769-L32E, 1769-L35E<br>±2 kV line-earth (CM) on communication ports | ±2 kV line-earth (CM) on communication ports |
| Conducted RF immunity<br>IEC 61000-4-6 | 10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz | | | | | |

(1) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, you must first adhere a bumper on the back of the controller. Failure to install the bumper before mounting the controller results in the system failing to meet this specification. For more information, see the CompactLogix 5370 Controllers User Manual, publication 1769-UM021.

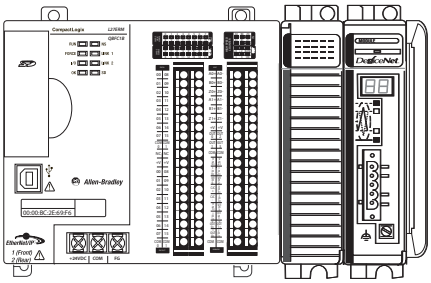
(2) If you are mounting a CompactLogix 5370 L1 controller on a EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail, the Shock, nonoperating specification = 30 g.

# CompactLogix 5370 Controllers

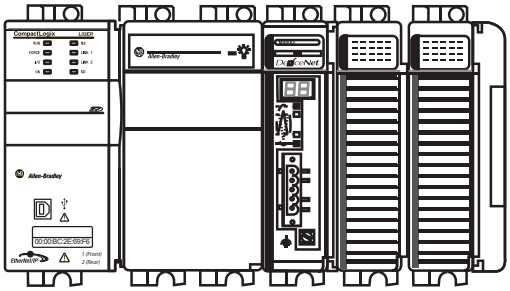
CompactLogix 5370 L1 Control System



CompactLogix 5370 L2 Control System



CompactLogix 5370 L3 Control System



CompactLogix™ 5370 controllers provide scalable controller solutions capable of addressing a wide variety of applications. All CompactLogix 5370 controllers provide the following functionality:

- Two EtherNet/IP ports
- One USB port
- Support for local expansion modules
- Control of local and distributed I/O modules
- Use of 1784-SD1 or 1784-SD2 secure digital (SD) card for nonvolatile flash memory
- Internal energy storage solution eliminating the need for a battery

Some CompactLogix 5370 controllers provide the following functionality:

- Built-in power supply
- Some combination of embedded digital, analog and high-speed counter modules
- Support for Integrated Motion over an EtherNet/IP network
- Access to DeviceNet networks

**Table 2 - Features - CompactLogix 5370 Controllers**

| Feature | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM |
|---|---|---|---|
| Controller tasks:<br>• Continuous<br>• Periodic | • 32 tasks<br>• 100 programs/task | | |
| Built-in communication ports | • Two EtherNet/IP ports - CompactLogix 5370 controllers have two EtherNet/IP ports to connect to an EtherNet/IP network. The ports carry the same network traffic as part of the controller's embedded switch. However, the controller uses only one IP address.<br>• One USB port (for temporary connection only) | | |
| Communication options | EtherNet/IP | • EtherNet/IP<br>• DeviceNet via 1769-SDN scanner module | |
| EtherNet/IP node, max | • 1769-L16ER-BB1B: Up to four nodes<br>• 1769-L18ER-BB1B, 1769-L18ERM-BB1B: Up to 8 nodes | • 1769-L24ER-QB1B, 1769-L24ER-QBFC1B: Up to 8 nodes<br>• 1769-L27ERM-QBFC1B: Up to 16 nodes | • 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: Up to 16 nodes<br>• 1769-L33ER, 1769-L33ERM: Up to 32 nodes<br>• 1769-L36ERM: Up to 48 nodes |
| Controller connections | 256 | | |
| Embedded I/O modules | • 16 DC digital inputs<br>• 16 DC digital outputs | All controllers:<br>• 16 DC digital inputs<br>• 16 DC digital outputs<br><br>1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B only:<br>• 4 high-speed counters<br>• 4 high-speed counter outputs<br>• 4 universal analog inputs<br>• 2 analog output points | None |

**Table 2 - Features - CompactLogix 5370 Controllers**

| Feature | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM |
|---|---|---|---|
| Sockets, max | 32 | | |
| Integrated Motion over an EtherNet/IP network | 1769-L18ERM-BB1B - 1 or 2 axes | 1769-L27ERM-QBFC1B - As many as 4 axes | • 1769-L30ERM - As many as 4 axes<br>• 1769-L33ERM - As many as 8 axes<br>• 1769-L36ERM - As many as 16 axes |
| Programming languages | • Relay ladder<br>• Structured text<br>• Function block<br>• SFC | | |

**Table 3 - Technical Specifications - CompactLogix 5370 Controllers**

| Attribute | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM |
|---|---|---|---|
| User memory | • 1769-L16ER: 384 KB<br>• 1769-L18ER, 1769-L18ERM: 512 KB | • 1769-L24ER-QB1B, 1769-L24ER-QBFC1B: 750 KB<br>• 1769-L27ERM-QBFC1B: 1 MB | • 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: 1MB<br>• 1769-L33ER, 1769-L33ERM: 2 MB<br>• 1769-L36ERM: 3 MB |
| Optional flash memory | 1784-SD1 card with 1 Gb of available memory (shipped with controller)<br>1784-SD2 card with 2 Gb of available memory (available for separate ordering) | | |
| Number of local expansion modules, max | • 1769-L16ER-BB1B: Six 1734 POINT I/O modules<br>• 1769-L18ER-BB1B, 1769-L18ERM-BB1B: Eight 1734 POINT I/O modules | Four 1769 Compact I/O modules | • 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM: Eight 1769 Compact I/O™ modules<br>• 1769-L33ER, 1769-L33ERM: Sixteen 1769 Compact I/O modules<br>• 1769-L36ERM: Thirty 1769 Compact I/O modules |
| Number of I/O module banks, max | NA | 1 | 3 |
| Current draw @ 5V DC | 1 A | • 1769-L24ER-QB1B: 1.54 A<br>Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).<br>• 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 1 A<br>Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F). | 500 mA |
| Current draw @ 24V DC | Power supply: 4 A Class 2<br>Input: 5 mA<br>Output:<br>• 500 mA, max per channel<br>• 3 A, max per module, pilot duty | • 1769-L24ER-QB1B: 0.95A<br>Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F).<br>• 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B: 0.8 A<br>Value rated at the following ambient temperatures: 40 °C (104 °F), 55 °C (131 °F), 60 °C (140 °F). | 225 mA |
| Power dissipation, max | 12 W | • 1769-L24ER-QB1B: 12 W<br>• 1769-L24ER-QBFC1B, L27ERM-QBFC1B: 21 W | 4.5 W |
| Isolation voltage | 50V (continuous), Basic Insulation Type<br>Tested at 500V AC for 60 s, System to Field | 30V (continuous), Basic Insulation Type, USB to system, Ethernet to system and Ethernet to Ethernet<br>Type tested at 500V AC for 60 s | |
| Weight, approx. | 0.66 kg (1.5 lb) | • 1769-L24ER-QB1B = 0.63 kg (1.39 lb)<br>• 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B = 0.9 kg (1.9 lb) | 0.31 kg (0.68 lb) |
| Module width | 100.00 mm<br>(3.94 in.) | 1769-L24ER-QB1B = 115.00 mm (4.53 in.)<br>1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B = 140 mm (5.51 in.) | 100.00 mm<br>(3.94 in.) |
| Module location | DIN rail mount | DIN rail or panel mount | |
| Panel-mounting screw torque | NA | 1.1…1.8 N•m (10…16 lb•in) - use M4 or #8 screws | |
| Embedded power supply | 24V DC input, non-isolated, Class 2 | 24V DC Input, isolated, Class 2/SELV | 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 |

**Table 3 - Technical Specifications - CompactLogix 5370 Controllers**

| Attribute | 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B | 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B | 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM |
|---|---|---|---|
| Power supply distance rating | NA | | • Controller and 1769-SDN: 4<br>• 1769 Compact I/O modules: 4…8, depending on module |
| Wire category(1) | 1 - signal ports<br>1 - power ports<br>2 - communication ports | | 2 - communication ports |
| Wire type, Ethernet | RJ-45 connector according to IEC 60603-7, 2 or 4 pair Category 5e minimum cable according to TIA 568-B.1 or Category 5 cable according to ISO/IEC 24702 | | |
| Wire type, power terminals and embedded I/O connections | Copper | | NA |
| Wire size, power terminals(2) | 0.051…3.31 $mm^2$ (30…12 AWG) solid or stranded copper wire rated at 75 °C (167 °F), or greater,<br>1.2 mm (3/64 in.) insulation, max<br>Each terminal accepts 1 or 2 wires | 0.25…2.50 $mm^2$ (22...14 AWG) solid copper wire rated at 75 °C (167 °F ), or greater<br>1.2 mm (3/64 in.) insulation, max<br>Each terminal accepts only 1 wire | NA |
| Wire stripping length, power terminals(2) | 10 mm (0.39 in) | 8 mm (0.31 in) | NA |
| Screw torque, power terminals (2) | 0.5…0.6 N•m (4.4…5.3 lb•in) | 1.0…1.2 N•m (8.9…10.6 lb•in) | NA |
| Wire size, embedded I/O connections | 0.205…1.31 $mm^2$ (24…16 AWG) solid or stranded copper wire rated at 75 °C (167 °F), or greater<br>1.2 mm (3/64 in.) insulation, max or 90 °C (194 °F)<br>Each terminal accepts only 1 wire | | NA |
| Wire stripping length, embedded I/O connections | 10 mm (0.39 in) | | NA |
| North American temperature code | T4A | T3C | T5 |
| IEC temperature code | T4 | | T5 |
| Enclosure type rating | None (open-style) | | |

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 and the appropriate system-level installation manual.

(2) With respect to the CompactLogix 5370 L1 controllers, this specification applies to connecting wires to the power connector that is inserted in the controller. With respect to the CompactLogix 5370 L2 controllers, this specification applies to connecting wires to power terminals built into the controller.

## Real-time Clock Accuracy

The following table lists the real-time clock accuracy specifications for the CompactLogix 5370 controllers.

| Ambient Temperature | Accuracy |
|---|---|
| 0° C (32° F) | -143…42 s/month |
| 25° C (77° F) | -78…91 s/month |
| 40° C (104° F) | -101…73 s/month |
| 60° C (140° F) | -204…-4.50 s/month |

## Real-time Clock Hold-up Times

The following table lists the typical real-time clock hold-up specifications for the CompactLogix 5370 controllers.

**IMPORTANT** The values in the following table are typical and might vary with some CompactLogix 5370 control systems.

| Ambient Temperature | Holdup Time, Typical |
|---|---|
| 0 °C (32 °F) | 40 days |
| 25 °C (77 °F) | 35 days |
| 40 °C (104 °F) | 28 days |
| 60 °C (140 °F) | 16 days |

The I/O module support for CompactLogix 5370 controller systems varies by controller.

## I/O Module Support - CompactLogix 5370 L1 Controllers

The CompactLogix 5370 L1 controllers offer an embedded I/O module and the option of using 1734 POINT I/O™ modules as local expansion modules.

The embedded I/O module provides the following:

- 16 sinking 24V DC digital input points
- 16 sourcing 24V DC digital output points

To use 1734 POINT I/O modules as local expansion modules, keep in mind the following:

- Local expansion modules must be installed in the same system as the CompactLogix 5370 L1 controller and power supply.
- The modules are installed to the right of the power supply.
- The maximum number of local expansion modules available depends on the controller catalog of that system.

# CompactLogix Power Supplies Specifications

## 1768 CompactLogix Power Supplies Catalog Numbers 1768-PA3, 1768-PB3

## 1769 Compact I/O Power Supplies Catalog Numbers 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4


| Topic | Page |
|---|---|
| 1768 CompactLogix Power Supplies | 3 |
| 1769 Compact I/O Power Supplies | 7 |


### Environmental Specifications - 1768 and 1769 Power Supplies

| Attribute | 1768-PA3, 1768-PB3<br>1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 |
|---|---|
| Temperature, operating<br>IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock) | 0…60 °C (32…140 °F) |
| Temperature, storage<br>IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold),<br>IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat),<br>IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock) | -40…85 °C (-40…185 °F) |
| Relative humidity<br>IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat) | 5…95% noncondensing |
| Vibration<br>IEC 60068-2-6 (Test Fc, Operating) | 5 g @ 10…500 Hz |
| Shock, operating<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | 30 g |
| Shock, nonoperating<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | 50 g |

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| **WARNING** | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **ATTENTION** | Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence |
| **SHOCK HAZARD** | Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present. |
| **BURN HAZARD** | Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures. |

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## 1769 Compact I/O Power Supplies

Each 1769-L3*x* controller and additional bank of I/O modules requires a 1769 power supply. Place 1769 I/O modules to the left or right of the 1769 power supply. As many as eight I/O modules can be placed on each side of the power supply.

Each 1769 module also has a power supply distance rating (the number of modules from the power supply). Each module must be located within its distance rating. See the specifications for the module to determine its distance rating.

### Technical Specifications - 1769 Compact I/O Power Supplies

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Input voltage range | 85…265V AC | 19.2...31.2V DC | 85…265V AC or 170...265V AC, switch selectable | 19.2...31.2V DC |
| Input voltage, nom | 120V/220V AC | 24V DC | 120V/220V AC | 24V DC |
| Power consumption | 100 VA @ 120V AC<br>130 VA @ 240V AC | 50 VA @ 24V DC | 200 VA @ 120V AC<br>240 VA @ 240V AC | 100 VA @ 24V DC |
| Power dissipation | 8 W @ 60° C (140° F) | 7.5 W @ 60° C (140° F) | 18 W @ 60° C (140° F) | 14.5 W @ 60° C (140° F) |
| Current capacity @ 5V | 2.0 A | 2.0 A | 4.0 A | 4.0 A |
| Current capacity @ 24V | 0.8 A | 0.8 A | 2.0 A | 2.0 A |
| Inrush current, max | 25 A @ 132V AC | 30 A @ 31.2V DC | 25 A @ 132V AC | 30 A @ 31.2V DC |
| Isolation voltage | 265V (continuous), reinforced insulation type (IEC Class 1 grounding required)<br>Routine tested @ 2596V DC for 1 s, AC power input to system and AC power input to 24V DC user power | 75V (continuous), reinforced insulation type (IEC Class 1 grounding required)<br>Routine tested at 1697V DC for 1 s, DC power input to system | 265V (continuous), reinforced insulation type (IEC Class 1 grounding required)<br>Routine tested at 2596V DC for 1 s, AC power input to system | 75V (continuous), reinforced insulation type (IEC Class 1 grounding required)<br>Routine tested at 1697V DC for 1 s, DC power input to system |
| Fuse type | Wickmann 19195-3.15A<br>Littelfuse 02183.15MXP | Wickmann 19193-6.3A<br>Littelfuse 021706.3MXP | Wickmann 19195-3.15A<br>Littelfuse 02183.15MXP | Wickmann 19193-6.3A<br>Littelfuse 021706.3MXP |
| Weight, approx. | 525 g (1.16 lb) | | 630 g (1.39 lb) | |
| Dimensions (HxWxD), approx. | 118 x 70 x 87 mm (4.65 x 2.76 x 3.43 in.) | | | |
| Module location | DIN rail or panel mount | | | |
| Mounting screw torque | 1.16 N•m (10 lb•in) - use M4 or #8 screws | | | |
| Power supply distance rating | 8<br>8 I/O modules can be connected on either side of the power supply for a maximum of 16 modules | | | |
| Wire category[1] | 1 - on power ports | 2 - on power ports | 1 - on power ports | 2 - on power ports |
| Wire size | 14 AWG (2.5 mm$^2$) solid copper wire rated at 90 °C (194 °F) or greater, 1.2 mm (3/64 in.) insulation max | | | |
| North American temperature code | T3C | | | |
| IEC temperature code | — | T4 | — | T4 |
| Enclosure type rating | None (open-style) | | | |

(1) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

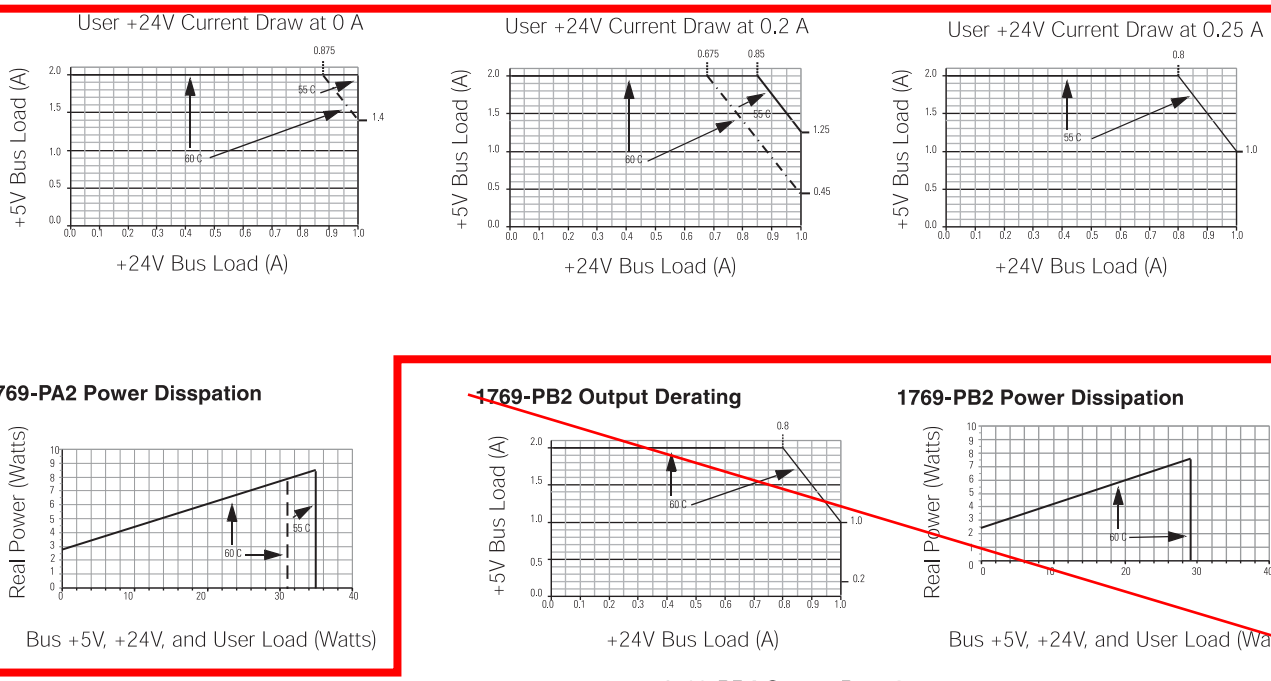
## Certifications - 1769 Compact Power Supplies

| Certification[1] | 1769-PA2, 1769-PA4 | 1769-PB2, 1769-PB4 |
|---|---|---|
| c-UL-us | UL Listed for Class 1, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E10314 | |
| CE | European Union 2004/108/EC EMC Directive, compliant with:<br>• EN 61000-6-2; Industrial Immunity<br>• EN 61000-6-4; Industrial Emissions | |
| C-Tick | Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions | |
| | — | European Union 94/9/EC ATEX Directive, compliant with:<br>• EN 60079-15; Potentially Explosive Atmospheres, Protection "n" (Zone 2)<br>• EN 60079-0; General Requirements (Zone 2) |

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# Power Requirements and Transformer Sizing - 1769 CompactLogix Power Supplies

### 1769-PA2 Output Derating



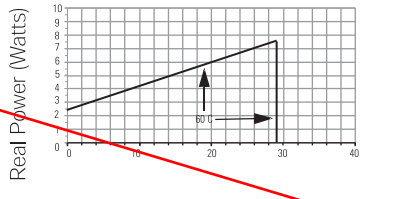

### 1769-PA2 Power Disspation




### 1769-PB2 Output Derating

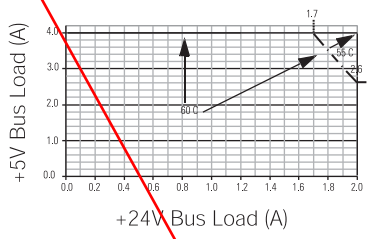



### 1769-PB2 Power Dissipation



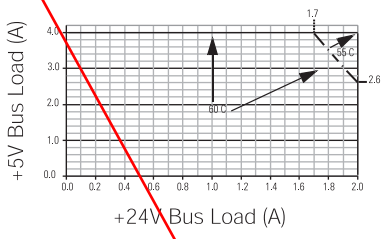

### 1769-PA4 Output Derating

Total Output: 68 W @ 55 °C (131 °F) or below
61 W @ 60 °C (140 °F) or below

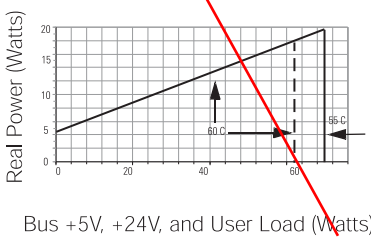



### 1769-PB4 Output Derating

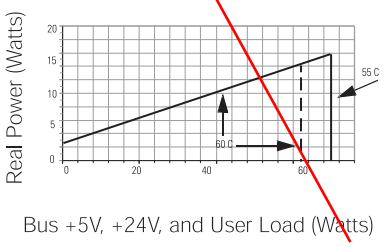
Total Output: 68 W @ 55 °C (131 °F) or below
61 W @ 60 °C (140 °F) or below



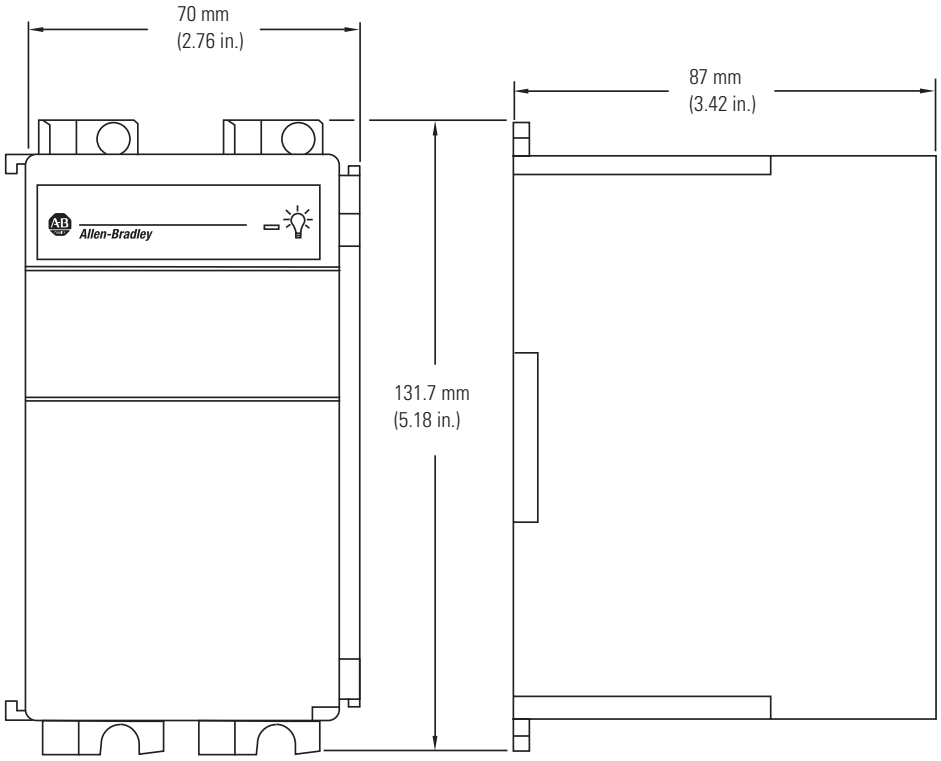

### 1769-PA4 Power Disspation



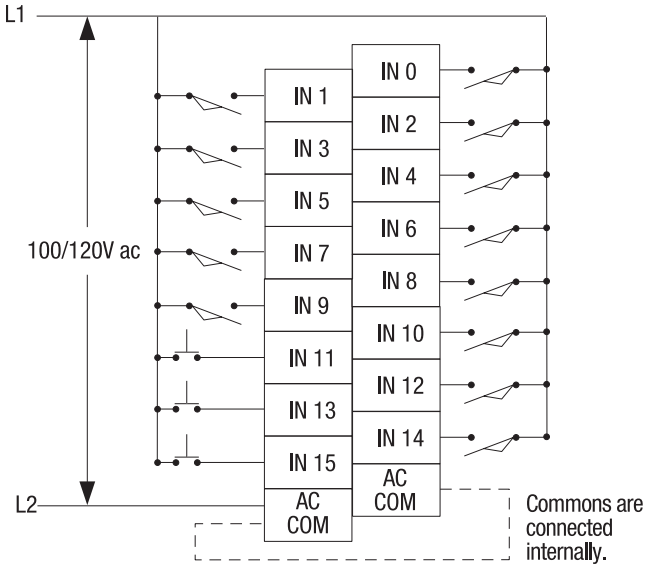

### 1769-PB4 Power Disspation



## Mounting Dimensions - 1769 CompactLogix Power Supplies



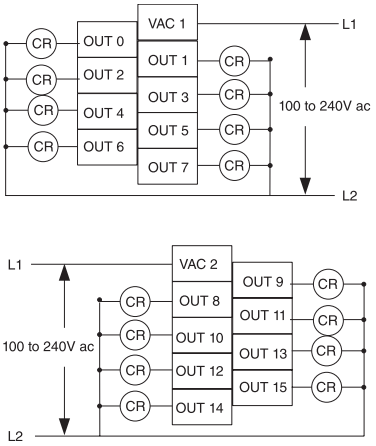
# 1769-IA16 120V ac Input Module




| Attribute | Value |
|---|---|
| Voltage Category/Type, Input | 100 or 120V AC |
| Voltage, On-State Input, Min. | 132V ac |
| Voltage, On-State Input, Max. | 132V ac |
| Operating Frequency Range | 47…63 Hz |
| Number of Inputs | 16 |
| Backplane Current (mA) at 5V | 115 mA |
| Voltage, Off-State Input, Max. | 20V ac |
| Current, Off-State Input, Max. | 2.5 mA |
| Voltage, On-State Input, Min. | 79V ac |
| Current, On-State Input, Min. | 5 mA @ 79V ac |
| Inrush Current, Max. | 250 mA✶ |
| Input Impedance, Nom. | 12 kΩ @ 50 Hz<br>10 kΩ @ 60 Hz |
| IEC Input Compatibility | Type 1+ |
| Power Supply Distance Rating | 8 modules |
| Isolated Groups | Group 1: outputs 0 to 15 (internally connected to common) |

✶A current limiting resistor can be used to limit inrush current; however, the operating characteristics of the ac input circuit will be affected. If a 6.8 kΩ (2.5 W minimum) resistor is placed in series with the input, the inrush current is reduced to 35 mA. In this configuration the minimum on-state voltage increases to 92V ac. Before adding the resistor in a hazardous environment, be sure to consider the operating temperature of the resistor and the temperature limits of the environment. The operating temperature of the resistor must remain below the temperature limit of the environment.

# 1769-OA16 120/240V ac Output Module✶




| Attribute | Value |
|---|---|
| Voltage Category/Type, Output | 100…240V AC |
| Voltage, On-State Output, Min. | 85V ac |
| Voltage, On-State Output, Max. | 265V ac |
| Operating Frequency Range | 47…63 Hz |
| Number of Outputs | 16 |
| Backplane Current (mA) at 5V | 225 mA |
| Leakage Current, Off-State Output, Max | 2.0 mA at 132V ac<br>2.5 mA at 265V ac✶ |
| Current, On-State Output, Min. | 10.0 mA |
| Voltage Drop, On-State Output, Max. | 1.5V ac at 0.5A |
| Output Surge Current, Max. | 10.0 A❄‡ |
| Power Supply Distance Rating | 8 modules |
| Isolated Groups | Group 1: outputs 0 to 7<br>Group 2: outputs 8 to 15 |

✶Recommended Loading Resistor - To limit the effects of leakage current through solid state outputs, a loading resistor can be connected in parallel with your load. For 120V ac operation, use a 15 kΩ, 2W resistor. For 240V ac operation use a 15 kΩ, 5W resistor.

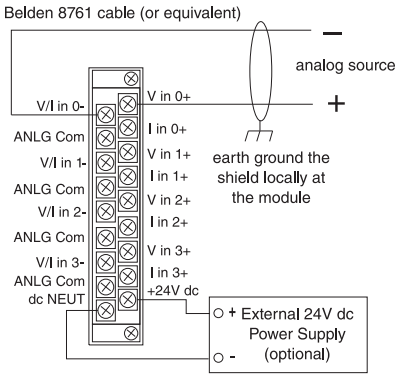
❄Repeatability is once every 2 seconds for a duration of 25 ms.

‡Surge Suppression - Connecting surge suppressors across your external load will extend the life of the Triac outputs. For additional details, refer to "Industrial Automation Wiring and Grounding Guidelines," Allen-Bradley publication 1770-4.1.

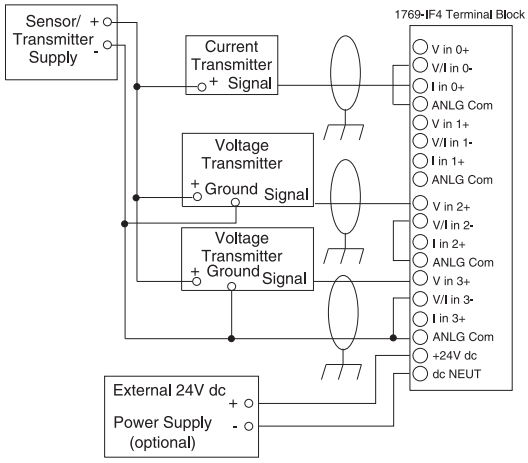
✶The 1769-OA16 module is a 1.5-slot wide module.

# 1769-IF4 Analog Input Module

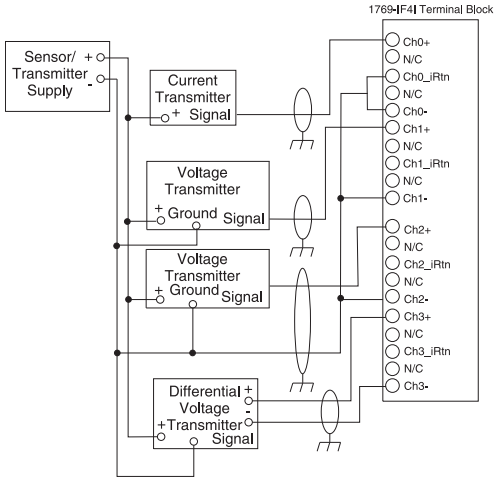
## Wiring Differential Inputs




## Wiring Single-ended Sensor/Transmitter Inputs




## Wiring Mixed Transmitter Inputs



## 1769-IF4 Specifications

The external power supply must be rated Class 2, with a 24V dc range of 20.4…26.4V dc and 60 mA minimum.

Series B and later modules provide this option.

| Attribute | Value |
|---|---|
| Voltage Category/Type, Input | ±10V dc (±10.5V dc full scale)<br>0…10V dc (-0.5…10.5V dc full scale)<br>0…5V dc (-0.5…5.25V dc full scale)<br>1…5V dc (0.5…5.25V full scale) |
| Current Range, Analog Input | 0…21 mA or 3.2…21 mA, full-scale✶ |
| Number of Inputs | 4 |
| Backplane Current (mA) at 5V | 105 mA |
| Backplane Current (mA) at 24V | 60 mA❄ |
| Input Resolution | 14 bits (unipolar)‡ |
| Normal Mode Rejection Ratio | -50 dB at 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively. |
| Input Impedance | Current Input: 250 Ω<br>Voltage Input: 220 Ω |
| Accuracy Drift w/Temp. | Current Input: ±0.0045%/°C<br>Voltage Input: ±0.003%/°C |
| Non-linearity, Input | ±0.03% full scale |
| Input Repeatability | ±0.03%§ |
| Module Error over Full Temperature Range | ±0.03% - Voltage<br>±0.05% - Current |
| Input Channel Configuration | Configuration via configuration software screen or the user program (by writing a unique bit pattern into the module's configuration file). Refer to your controller's user manual to determine if user program configuration is supported. |
| Calibration | The module performs autocalibration on channel enable and on a configuration change between channels. |
| Diagnostics Type | Over- or under-range by bit reporting |
| Power Supply Distance Rating | 8 modules♣ |
| Isolation Voltage | 500V ac or 710V dc for 1 minute, 30Vac/30Vdc working voltage (IEC Class 2 reinforced insulation), input group to bus |

✶The over- or under-range flag will come on when the normal operating range (over/under) is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.
❄If the optional 24V dc Class 2 power supply is used, the 24V dc current draw from the bus is 0 mA.
‡Resolution is dependent upon your filter selection. The maximum resolution is achieved with either the 50 or 60 Hz filter selected. For resolution with other filter selections, refer to the user manual, publication 1769-UM002.
§Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.
♣The module may not be more than 8 modules away from the system power supply.

# PanelView Plus 7 – Standard Terminals

PanelView™ Plus 7 Standard terminals are operator interface devices. They monitor and control devices that are attached to ControlLogix® 5570 and CompactLogix™ 5370 controllers on an EtherNet/IP network. Animated graphic and text displays provide operators a view into the operating state of a machine or process. Operators interact with the control system by using touch screen input.

PanelView Plus 7 Standard terminals include these features:

- Terminal functionality permits connection to 1 controller, up to 25 screens, and up to 200 alarms.
- FactoryTalk® View Machine Edition software provides a familiar environment for creating HMI applications.
- Windows CE operating system with desktop access for configuration and third-party applications.
- Ethernet communication that supports linear, star, and ring network topologies.
- PDF viewer to access PDF files that are stored on the terminal.
- More screen options including 4-in., 6-in., 7-in., 9-in.,10-in., 12-in., and 15-in. terminals.
- Widescreen option on three sizes: 4-in., 9-in., and 12-in. terminals.
- Greater screen resolution.
- Terminals are available with an Allen-Bradley® label, or with no label for customers who want to put their own labeling on the terminal.
- Certifications including Class 1, Div 2 and ATEX zones 2 and 22.

**Terminal Features**

| Features | Description |
|---|---|
| High memory capacity | 512 MB RAM and 512 MB storage<br>Approx. 80 MB nonvolatile storage for applications |
| Power input | DC |
| Communication ports | Single 10/100Base-T, Auto MDI/MDI-X, Ethernet port for controller communication, or DLR |
| USB ports | One USB 2.0 high-speed host port (type A) support removal flash drives for storage<br>One high-speed 1.0 device port (type B) supports connection to host computer |
| Secure Digital (SD) card slot | One high-speed 1.0 device port (type B) supports future connection to host computer |
| Operating system | All terminals run the Windows CE 6.0 operating system (OS) which provides OS functionality that meets the needs of most users:<br>• FTP server<br>• VNC client/server<br>• PDF reader<br>• Active X controls<br>• Third-party device support<br>• FactoryTalk® ViewPoint |
| Software | FactoryTalk® View Machine Edition Station (runtime) software, version 7.0 or later, is preloaded and activated on each terminal<br>Single license support for FactoryTalk ViewPoint software, version 1.2 or later, gives remote users access to terminal displays via a standard web browser<br>HMI applications are developed with FactoryTalk View Studio for Machine Edition software, which is purchased separately |
| Preferred controller | CompactLogix |

For complete technical specifications, certifications, and environmental specifications on the PanelView Plus 7 Standard terminals, refer to the PanelView Plus 7 Standard Terminals Technical Data, publication 2711P-TD008.

## Terminal Selection

| Model | Color Touch Display | | Brand Identity | DLR Support |
|---|---|---|---|---|
| | Cat. No. | Size | | |
| 400W | 2711P-T4W21D8S | 4 in. (Wide) | x | |
| | 2711P-T4W21D8S-B | | | |
| | 2711P-T4W22D8S | | x | x |
| | 2711P-T4W22D8S-B | | | x |
| 600 | 2711P-T6C21D8S | 6 in. | x | |
| | 2711P-T6C21D8S-B | | | |
| | 2711P-T6C22D8S | | x | x |
| | 2711P-T6C22D8S-B | | | x |
| 700 | 2711P-T7C21D8S | 7 in. | x | |
| | 2711P-T7C21D8S-B | | | |
| | 2711P-T7C22D8S | | x | x |
| | 2711P-T7C22D8S-B | | | x |
| 900W | 2711P-T9W21D8S | 9 in. (Wide) | x | |
| | 2711P-T9W21D8S-B | | | |
| | 2711P-T9W22D8S | | x | x |
| | 2711P-T9W22D8S-B | | | x |
| 1000 | 2711P-T10C21D8S | 10 in. | x | |
| | 2711P-T10C21D8S-B | | | |
| | 2711P-T10C22D8S | | x | x |
| | 2711P-T10C22D8S-B | | | x |
| 1200W | 2711P-T12W21D8S | 12 in. (Wide) | x | |
| | 2711P-T12W21D8S-B | | | |
| | 2711P-T12W22D8S | | x | x |
| | 2711P-T12W22D8S-B | | | x |
| 1500 | 2711P-T15C21D8S | 15 in. | x | |
| | 2711P-T15C21D8S-B | | | |
| | 2711P-T15C22D8S | | x | x |
| | 2711P-T15C22D8S-B | | | x |

For information about accessories that are available for these terminals, see page 33.

## 316 Stainless Steel Enviroline® Series Single-Door Enclosures For Flange-Mounted Disconnects

### Application -
Designed to house most standard type disconnects. For installation information, consult our Installation Manual at www.saginawcontrol.com. For outdoor application a drip shield is recommended.

### Construction -
- 0.075" stainless steel Type 316.
- Seams continuously welded and ground smooth.
- Flange trough collar around all sides of door opening.
- Oil-resistant gasket.
- Collar studs provided for mounting optional panels.
- Holes provided in body for mounting disconnect operating handle and operating mechanism.
- Stainless Steel concealed hinge.
- Doors are interchangeable and easily removed by pulling hinge pin.
- 3-point latching mechanism.
- Latches are opened or closed with screwdriver (optional tamper-resistant inserts available).
- Mounting holes in back of enclosure.
- Mounting hardware, sealing washer and hole plug included.
- Ground studs on door and body.
- Black zinc die cast coinproof/padlocking handle.

**Disconnect switch (or circuit breaker) and operating mechanism are not furnished with this enclosure.**

### Finish -
#4 brushed finish on all exterior surfaces. Optional subpanels are powder coated white.

**IS5 - Industry Standards -**
NEMA Type 4, 4X 12 & Type 13
UL Listed Type 4, 4X & 12
CSA Type 4, 4X & 12
IEC 60529 IP66

## 316 STAINLESS STEEL ENVIROLINE® SERIES SINGLE-DOOR ENCLOSURES FOR FLANGE-MOUNTED DISCONNECTS

| ENCLOSURE PRODUCT CODE S7 | | | | | SUB-PANEL (P3) | | |
|---|---|---|---|---|---|---|---|
| Catalog No. | Height (A) | Width (B) | Depth (C) | Industry Standard | Catalog No. | Panel Height (D) | Panel Width (E) |
| SCE-20XEL2108SS6LP | 20.00 | 21.38 | 8.00 | IS5 | SCE-20P20 | 17.00 | 17.00 |
| SCE-24XEL2108SS6LP | 24.00 | 21.38 | 8.00 | IS5 | SCE-24P20 | 21.00 | 17.00 |
| SCE-24XEL2508SS6LP | 24.00 | 25.38 | 8.00 | IS5 | SCE-24P24 | 21.00 | 21.00 |
| SCE-24XEL2510SS6LP | 24.00 | 25.38 | 10.00 | IS5 | SCE-24P24 | 21.00 | 21.00 |
| SCE-30XEL2508SS6LP | 30.00 | 25.38 | 8.00 | IS5 | SCE-30P24 | 27.00 | 21.00 |
| SCE-30XEL2510SS6LP | 30.00 | 25.38 | 10.00 | IS5 | SCE-30P24 | 27.00 | 21.00 |
| SCE-36XEL2508SS6LP | 36.00 | 25.38 | 8.00 | IS5 | SCE-36P24 | 33.00 | 21.00 |
| SCE-36XEL3110SS6LP | 36.00 | 31.38 | 10.00 | IS5 | SCE-36P30 | 33.00 | 27.00 |
| SCE-36XEL3112SS6LP | 36.00 | 31.38 | 12.00 | IS5 | SCE-36P30 | 33.00 | 27.00 |
| SCE-42XEL3110SS6LP | 42.00 | 31.38 | 10.00 | IS5 | SCE-42P30 | 39.00 | 27.00 |
| SCE-42XEL3112SS6LP | 42.00 | 31.38 | 12.00 | IS5 | SCE-42P30 | 39.00 | 27.00 |
| SCE-42XEL3712SS6LP | 42.00 | 37.38 | 12.00 | IS5 | SCE-42P36 | 39.00 | 33.00 |
| SCE-42XEL3716SS6LP | 42.00 | 37.38 | 16.00 | IS5 | SCE-42P36 | 39.00 | 33.00 |
| SCE-48XEL3710SS6LP | 48.00 | 37.38 | 10.00 | IS5 | SCE-48P36 | 45.00 | 33.00 |
| SCE-48XEL3712SS6LP | 48.00 | 37.38 | 12.00 | IS5 | SCE-48P36 | 45.00 | 33.00 |
| SCE-48XEL3716SS6LP | 48.00 | 37.38 | 16.00 | IS5 | SCE-48P36 | 45.00 | 33.00 |
| SCE-60XEL3712SS6LP | 60.00 | 37.38 | 12.00 | IS5 | SCE-60P36 | 57.00 | 33.00 |
| SCE-60XEL3716SS6LP | 60.00 | 37.38 | 16.00 | IS5 | SCE-60P36 | 57.00 | 33.00 |

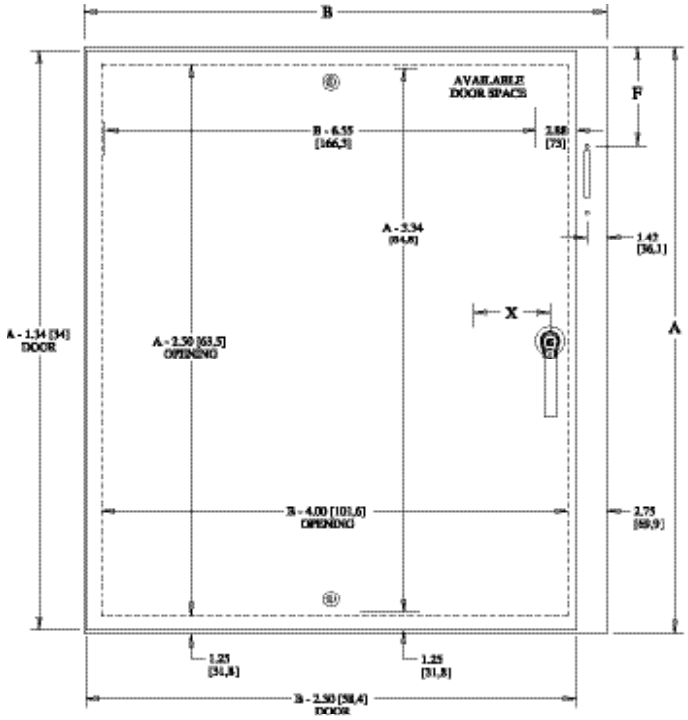
*Available within 10 working days if not in stock*

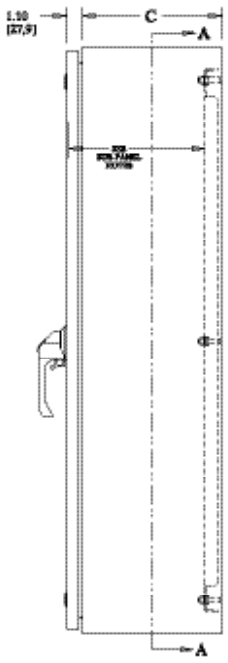
Phone (989) 799-6871
Fax (989) 799-4524

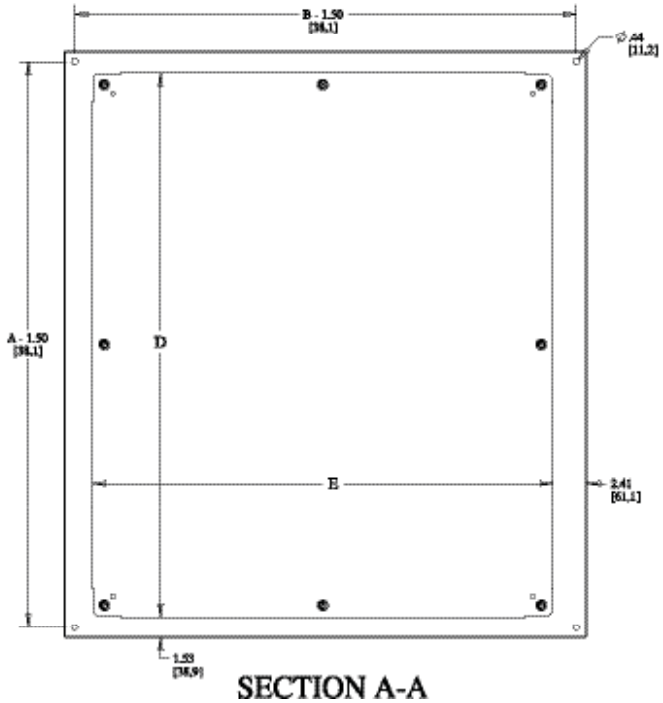
SCE SAGINAW CONTROL & ENGINEERING
Your Enclosure Source®

# STAINLESS STEEL ENVIROLINE® SERIES SINGLE-DOOR ENCLOSURES FOR FLANGE-MOUNTED DISCONNECTS

## TECHNICAL DATA




SECTION A-A

**SUB-PANEL NOTES:**
Dimensions are from the inside of the door.
C + .32 [8,1] for flat sub-panels
C - .18 [4,5] for bent sub-panels

**DISCONNECT NOTES:**
F = 4.75 [121] when C = 8.00 [203]
F = 7.09 [180] when C = 10.00 [254]
F = 11.62 [295] when C = 12.00 [304]
F = 11.62 [295] when C = 16.00 [406]
F = 18.38 [467] for SCE-60XEL3712LP4

**LATCH NOTES:**
Omit center latch top and bottom of door when door width is <= 30.00" [762]

**HANDLE NOTES:**
On enclosures <= 42.00 [1067]
X = 5.50 [140] and use 5.00 [127] padlocking handle with coin-proof.
On enclosures > 42.00 [1067]
X = 6.75 [171] and use 7.00 [178] padlocking handle with coin-proof.

Enclosures with a height dimension < 40.00 [1016] have a 2-point door closing mechanism.

Enclosures with a height dimension of >= 40.00 [1016] have a 3-point door latching mechanism.

**CONSTRUCTION NOTES:**
Door will be 0.125 [3,1] thick material when enclosure height is >= 42.00 and door width is > 24.00

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# Hazardous Location Push Buttons

Product Overview/Specifications

## Bulletin 800H/Hazardous Location Push Buttons

- Hazardous locations push buttons and stations
- Classes I, II & III Divisions 1 & 2
- 3/4 in. - 14 NPSM barrel
- Type 7 & 9
- Explosion-proof operators

## Table of Contents

**See below.**

## Standards Compliance

UL698, UL1604
CSA 22.2, No. 14

## Certifications

**Enclosures:**
UL Listed (File No. E71673 Guide No. NNNY)
**Devices:**
UL Listed (File No. E10314 Guide No. NOIV)
**Stations:**
CSA (File No. LR11924)

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## Description

### Application

When properly mounted in a Type 7 & 9 enclosure, Bulletin 800H Type 7 & 9 operators are designed to meet the requirements of the National Electrical Code for Class I, Divisions 1 & 2, Groups B, C & D Hazardous Gas; Class II, Divisions 1 & 2, Groups E, F and G Hazardous Dust; and, Class III Hazardous Fiber Locations. In addition, the single gang shallow base, Cat. No. 800H-IHZX7, meets Class I, Group B requirements. This Type 7 & 9 equipment is listed by Underwriters Laboratories, Inc.

**Per National Electrical Code:**

**Zone 1.** In Class I, Zone 1 locations, all wiring methods permitted for Class I, Division 1 locations and Class I, Zone 0 or Zone 1 locations, including requirements for sealing, shall be permitted.

**Zone 2.** In Class I, Zone 2 locations, all wiring methods permitted for Class I, Division 2, Class I, Division 1 or Division 2, and Class I, Zone 0 or Zone 1 locations, including requirements for sealing, shall be permitted.

10

### Operator Construction

The Allen-Bradley line of hazardous location devices features copper-free (less than 0.4 of 1% copper content) die cast aluminum bushings and mounting rings, Type #316 stainless steel operating shafts and an O-ring seal for added corrosion resistance. These components mount into a threaded hole (3/4 in.-14 NPSM) in a suitable enclosure.

Bulletin 800H Type 7 & 9 components are available in two basic formats: standard barrel (Bulletin 800H) and long barrel (Bulletin 800HL). Standard barrel devices are suitable for mounting in panel thickness up to 1 in.; Long barrel devices are suitable for mounting in panel thickness greater than 1 in. and no thicker than 2-1/2 in. Both style operators offer a unique locking bracket which provides an anti-turn feature to guard against loosening. The mounting rings in front of the panel are knurled to provide a second means of tightening each unit into the panel.

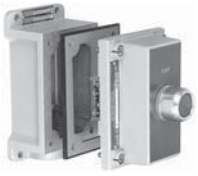
### Outdoor Use

Bulletin 800H Type 7 & 9 stations and enclosures are not configured for outdoor use as standard. A Type 3 rating is available, while maintaining Type 7 & 9 integrity of the enclosure, by the addition of a Type 3 sealing flange and an approved drain. The sealing flange shown below may be purchased as an option or as an accessory. A Type 4 rating can be achieved by using sealing nuts to seal the push button operators in addition to using the sealing flange. Sealing nuts are available as accessories (see page 10-179.)

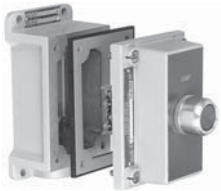
### Elimination of Conduit Seal Off Requirement

Bulletin 800H Type 7 & 9 units may be installed with a variety of sealing options. By utilizing either a sealing well or flanged sealing well, these stations may be installed without a conduit seal off in most applications (subject to applicable codes and laws). The sealing wells shown below may be purchased as an option or as an accessory. Sealing wells are also available with an integral Type 3 flange seal for outdoor applications.

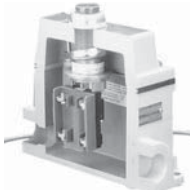
Sealed switch contact blocks are another way to eliminate the need for conduit seal fittings in most applications (subject to applicable codes and laws). Sealed switch contact blocks may be purchased as an option on assembled stations by changing the Bulletin No. from 800H to 800R. Sealed switch contact blocks can be ordered as an accessory (see page 10-175). A push button station with a sealed switch contact block is shown below.



*Type 3 Flange Seal*



*Sealing Wells*



*Sealed Switch Contact Blocks*

## Specifications*

| | | |
|---|---|---|
| **Electrical Ratings** | | |
| Contact Ratings | | Refer to the contact ratings tables below. |
| Dielectric Strength | | 2200V for one minute, 1300V for one minute (Logic Reed) |
| Electrical Design Life Cycles | | 1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed) |
| **Mechanical Ratings** | | |
| Vibration | | 10…2000 Hz 1.52 mm displacement (peak-to-peak) Max./10 G Max. (except Logic Reed) |
| Shock | | 1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G |
| Degree of Protection | | Type 7 & 9 Explosion Proof (Type 3 and Type 4 ratings available with accessories) |
| Mechanical Design Life Cycles | | |
| Push Buttons | | 250 000 minimum |
| Potentiometers | | 100 000 minimum |
| All other devices | | 200 000 minimum |
| Contact Operation | | Shallow and mini contact blocks: slow double make and break<br>Logic Reed & sealed switch contact blocks: snap-action |
| Wire Guage/Terminal Screw Torque | | # 18…12 AWG/6…8 lb•in |
| Typical Operating Forces | | |
| Operators without contact blocks: | | Flush, extended, standard mushroom, jumbo mushroom: 2.9 lb max.<br>Jumbo and extended aluminum mushroom head: 3.95 lb maximum<br>Maintained selector switch: 4.0 in•lb maximum |
| Spring Return Selector Switches: | | 5 in•lb to stop, 0.2 in•lb to return |
| Illuminated Push Buttons and Push-to-Test Pilot Lights | | 5.6 lb maximum |
| 2-Position Push-Pull | | 9 lb maximum push or pull |
| 3-Position Push-Pull | | 12 lb maximum push to in position or pull to center position<br>(15 lb maximum pull to out position) |
| Contact Blocks: | 800T-XA | 1 lb |
| | Logic Reed | 1 lb maximum |
| | Sealed Switch | 3 lb maximum at 0.205 in. plunger travel |
| | Stackable Sealed Switch | 1 lb maximum |
| **Environment** | | |
| Temperature Range | Operating | –4…+13 °F (–20…+55 °C) |
| | Storage | –40…+185 °F (–40…+85 °C) |
| **Note:** Operating temperatures below freezing are based on the absence of freezing moisture and liquids. | | |
| Humidity | | 50% at +104 °F (+40 °C) |

* Performance Data — See page Important-3.

❄ External thread major diameter: 1.034 in. max., 1.024 in. min. Internal thread minor diameter: 0.958 in. min., 0.970 in. max.

### Standard Contact Ratings

Maximum thermal continuous current $I_{th}$ 10 A AC/2.5 A DC.
Bulletin 800H Type 7 & 9 units with 800T-XA contacts have ratings as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 600 | AC-15 | A600 | 120…600 | 7200VA | 720VA |
| | | | 72…120 | 60 A | 720VA |
| | | | 24…28❄ | 60 A | 10 A |
| DC 600 | DC-13 | Q600 | 28…600 | 69VA | |
| | | | 24…28❄ | 2.5 A | |

❄ For applications below 24V and 24 mA, Pen*TUFF*™, Logic Reed or stackable sealed switch contacts are recommended.

### Sealed Switch Contact Ratings

Maximum continuous current $I_{th}$ 5 A.

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 600 | AC-15 | B600 | 120…600 | 3600VA | 360VA |
| | | | 0…120 | 30 A | 3 A |
| DC 300 | DC-13 | P300 | 24…300 | 138VA | |
| | | | 0…24 | 5.0 A | |

### Stackable Sealed Switch Contact Ratings

Maximum continuous current $I_{th}$ 3 A. Bulletin 800T units have control circuit ratings with sealed switch contact blocks as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 300 | AC-15 | C300 | 120…300 | 1800VA | 180VA |
| | | | 0…120 | 15 A | 1.5 A |
| DC 150 | DC-13 | Q150 | 24…150 | 69VA | |
| | | | 0…24 | 2.5 A | |

### Logic Reed Contact Ratings

Maximum: 150V AC, 0.15 A, 8 VA and 30V DC, 0.06 A, 1.8 VA.

Should only be used with resistive loads.

### Pen*TUFF*™ (Low Voltage) Contact Ratings

Minimum DC: 5V, 1 mA

Maximum thermal continuous current Ith 2.5 A AC/1.0 A DC.
Bulletin 800H units with 800T-XAV contacts have ratings as follows:

| Max. Oprtnl. Volts $U_e$ | Utilization Category | | Rated Operational Currents | | |
|---|---|---|---|---|---|
| | IEC | NEMA | Volts $U_e$ | Make | Break |
| AC 300 | AC-15 | C300 | 120…300 | 1800VA | 180VA |
| | | | 0…120 | 15 A | 1.5 A |
| DC 150 | DC-13 | R150 | 24…150 | 28VA | |
| | | | 0…24 | 1.0 A | |

10

## Momentary Contact Push Button Units, Non-Illuminated

*Flush Head Unit*
***Cat. No. 800H-AP1A***

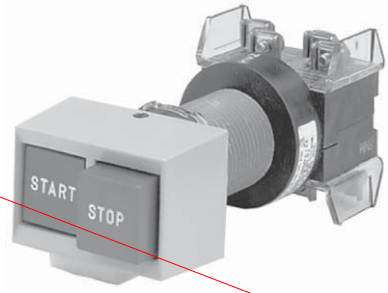
*Extended Head Unit*
***Cat. No. 800H-BP6B***

*Mushroom Head Unit*
***Cat. No. 800H-DP6A***

| Contact Type | Button Color | Flush Head Cat. No.∗ | Extended Head Cat. No.∗ | Mushroom Head Cat. No.∗ |
|---|---|---|---|---|
| No Contact | Green | 800H-AP1 | 800H-BP1 | 800H-DP1 |
| | Black | **800H-AP2** | 800H-BP2 | 800H-DP2 |
| | Red | 800H-AP6 | 800H-BP6 | 800H-DP6 |
| 1 N.O. | Green | **800H-AP1D1** | 800H-BP1D1 | 800H-DP1D1 |
| | Black | **800H-AP2D1** | **800H-BP2D1** | 800H-DP2D1 |
| | Red | 800H-AP6D1 | 800H-BP6D1 | 800H-DP6D1 |
| 1 N.C. | Green | 800H-AP1D2 | 800H-BP1D2 | 800H-DP1D2 |
| | Black | 800H-AP2D2 | 800H-BP2D2 | 800H-DP2D2 |
| | Red | 800H-AP6D2 | **800H-BP6D2** | 800H-DP6D2 |
| 1 N.O. - 1 N.C. | Green | **800H-AP1A** | 800H-BP1A | 800H-DP1A |
| | Black | **800H-AP2A** | 800H-BP2A | 800H-DP2A |
| | Red | **800H-AP6A** | **800H-BP6A** | **800H-DP6A** |
| 2 N.O. - 2 N.C. | Green | 800H-AP1B | 800H-BP1B | 800H-DP1B |
| | Black | 800H-AP2B | 800H-BP2B | 800H-DP2B |
| | Red | 800H-AP6B | 800H-BP6B | 800H-DP6B |

∗ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-AP1.

## Dual Momentary Contact Push Button Units




***Dual Push Button Unit***
*Cat. No. 800H-DPH16AXX64*

| Contact Arrangement | | Legend Marking | | |
|---|---|---|---|---|
| Type | Contacts | Left | Right | Cat. No.❄ |
| 2 N.O. - 2 N.C. | | START (Flush/Green) | STOP (Extended/Red) | **800H-DPH16AAXX64** |
| | | ON (Flush/Black) | OFF (Flush/Black) | 800H-DPH22AAXX50 |
| | | OPEN (Flush/Black) | CLOSE (Flush/Black) | 800H-DPH22AAXX57 |
| | | UP (Flush/Black) | DOWN (Flush/Black) | 800H-DPH22AAXX66 |
| | | Blank (Flush/Black) | Blank (Flush/Black) | 800H-DPH22AAXX |

❄ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-DPH16AAXX64.

10

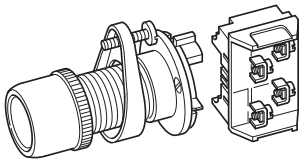
# Hazardous Location Push Buttons

Product Selection

## Momentary Contact Push Button Units, Non-Illuminated

800 H – AP 1 A

a b c d e



### a

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

### b

| Operator Type | |
|---|---|
| Code | Description |
| AP | Flush head |
| BP | Extended head |
| DP | Mushroom head |
| DPX | Mushroom head less color cap |

### c

| Color Cap | |
|---|---|
| Code | Description |
| Blank | Used only when ordering operator type DPX (Table b) |
| 1 | Green |
| 2 | Black |
| 3 | Orange |
| 4 | Grey |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow |

### d

| Special Mushroom Head | |
|---|---|
| Code | Description |
| Blank | No special head |
| J | Jumbo mushroom head — plastic |
| L | Jumbo mushroom head — metal |

**Note:** Special mushroom head options only apply to mushroom head operator type DP (Table b).

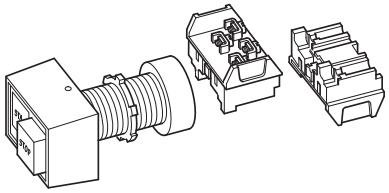
### e

| Contact Block(s)∗ | |
|---|---|
| Standard | |
| Code | Description |
| Blank | No contacts |
| D1 | 1 N.O. |
| D2 | 1 N.C. |
| D5 | 1 N.O. (Mini) |
| D6 | 1 N.C. (Mini) |
| A2 | 2 N.O. |
| A4 | 2 N.C. |
| A | 1 N.O. - 1 N.C. |
| B | 2 N.O. - 2 N.C. |
| H | 3 N.O. - 3 N.C. |
| C | 4 N.O. - 4 N.C. |
| Pen*TUFF* (Low Voltage) | |
| Code | Description |
| D1V | 1 N.O. |
| D2V | 1 N.C. |
| AV | 1 N.O. - 1 N.C. |
| BV | 2 N.O. - 2 N.C. |
| HV | 3 N.O. - 3 N.C. |
| CV | 4 N.O. - 4 N.C. |

## Dual Push Button Units

800 H – DP H 16 AAXX 64

a b c d e f



### a

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel |
| HL | Long barrel |

### b

| Operator Type | |
|---|---|
| Code | Description |
| DP | Dual push button |

### c

| Mounting | |
|---|---|
| Code | Description |
| H | Horizontal |
| B | Vertical |

### d

| Color of Button | |
|---|---|
| Code | Description |
| 16 | Left green flush/right red extended |
| 22 | Left black flush/right black flush |

### e

| Contact Block(s)∗ | | |
|---|---|---|
| Code | Contact Arrangement | |
| | Left button for horizontal Top button for vertical | Right button for horizontal Bottom button for vertical |
| AAXX | 1 N.O. - 1 N.C. | 1 N.O. - 1 N.C. |
| AAAA | 2 N.O. - 2 N.C. | 2 N.O. - 2 N.C. |

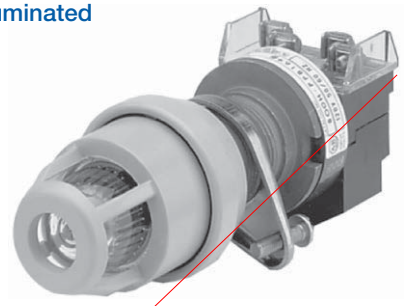
### f

| Marking | | |
|---|---|---|
| Code | Description | |
| | Left button for horizontal Top button for vertical | Right button for horizontal Bottom button for vertical |
| Blank | No mark specified | No mark specified |
| 64 | START | STOP |
| 50 | ON | OFF |
| 51 | FORWARD | REVERSE |
| 57 | OPEN | CLOSE |
| 66 | UP | DOWN |
| 99❄ | Marking specified | Marking specified |

∗ For sealed switch and Logic Reed contact blocks, see page 10-175.
❄ To order with special marking, specify marking; seven characters maximum per button, single line only.

10

## Momentary Contact Push Button Units, Illuminated



***Extended Head with Guard***
*Cat. No. 800H-PPB16M*

| Type | Lamp | Supply Voltage | Lens Color♣ | Extended Head with Guard |
|---|---|---|---|---|
| | | | | Cat. No.§❖ |
| Operator only➢ | | | | 800H-QPB00XX |
| Full Voltage | Incandescent | 24V AC/DC | Multi-color kit | **800H-QPB24M** |
| | | 120V AC/DC | | **800H-QPB10M** |
| | No lamp | 0…250V AC/DC | No lens | 800H-QPBN25 |
| Universal | LED | 12…130V AC/DC | Multi-color kit | 800H-QPBH2M |
| Transformer | Incandescent | 120V AC 50/60 Hz | Multi-color kit | 800H-PPB16M |
| | LED | | | 800H-PPBH16M |
| | No lamp | | No lens | 800H-PPBN16 |

♣ Units ship with multi-color insert packet including amber, blue, green, red, and white.
§ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-QPB2M.
❖ Includes as standard one Cat. No. 800T-XA (1 N.O./1 N.C.) contact block.
➢ Operator only supplied without power module, lamp, lens cap, or contact blocks.

## Potentiometer Units‡

***Potentiometer Unit***
*Cat. No. 800H-UP24*

| Resistance | Potentiometer✶ Cat. No.⌘ | Resistance | Potentiometer✶ Cat. No.⌘ |
|---|---|---|---|
| Operator Only (without Resistive Element) | 800H-NP37❄ | 2.5 kΩ | **800H-UP19** |
| | | 5 kΩ | **800H-UP21** |
| 1 kΩ | **800H-UP13** | 10 kΩ | **800H-UP29** |

✶ Rated for 300V AC/DC, 2W maximum.
❄ For use with Type J potentiometers having a shaft length of 7/8 in. (22.2 mm) and a shaft diameter of 1/4 in. (6.3 mm).
‡ Single-turn operation with 312° rotation.
⌘ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-UP13.

10

## 2-Position Push-Pull Units, Non-Illuminated

***2-Position Push-Pull***
*Cat. No. 800H-FPX6A5*

| Contact Type | Operator Position: Maintained Out | Operator Position: Maintained In | Button Color | Push-Pull Cat. No.∗ |
|---|---|---|---|---|
| N.C.L.B. | X | O | Red | **800H-FPX6D4** |
| N.O. - N.C.L.B. | O<br>X | X<br>O | Red | **800H-FPX6A1** |
| N.C.L.B. - N.C.L.B. | X<br>X | O<br>O | Red | **800H-FPX6A5** |

**Note:** X = Closed/O = Open
∗ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-FPX6D4.

## 3-Position Push-Pull Units, Non-Illuminated

***3-Position Push-Pull***
*Cat. No. 800H-FPXM6A7*

| Contact Type | Operator Position: Momentary Out | Operator Position: Maintained Center | Operator Position: Maintained In | Button Color | Push-Pull Cat. No.❄ |
|---|---|---|---|---|---|
| N.C. - N.C.L.B. | X<br>X | O<br>X | O<br>O | Red | 800H-FPXM6A7 |

| Contact Type | Operator Position: Momentary Out | Operator Position: Maintained Center | Operator Position: Momentary In | Button Color | Push-Pull Cat. No.❄ |
|---|---|---|---|---|---|
| N.C. - N.C.L.B. | X<br>X | O<br>X | O<br>O | Red | 800H-FPXN6A7 |

**Note:** X = Closed/O = Open
❄ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-FPXM6A7.

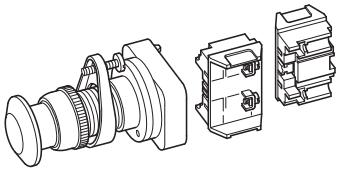
10

# Hazardous Location Push Buttons

## Product Selection

### 2-Position Push-Pull Units, Non-Illuminated

| 800 | H | – FPX | | 1 | A1 |
|---|---|---|---|---|---|
| | *a* | *b* | *c* | *d* | *e* |



*a*

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

*b*

| Operator Type | |
|---|---|
| Code | Description |
| FPX | Push-pull unit |

*c*

| Head Type | |
|---|---|
| Code | Description |
| Blank | Mushroom head |
| J | Jumbo mushroom head∗ |

*d*

| Color Cap | |
|---|---|
| Code | Color |
| Blank | No cap |
| 1 | Green |
| 2 | Black |
| 4 | Grey (silver) |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow (gold) |

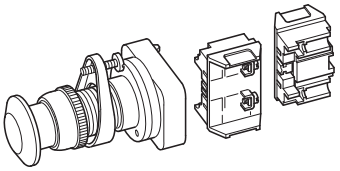
*e*

| Contact Block(s) | | | |
|---|---|---|---|
| Standard | | | |
| Code | Operator Position: Out | Operator Position: In | Description |
| Blank | — | — | No contacts |
| A1 | O<br>X | X<br>O | 1 N.O. -<br>1 N.C.L.B.∗ |
| A5 | X<br>X | O<br>O | 2 N.C.L.B.∗ |
| D1 | O | X | 1 N.O. |
| D4 | X | O | 1 N.C.L.B.∗ |
| Pen*TUFF* (Low Voltage) | | | |
| D1V | O | X | 1 N.O. |
| AV | O<br>X | X<br>O | 1 N.O. - 1 N.C. |
| **Note:** X = Closed/O = Open. | | | |

∗ Normally closed late break contact. When button is pushed from the OUT to the IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

### 3-Position Push-Pull Units, Non-Illuminated

| 800 | H | – FPX | | M | 1 | A7 |
|---|---|---|---|---|---|---|
| | *a* | *b* | *c* | *d* | *e* | *f* |



*a*

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

*b*

| Operator Type | |
|---|---|
| Code | Description |
| FPX | Push-pull unit |

*c*

| Head Type | |
|---|---|
| Code | Description |
| Blank | Mushroom head |
| J | Jumbo mushroom head❄ |

❄ Not valid with color cap option **Blank** (no cap).

*d*

| Operator Function | | | |
|---|---|---|---|
| Code | Operator Position: Out | Operator Position: Center | Operator Position: In |
| M | Momentary | Maintained | Maintained |
| N | Momentary | Maintained | Momentary |

*e*

| Color Cap | |
|---|---|
| Code | Color |
| Blank | No cap |
| 1 | Green |
| 2 | Black |
| 4 | Grey (silver) |
| 6 | Red |
| 7 | Blue |
| 9 | Yellow (gold) |

*f*

| Contact Block(s) | | | | |
|---|---|---|---|---|
| Standard | | | | |
| Code | Operator Position: Out | Operator Position: Ctr. | Operator Position: In | Description |
| Blank | — | — | — | No contacts |
| A | O<br>X | O<br>O | X<br>O | 1 N.O. -<br>1 N.C. |
| A1 | O<br>X | O<br>X | X<br>O | 1 N.O. -<br>1 N.C.L.B. |
| A7 | X<br>X | O<br>X | O<br>O | 1 N.C. -<br>1 N.C.L.B. |
| B6 | X<br>X | O<br>X | O<br>O | 2 N.C. -<br>2 N.C.L.B. |
| Pen*TUFF* (Low Voltage) | | | | |
| AV | O<br>X | O<br>O | X<br>O | 1 N.O. -<br>1 N.C. |
| **Note:** X = Closed/O = Open. | | | | |

## 3-Position Selector Switch Units, Non-Illuminated

*Standard Knob Operator*
***Cat. No. 800H-JP2KB7AXXX***

*Knob Lever Operator*
***Cat. No. 800H-JP17KB7AXXX***

*Metal Wing Lever Operator*
***Cat. No. 800H-JP11KB7AXXX***

| Contact Type | Operator Position | | | M = Maintained<br>S = Spring Return | Standard Knob<br>Cat. No.‡ | Knob Lever<br>Cat. No.‡ | Metal Wing Lever<br>Cat. No.‡ |
|---|---|---|---|---|---|---|---|
| No Contacts | — | — | — | M M M | **800H-JP2KB7** | 800H-JP17KB7 | 800H-JP11KB7 |
| | | | | S→M M | 800H-JP4KB7 | 800H-JP18KB7 | 800H-JP15KB7 |
| | | | | M M←S | 800H-JP5KB7 | 800H-JP19KB7 | 800H-JP16KB7 |
| | | | | S→M←S | 800H-JP91KB7 | 800H-JP20KB7 | 800H-JP141KB7 |
| 1 N.O. - 1 N.C. | O<br>X | O<br>O | X<br>O | M M M | **800H-JP2KB7AXXX** | 800H-JP17KB7AXXX | 800H-JP11KB7AXXX |
| | | | | S→M M | 800H-JP4KB7AXXX | 800H-JP18KB7AXXX | 800H-JP15KB7AXXX |
| | | | | M M←S | 800H-JP5KB7AXXX | 800H-JP19KB7AXXX | 800H-JP16KB7AXXX |
| | | | | S→M←S | **800H-JP91KB7AXXX** | 800H-JP20KB7AXXX | 800H-JP141KB7AXXX |
| 2 N.O. - 2 N.C. | O<br>X<br>O<br>X | O<br>O<br>O<br>O | X<br>O<br>X<br>O | M M M | **800H-JP2KB7AAXX** | 800H-JP17KB7AAXX | 800H-JP11KB7AAXX |
| | | | | S→M M | 800H-JP4KB7AAXX | 800H-JP18KB7AAXX | 800H-JP15KB7AAXX |
| | | | | M M←S | 800H-JP5KB7AAXX | 800H-JP19KB7AAXX | 800H-JP16KB7AAXX |
| | | | | S→M←S | 800H-JP91KB7AAXX | 800H-JP20KB7AAXX | 800H-JP141KB7AAXX |

**Note:** X = Closed/O = Open

***3-Position Cylinder Lock Operator***
*Cat. No. 800H-JP42KB7AXXX*

| Contact Type | Operator Position | | | M = Maintained<br>S = Spring Return | Cylinder Lock<br>Key Removal Left<br>Cat. No.‡ | Key Removal Center<br>Cat. No.‡ | Key Removal All∗<br>Cat. No.‡ |
|---|---|---|---|---|---|---|---|
| No Contacts | O | X | X | M M M | 800H-JP41KB7 | 800H-JP42KB7 | 800H-JP44KB7 |
| | | | | S→M∗ | — | 800H-JP50KB7 | 800H-JP51KB7 |
| | | | | M←S | 800H-HP5KL8DXXX | 800H-JP38KB7 | 800H-JP73KB7 |
| | | | | M M | — | 800H-JP631KB7 | — |
| 1 N.O. - 1 N.C. | O<br>X | O<br>O | X<br>O | M M M∗ | 800H-JP41KB7AXXX | 800H-JP42KB7AXXX | 800H-JP44KB7AXXX |
| | | | | M←S | — | 800H-JP50KB7AXXX | 800H-JP51KB7AXXX |
| | | | | M M←S | 800H-JP69KB7AXXX | 800H-JP38KB7AXXX | 800H-JP73KB7AXXX |
| | | | | S→M←S | — | 800H-JP631KB7AXXX | — |

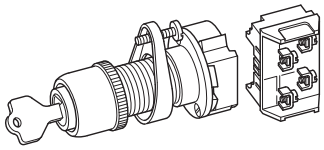
**Note:** X = Closed/O = Open
∗ Key removable in maintained positions only.
‡ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-JP41KB7.

10

# Hazardous Location Push Buttons

## Product Selection

### 3-Position Selector Switch Units, Non-Illuminated



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 800 | H | – | JP | | 2 | KB7 | AAXX | (Knob/Wing Lever) |
| | *a* | | *b* | *c* | *d* | *e* | *f* | |
| 800 | H | – | JP | 41 | | KB7 | AAXX | (Cylinder Lock) |
| | *a* | | *b* | $c_1$ | $d_1$ | *e* | *f* | |

#### *a*

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

#### *b*

| Number of Positions | |
|---|---|
| Code | Description |
| JP | 3-position |

#### *c*

| Knob Insert Colors* | |
|---|---|
| Code | Color |
| Blank | White knob insert or cylinder lock operator |
| X | Packet of colored inserts❄ |
| **Metal Wing Lever Colors** | |
| **Code** | **Color** |
| A | Red |
| Blank | Grey |

#### $c_1$

| Cylinder Lock Operators | |
|---|---|
| **Maintained Position** | |
| **Code** | **Locking Position** |
| 41 | Left |
| 42 | Center |
| 43 | Right |
| 44 | All |
| 45 | Left and center |
| 46 | Right and left |
| 47 | Right and center |
| **Spring Return from Left** | |
| **Code** | **Locking Position** |
| 50 | Center |
| 52 | Right |
| 51 | Right and center |
| **Spring Return from Right** | |
| **Code** | **Locking Position** |
| 69 | Left |
| 38 | Center |
| 73 | Left and center |
| **Spring Return from Both** | |
| **Code** | **Locking Position** |
| 631 | Center |

#### *d*

| Knob/Lever Type Operators | |
|---|---|
| **Standard Knob** | |
| **Code** | **Operator Function** |
| 2 | Maintained |
| 4 | Spring return from left |
| 5 | Spring return from right |
| 91 | Spring return from both |
| **Knob Lever** | |
| **Code** | **Operator Function** |
| 17 | Maintained |
| 18 | Spring return from left |
| 19 | Spring return from right |
| 20 | Spring return from both |
| **Metal Wing Lever§** | |
| **Code** | **Operator Function** |
| 11 | Maintained |
| 15 | Spring return from left |
| 16 | Spring return from right |
| 141 | Spring return from both |

#### $d_1$

| Operator Type/Function‡ | |
|---|---|
| **Standard Knob** | |
| **Code** | **Key No.** |
| Blank | D018 (standard key) |
| **Note:** Refer to page 10-164 for additional key option codes. | |

#### *e*

| Cam Option | |
|---|---|
| Code | Description |
| KB7 | Standard cam KB7 |
| KA1 | Cam KA1 |
| KA7 | Cam KA7 |
| **Note:** For additional Cam descriptions, see Table 5. | |

#### *f*

| Contact Block Option | |
|---|---|
| **Code** | **Description** |
| Blank | No contacts |
| AXXX | Two contact targets for a given cam as shown in the W (white side) column of Table 5. |
| AAXX | Two contact targets for a given cam as shown in the W (white side) column of Table 1 **and** 2 contact targets for the same cam as shown in the B (black side) column of Table 5. (One **Cat. No. 800T-XA** contact block per side. Two contact blocks total.) |
| AAAA | Four contact targets for a given cam as shown in the W (white side) column of Table 5 **and** 4 contact targets for the same cam as shown in the B (black side) column of Table 5. (Two **Cat. No. 800T-XA** contact blocks per side. Four contact blocks total.) |

### Table 5. Cam and Contact Block Functionality Table

| Contact Block Suffix Code | Contact Block Side | Circuits | Cam Codes | | | | | | | |

## Pilot Light Units

*Transformer Type Pilot Light*
***Cat. No. 800H-PP16M***

*Push-to-Test Pilot Light*
***Cat. No. 800H-PPT16M***

*Pigtail Pilot Light*
***Cat. No. 800H-LP24M***

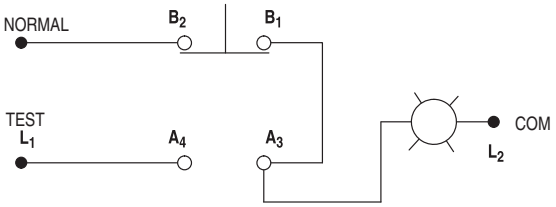
| Type | Lamp Type | Supply Voltage | Lens Color✶ | Pilot Light Cat. No.❄ | Push-to-Test Cat. No.❄‡ | Pigtail Cat. No.❄§ |
|---|---|---|---|---|---|---|
| Operator only♣ | | | | 800H-QPN00 | 800H-QPB00XX | — |
| Full voltage | Incandescent | 24V AC/DC | Multi-color kit | 800H-QP24M | 800H-QPT24M | 800H-LP24M |
| | | 120V AC/DC | | **800H-QP10M** | **800H-QPT10M** | **800H-LP10M** |
| | No lamp | 0…250V AC/DC | No lens | 800H-QPN25 | 800H-QPTN25 | 800H-LPN25 |
| | LED | 24V AC/DC | Multi-color kit | — | — | 800H-LPH24M |
| | | 120V AC | | — | — | 800H-LPH10M |
| Universal | LED | 12…130V AC/DC | Multi-color kit | **800H-QPH2M** | 800H-QPTH2M | — |
| Transformer | Incandescent | 120V AC, 50/60 Hz | Multi-color kit | **800H-PP16M** | 800H-PPT16M | — |
| | LED | | | 800H-PPH16M | 800H-PPTH16M | — |

✶ Units ship with multi-color insert packet including amber, blue, green, red, and white.
❄ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-QPH2M
‡ Includes one standard Cat. No. 800T-XA (1 N.O./1 N.C.) contact block.
§ Pigtail length is 7 in.
♣ Operator only supplied without power module, lamp, lens cap, or contact blocks.

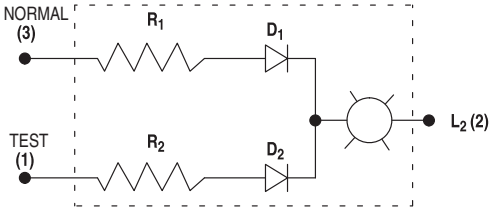
## Typical Pilot Light Wiring Diagrams

See applicable Codes and Laws.

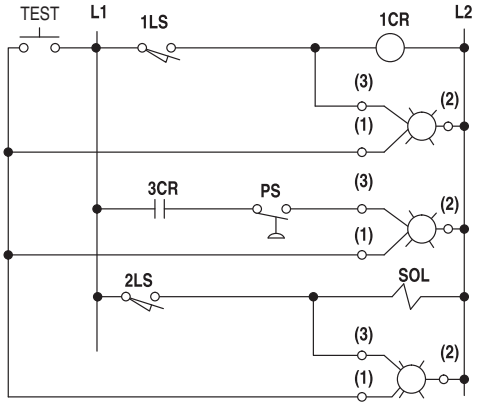
### Push-to-Test Pilot Light Device Schematic



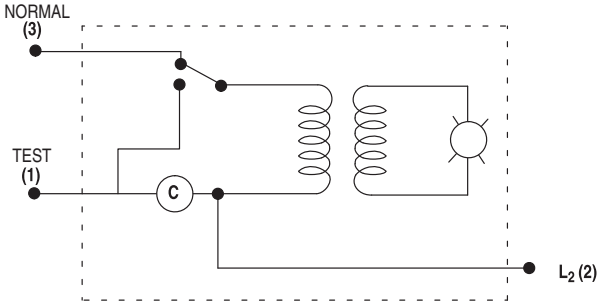

### Dual Input Diode Pilot Device Schematic




### Dual Input Pilot Light Typical Application Wiring Diagram




### Dual Input Pilot Light Transformer Type Device Schematic



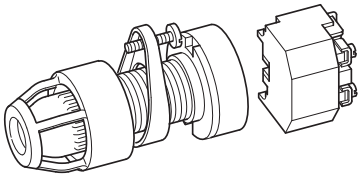

10

# Hazardous Location Push Buttons

## Product Selection

### Pilot Light Units

| 800 | H | – | PP | T | | 16 | M |
|---|---|---|---|---|---|---|---|
| | *a* | | *b* | *c* | *d* | *e* | *f* |



*a*

| Barrel Type | |
|---|---|
| Code | Description |
| H | Standard barrel length |
| HL | Long barrel |

*b*

| Power Module Type | |
|---|---|
| Code | Description |
| PP | Transformer (or dual input) |
| QP | Full voltage/Universal |
| LP | Pigtail — full voltage❄ |
| LPK | Pigtail — full voltage❄ (for dual push buttons) |

*c*

| Lamp Test Options | |
|---|---|
| Code | Description |
| Blank | No test option |
| T | Push-to-test |
| D | Dual input — diode‡ |
| DT | Dual input — transformer relay‡ |

*d*

| Illumination Option | |
|---|---|
| Code | Description |
| Blank | Incandescent |
| H | LED♣ |

*e*

| Voltage | |
|---|---|
| Transformer | |
| Code | Description |
| 16 | 120V AC, 50/60 Hz |
| 26 | 240V AC, 50/60 Hz |
| 46 | 480V AC, 50/60 Hz |
| 56 | 600V AC, 50/60 Hz |
| Full Voltage — Incandescent | |
| Code | Description |
| 24 | 24V AC/DC |
| 10 | 120V AC/DC |
| 20 | 240V AC/DC |
| Universal — LED | |
| Code | Description |
| 2 | 12…130V AC/DC |
| Dual Input | |
| Code | Description |
| 16 | 120V AC |
| 24 | 24V AC/DC✦ |
| Pigtail | |
| Code | Description |
| 24 | 24V AC/DC |
| 10 | 120V AC/DC |
| 20 | 240V AC/DC |

*f*

| Lens Color | |
|---|---|
| Code | Color |
| Blank | No lens with no contacts |
| M | Multi-color✶ |

**Note:** Push-to-test pilot light is supplied with a factory jumpered 800T-XA, 1 N.O - 1 N.C contact block.
✶ Multi-color insert packet includes amber, blue, green, red, and white
❄ Lamp test options is not available with pigtail.
‡ Only available with power module type code **PP**.
♣ LED illumination option is not available with diode type dual input lamp test options.
✦ Dual input diode only.

## Ordering Information for Stations

### Stations

Bulletin 800H Type 7 & 9 stations are available as factory assembled or as components for field assembly.

### Factory-Assembled Stations

Bulletin 800H Type 7 & 9 control stations are designed to meet the requirements of the National Electrical Code. These stations are listed by Underwriters Laboratories, Inc. for Class I, Divisions 1 & 2, Groups C & D Hazardous Gases or Vapors, Class II, Divisions 1 & 2, Groups E, F & G Hazardous Dust and Class III Hazardous Fiber Locations. In addition the single gang shallow base, **Cat. No. 800H-IHZX7**, meets Class I, Group B requirements as defined in the National Electrical Code.

Factory-assembled stations may be ordered in three ways:

- **Standard**, factory-assembled stations listed on page 10-154.
- **Custom**, factory-assembled stations can be ordered by following the instructions listed on this page.

### Components for Field Assembled Stations

**Eight-gang maximum**∗. These 2- and 3-gang modules may be assembled into the multi-gang stations by installing a coupler kit between the enclosures. These separate bases, covers, or bases with covers are Underwriters Laboratories, Inc. listed when properly assembled. These enclosures meet the requirements of Class I, Division 1 & 2, Groups C & D, Class II, Divisions 1 & 2, Groups E, F & G, and Class III hazardous locations as defined in the National Electrical Code. Bulletin 800H Type 7 & 9 components are designed for these modular enclosures and are UL Listed for this purpose.

**Note:** Components may be assembled as multi-gang units up to an **eight-gang maximum**∗.

To select components for field assembly, follow the instructions for ordering a custom-built station.

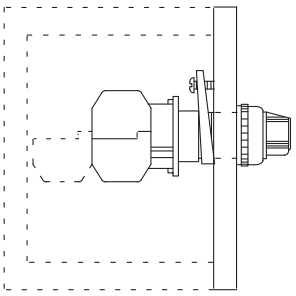
### Instructions for Ordering Custom-Built Stations

1. Select operators required from page 10-154. (If lever type, select covers from page 10-172 and go to Step 3).
2. Select covers based on mounting requirements on page 10-172.
3. Select an assembled base from page 10-173 in accordance with the number of covers selected in Step 2.
4. Select legend plates from page 10-181…10-182 (and accessories, if required, from pages page 10-175…10-179).
5. If a particular sequence of operators or mounting orientation (vertical versus horizontal) is required, include a rough sketch.

## Station Design Guidelines

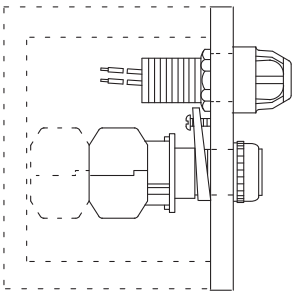
(Also see Applicable Codes and Standards)

1. Push-to-test pilot lights, illuminated push buttons, push-to-pull units, 4-position selector switches, and all operators with two contact blocks fastened along side one another or with a power module and contact block along side one another must be installed in a single hole cover.
2. Dual push button units may only be installed in a single-hole cover or the specially designed two-hole cover (Cat. No. 800H-NP33), which can accommodate the dual push button and the special pigtail pilot light (Cat. No. 800H-LPK10R).
3. When two components are installed in one cover, contact blocks are restricted to one side of the operator. Contact blocks of each operator must face each other.
4. One level of contact blocks is maximum in a shallow base or deep base when used with a sealing well. Contact blocks, except sealed switch type, may be mounted two deep in other bases.
5. If sealed switch contact blocks or a sealing well are used, a deep enclosure is required.
6. a. START push buttons should be green or black flush, installed to the left or above STOP push buttons.
   b. EMERGENCY STOP push buttons should be a red mushroom.
   c. STOP push buttons should be red extended, installed to the right or below START push button.
   d. STOP push buttons should be installed in the last position (bottom or right) of each unit when required.
   e. Pilot lights should be installed in the first position (top or left side) of each unit when required.



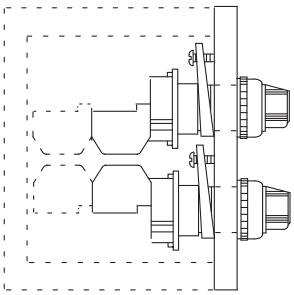
### Design Guideline #1

Push-to-test pilot lights, illuminated push buttons, push-pull units, 4-position selector switches, all operators with two contact blocks fastened along side one another or with a power module and contact block along side one another must be installed in a single hole cover.



### Design Guideline #2

Dual push button units may only be installed in a single hole cover or the specially designed two hole cover (Cat. No. 800H-NP33), which can accommodate the dual push button and the special pigtail pilot light (Cat. No. 800H-LPK10R).



### Design Guideline #3

When two components are installed in one cover, contact blocks are restricted to one side of the operator. Contact blocks of each operator must face each other.

### Design Guideline #4

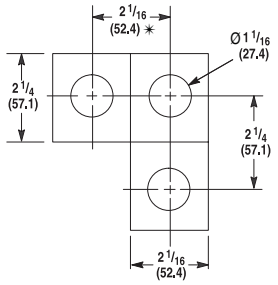
One level of contact blocks is maximum in a shallow base or deep base when used with a sealing well. Contact blocks, except sealed switch type, may be mounted two deep in other bases.

∗ Flange width is designed to comply with Underwriters Laboratories standards to enclosures with an internal free volume of up to 300 cubic inches (a maximum 8-gang assembly).

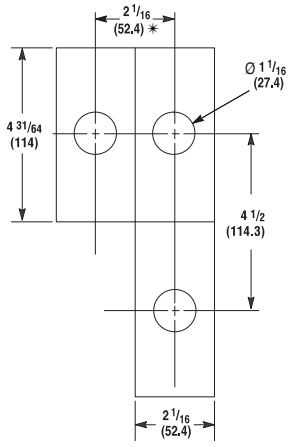
## Approximate Dimensions and Shipping Weights

Dimensions in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

***Standard Legend Plate (used with two-hole cover)***




***Jumbo Legend Plate (used with one-hole cover)***



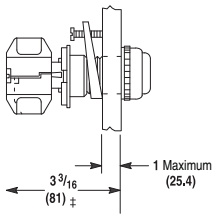

**Note:** Mounting hole requirements for components — 3/4 in. - 14 NPSM.✳

✳ External thread major diameter: 1.034 in. max., 1.024 in. min.
Internal thread minor diameter: 0.958 in. min., 0.970 in. max.

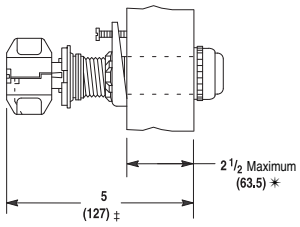
❄ Sketch illustrates the minimum distance between center lines when mounting Bulletin 800H units with legend plates either side by side or one above the other in non Allen-Bradley enclosures. **Minimum spacing without legend plate:** When units are mounted so that the contact block terminals face each other, the 2-1/4 in. (57.2 mm) dimension must be used in order to get proper electrical clearance. When control units are mounted so that the contact block terminals do not face each other, the 1-27/32 in. (46.8 mm) dimension can be used.

## Panel Thickness Requirements

***Standard Barrel [devices will fit panels up to 1 in. (25.4 mm)]***



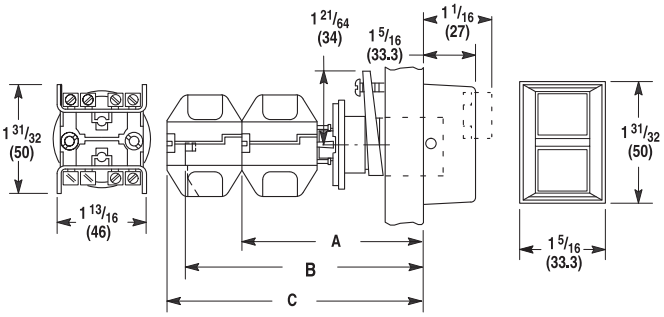

***Long Barrel [devices will fit panels up to 2-1/2 in. (63.5 mm)]***




❄ When mounting in a panel thicker than 2-1/8 in. (54 mm) locking bracket not required.
‡ This dimension for push buttons only.

## Push Buttons

### Dual Head




| Dim. | A | B | C | Ship. Wt. [oz (kg)] |
|---|---|---|---|---|
| Standard Barrel | 3-5/16 (84.1) | 4-3/16 (106.4) | 4-7/16 (112.7) | 10-3/8 (0.30) |
| Long Barrel | 4-19/32 (116.7) | 5-15/32 (138.9) | 5-23/32 (145.2) | 13 (0.37) |

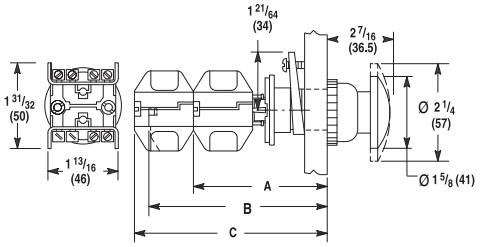
10

## Approximate Dimensions and Shipping Weights, Continued

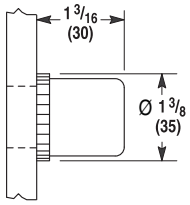
Dimensions in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

### Push Buttons

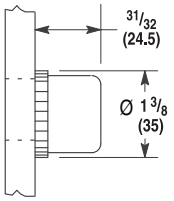
***Mushroom Head***



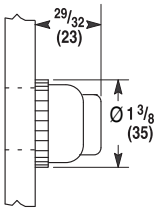

***Push Button with Extra Long Guard***




***Flush Head***




***Extended Head***

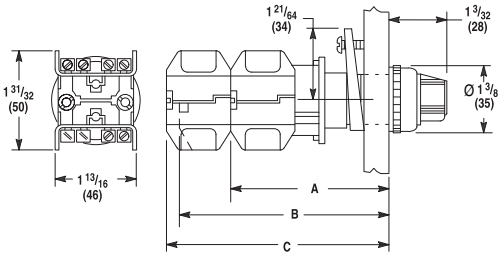



| Type | Standard Barrel | | | | Long Barrel | | | |
|---|---|---|---|---|---|---|---|---|
| | A ✶ | B | C | Ship. Wt. [oz (kg)] | A ❄ | B | C | Ship. Wt. [oz (kg)] |
| Mushroom, Flush and Extended Head | 3-3/16 (81) | 4-1/8 (105) | 4-3/8 (111) | 9-7/8 (0.28) | 5 (127) | 5-7/8 (149.2) | 6-1/8 (155.6) | 13-5/16 (0.38) |
| Extra Long Guard | 3-3/16 (81) | 4-1/8 (105) | 4-3/8 (111) | 10-7/8 (0.31) | 5 (127) | 5-7/8 (149.2) | 6-1/8 (155.6) | 14-5/16 (0.40) |

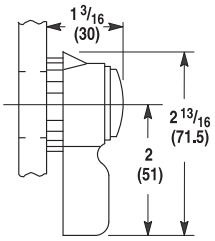
✶ When using sealed switch contact block, this dimension is 4-1/16 in. (103 mm).
❄ When using sealed switch contact block, this dimension is 5-7/8 in. (149.2 mm).

### Selector Switches

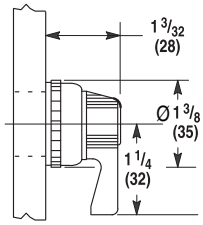
***Standard Operator***



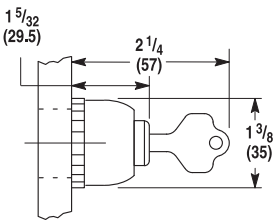

***Knob Lever Operator***




***Wing Lever Operator***




***Cylinder Lock Operator***




| Type | Standard Barrel | | | | Long Barrel | | | |
|---|---|---|---|---|---|---|---|---|
| | A ✶ | B | C | Ship. Wt. [oz (kg)] | A ❄ | B | C | Ship. Wt. [oz (kg)] |
| Standard and Knob Lever | 3-3/16 (81) | 4-1/8 (105) | 4-3/8 (111) | 9-1/2 (0.27) | 5 (127) | 5-7/8 (149.2) | 6-1/8 (155.6) | 14-3/8 (0.41) |
| Wing Lever | 3-3/16 (81) | 4-1/8 (105) | 4-3/8 (111) | 10-1/2 (0.30) | 5 (127) | 5-7/8 (149.2) | 6-1/8 (155.6) | 15 (0.42) |
| Cylinder Lock | 3-3/16 (81) | 4-1/8 (105) | 4-3/8 (111) | 11-1/4 (0.32) | 5 (127) | 5-7/8 (149.2) | 6-1/8 (155.6) | 16 (0.45) |

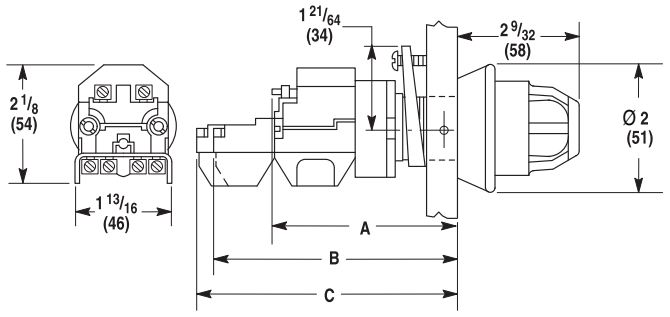
✶ When using sealed switch contact block, this dimension is 4-1/16 in. (103 mm).
❄ When using sealed switch contact block, this dimension is 5-7/8 in. (149.2 mm).

## Approximate Dimensions and Shipping Weights, Continued

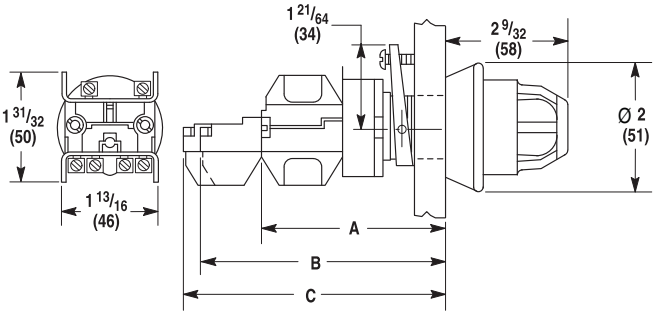
Dimensions in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

### Illuminated Push Buttons or Push-to-Test Pilot Lights

*Transformer Type*




*Full Voltage, Dual Input or Neon Type*

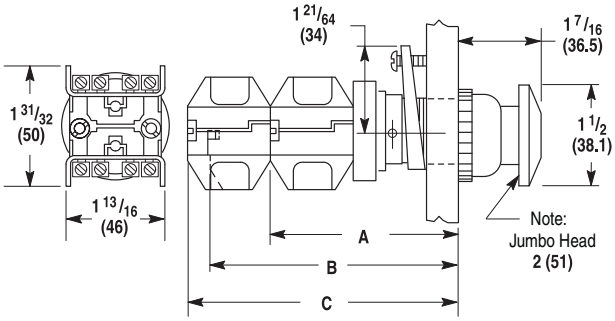



Illuminated Push Buttons, Push-to-Test Pilot Lights

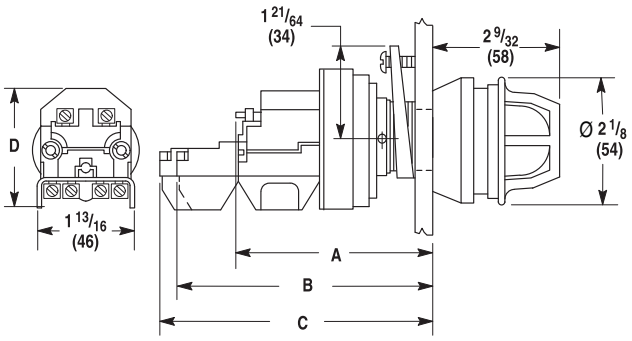
| Description | Style | A ∗ | B | C | Ship. Wt. [oz (kg)] |
|---|---|---|---|---|---|
| Transformer Type | Standard Barrel | 3-5/32 (80.2) | 3-29/32 (99) | 4-1/8 (105) | 14 (0.40) |
| | Long Barrel | 5-1/16 (128.6) | 5-13/16 (147.6) | 6-1/16 (154) | 16-3/16 (0.45) |
| Full Voltage Dual Input or Neon Type | Standard Barrel | 3-1/32 (77) | 3-29/32 (99) | 4-1/8 (105) | 11-5/8 (0.33) |
| | Long Barrel | 4-15/16 (125.4) | 5-13/16 (147.6) | 6-1/16 (154) | 13-7/16 (0.38) |

### Push-Pull Units

*Non-Illuminated*




*Illuminated*




Push-Pull Units

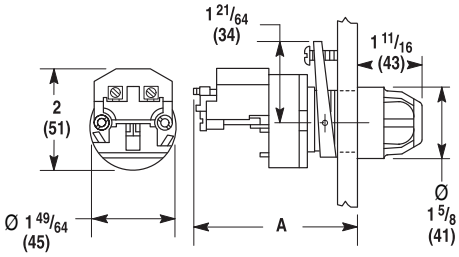
| Description | Style | A ∗ | B | C | D | Ship. Wt. [oz (kg)] |
|---|---|---|---|---|---|---|
| Illuminated Transformer Type | Standard Barrel | 3-9/16 (90.5) | 4-9/16 (115.9) | 4-5/8 (117.5) | 2-1/8 (54) | 15-1/2 (0.44) |
| | Long Barrel | 4-21/32 (118.3) | 5-13/32 (137) | 5-21/32 (143.7) | 2-1/8 (54) | 17-7/16 (0.49) |
| Illuminated Full Voltage Type | Standard Barrel | 3-7/16 (87.3) | 4-9/16 (115.9) | 4-5/8 (117.5) | 1-31/32 (50) | 12-13/16 (0.33) |
| | Long Barrel | 4-17/32 (115.1) | 5-13/32 (137) | 5-21/32 (143.7) | 1-31/32 (50) | 14-3/4 (0.41) |
| Non-Illuminated Push-Pull Units | Standard Barrel | 3-1/2 (88.9) | 4-3/8 (111.1) | 4-5/8 (117.5) | — | 11-1/8 (0.32) |
| | Long Barrel | 4-17/32 (115.1) | 5-13/32 (137) | 5-21/32 (143.7) | — | 12-5/16 (0.34) |

∗ When using sealed switch contact block add 7/8 in. (22.2 mm) to the listed dimension.

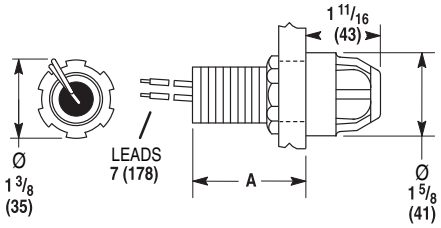
## Approximate Dimensions and Shipping Weights, Continued

Dimensions in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

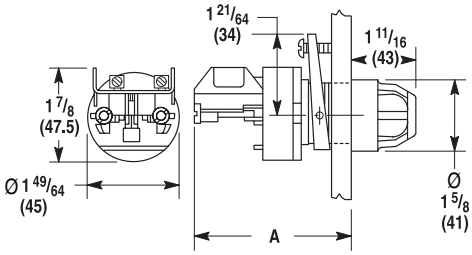
***Pilot Lights***




***Transformer Type***

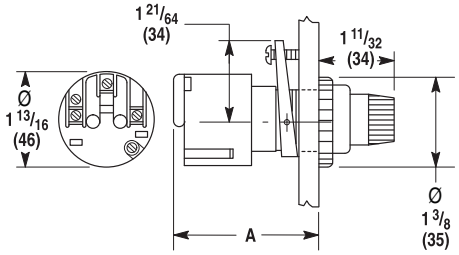



***Full Voltage, Pigtail Type***




| Description | Style | A | Ship. Wt. [oz (kg)] |
|---|---|---|---|
| Transformer type and dual input transformer type pilot lights | Standard Barrel | 3-5/32 (80) | 8-9/16 (0.24) |
| | Long Barrel | 4-9/16 (115.9) | 30-1/4 (0.85) |
| Full voltage, neon or dual input diode and resistor type pilot lights | Standard Barrel | 3-1/32 (77) | 5-13/16 (0.17) |
| | Long Barrel | 4-7/16 (112.7) | 27-1/2 (0.77) |
| Full voltage pigtail type pilot lights | Standard Barrel | 2-3/16 (55.5) | 5-5/8 (0.16) |
| | Long Barrel | 3-43/64 (94) | 8-5/16 (0.24) |

## Potentiometer Units



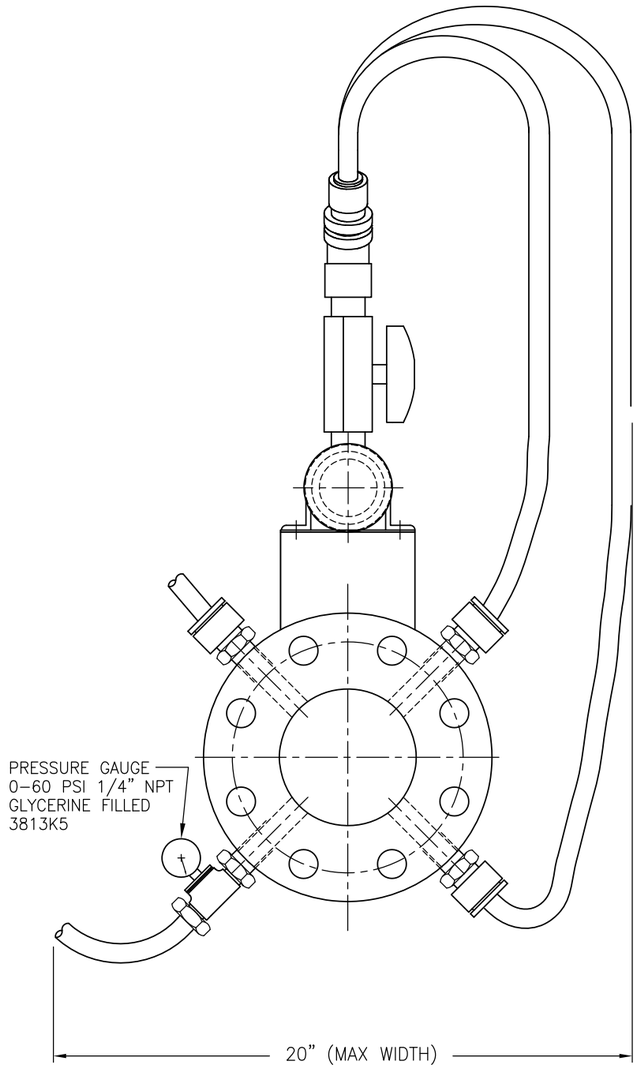

| Style | A | Ship. Wt. [oz (kg)] |
|---|---|---|
| Standard barrel | 3-1/8 (79.5) | 5-3/8 (0.16) |
| Long barrel | 4-1/2 (114.3) | 8 (0.23) |

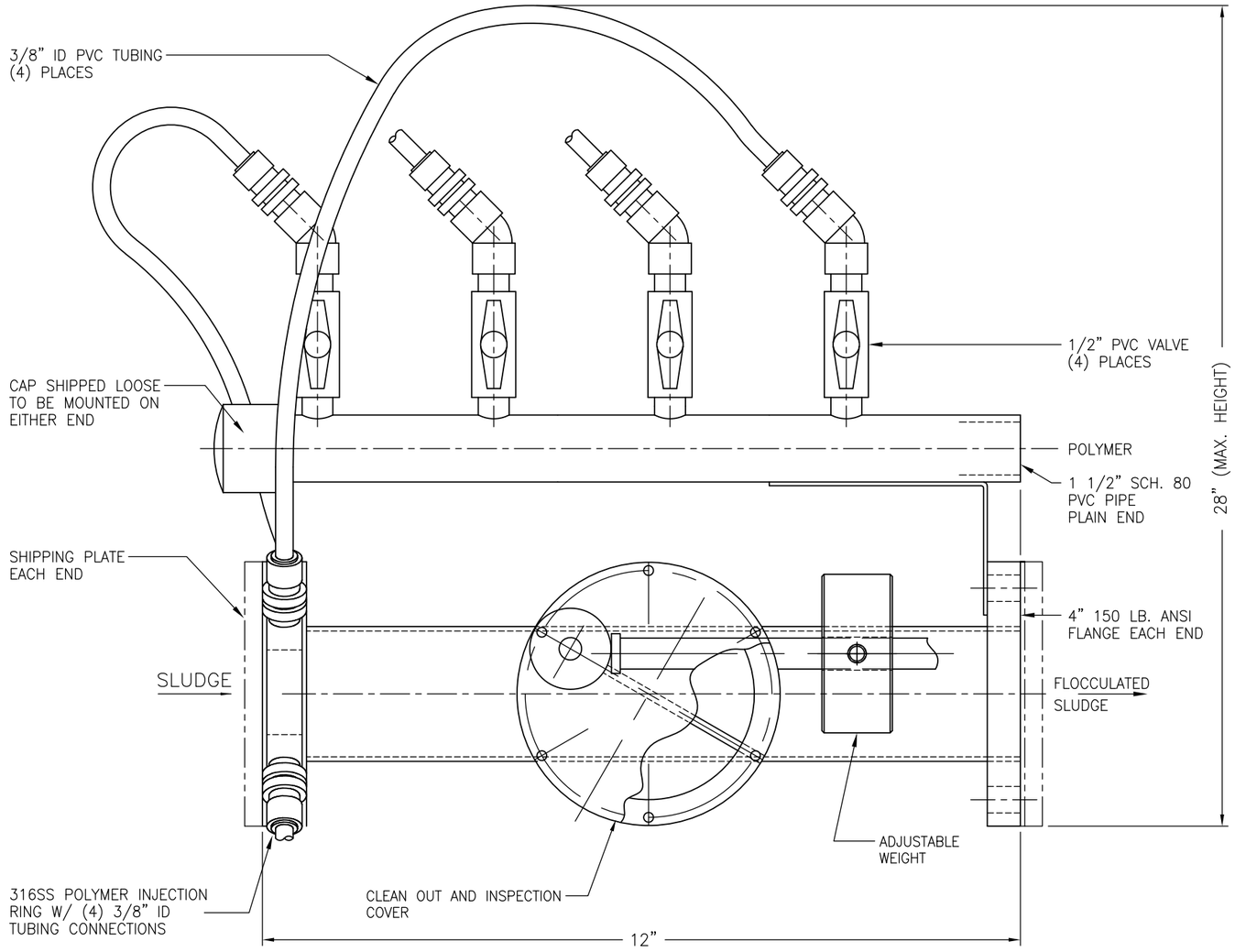
# VENTURI MIXER

## A. General

All venturi mixers are designed and fabricated by BDP Industries. The in-line venturi mixer is designed to mix the feed slurry with made down polymer solution in order to obtain flocculated feed slurry. "Made down" is defined as diluting the polymer from its original state to a desired percentage (e.g., 0.35%) solution mixture. Depending on the type of sludge and the molecular weight and charge of the polymer solution, the amount of mixing required in the venturi mixer will vary. The mixing intensity is varied by adding or removing weight on the mixing arm. The amount of mixing intensity is measured by the pressure gauge mounted to the injection polymer manifold.

The venturi mixer is supplied with a vortex polymer injection ring with four (4) tangentially mounted polymer injection ports. The injection manifold is supplied with PVC ball valves. The mixer is provided with an adjustable counter weight on the mixing arm which moves the wear plate inside the mixer. This controls the amount of mixing. The mixer is provided with a removable side plate for easy cleaning and maintenance.




NOTE:

1. MAY BE MOUNTED HORIZONTAL OR VERTICAL.
2. VENTURI MIXER IS MANUFACTURED BY BDP.

| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|
| 3 | ADDED 316 SS CONSTRUCTION NOTE | DCW | 6/12/03 |
| 2 | CHG'D PIPE BRACKET | KCE | 2/22/01 |
| 1 | ISSUED | KCE | 1/18/01 |

| QTY. | DESCRIPTION | MAT. | ITEM | REMARKS |
|---|---|---|---|---|

**BDP INDUSTRIES, INC.**
**GREENWICH, N.Y. 12834**

| | | | |
|---|---|---|---|
| CUSTOMER: GENERAL | MACHINE: | DWG TITLE: 4" VENTURI MIXER 316 SS CONSTRUCTION | |
| BDP JOB NO. | DWN BY: SKD | DATE: 0118/01 | |
| APP'D BY: | SCALE: | SHT. 1 OF 1 | REV. 2 |
| | | DWG NO. 3–110–83 | |

**Orleans, MA**
**BDP JOB 1529**
**Dual 4x10 RDT**

DATE: 8/27/2019 NO. OF UNITS:
REV: 0 1

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION | SPARE | TOTAL REQD. |
|---|---|---|---|---|---|---|
| FLOW METER | | | | | | |
| | 1 | SIEMENS | 7ME6520-3TJ12-2CA2 | 4" MAG 5100W SENSOR WITH MAG6000 I CLASS I DIV 2 TRANSMITTER MOUNTED TO FLOW SENSOR | | 1 |

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# Transmitter MAG 6000 I/6000 I Ex d

## Overview

The SITRANS F M MAG 6000 I/I Ex d transmitter is designed for the demands in the process industry. The robust die cast aluminium housing provides superb protection, even in the most harsh industrial environments. Full input and output functionality is given even in the Ex version.

## Benefits

- Full range of ATEX rated flowmeters with intrinsically safe rated input and outputs
- For compact or remote installation
- HART, FOUNDATION Fieldbus H1, DeviceNet, PROFIBUS PA and DP, MODBUS RTU/RS485 add-on communication modules available
- Superior signal resolution for optimum turn down ratio
- Digital signal processing with many possibilities
- Automatic reading of SENSORPROM data for easy commissioning
- User configurable operation menu with password protection
  - 3 lines, 20 characters display in 11 languages
  - Flow rate in various units
  - Totalizer for forward, reverse and net flow as well as much more information available.
- Multiple functional outputs for process control, minimum configuration with analogue, pulse/frequency and relay output (status, flow direction, limits)
- Comprehensive self-diagnostic for error indication and error logging
- Batch control

## Design

The transmitter is designed for either compact or remote installation in non-hazardous or hazardous areas (compact mounted transmitter to be ordered together with the sensors).

## Function

The following functions are available:

- Flow rate
- 2 measuring ranges
- 2 totalizers
- Low flow cut-off
- Flow direction
- Error system
- Operating time
- Uni-/bidirectional flow
- Limit switches and pulse output
- Batch control

The MAG 6000 I/6000 I Ex d is a microprocessor-based transmitter with a build-in alphanumeric display in several languages. The transmitters evaluate the signals from the associated electromagnetic sensors and also fulfil the task of a power supply unit which provides the magnet coils with a constant current.

Further information on connection, mode of operation and installation can be found in the data sheets for the sensors.

### *Displays and keypads*

Operation of the transmitter can be carried out using:

- Keypad and display unit
- HART communicator
- PC/laptop and SIMATIC PDM software via HART communication
- PC/laptop and SIMATIC PDM software using PROFIBUS or MODBUS communication

## Technical specifications

| | |
|---|---|
| **Mode of operation and design** | |
| Measuring principle | Electromagnetic with pulsed constant field |
| Empty pipe | Detection of empty pipe (special cable required in remote mounted installation) |
| Excitation frequency | Depend on sensor size |
| Electrode input impedance | > 1 x $10^{14}$ Ω |
| **Input** | |
| Digital input | DC 11 ... 30 V, Ri = 4.4 kΩ |
| • Activation time | 50 ms |
| • Current | $I_{DC\ 11\ V}$ = 2.5 mA, $I_{DC\ 30\ V}$ = 7 mA |
| **Output** | |
| Current output | |
| • Signal range | 0 ... 20 mA or 4 ... 20 mA (active/passive) |
| • Load | < 560 Ω |
| • Time constant | 0.1 … 30 s, adjustable |
| **Digital output** | |
| Frequency | 0 … 10 kHz, 50% duty cycle (uni-/bidirectional) |
| Time constant | 0.1 … 30 s, adjustable |
| Pulse (passive) | 3 … 30 V DC, max 110 mA (30 mA Ex version), 200 Ω ≤ Ri ≤ 10 kΩ (powered from connected equipment) |
| Time constant | 0.1 … 30 s, adjustable |
| **Relay output** | |
| Time constant | Changeover relay, same as current output |
| Load | 42 V AC/2 A, 24 V DC/1 A |
| **Low flow cut off** | 0 … 9.9% of maximum flow |
| **Galvanic isolation** | All inputs and outputs are galvanic isolated |
| **Max. measuring error** | |
| MAG 6000 I/MAG 6000 I Ex d | 0.25% of rate |

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## Technical specifications (continued)

| | |
|---|---|
| **Rated operation conditions** | |
| Ambient temperature | |
| • Operation | |
| - MAG 6000 I | -20 … +60 °C (-4 … +140 °F) |
| - MAG 6000 I Ex | -10 … +60 °C (+14 … +140 °F) |
| • Storage | -40 … +70 °C (-40 … +158 °F) |
| Mechanical load | 18 ... 1000 Hz random in x, y z, directions for 2 hours according to EN 60068-2-36<br>Transmitter: 1.14 grms |
| Degree of protection | IP67/NEMA 4X to IEC 529 and DIN 40050 (1 m$H_2O$ 30 min.) |
| EMC performance | EN 61326 |
| **Display and keypad** | |
| Totalizer | Two eight-digit counters for forward, net or reverse flow |
| Display | Background illumination with alphanumeric text, 3 x 20 characters to indicate flow rate, totalized values, settings and faults; Reverse flow indicated by negative sign |
| Keypad | Capacitive touch keypad with LED light for feedback indication |
| Time constant | Time constant as current output time constant |
| **Design** | |
| Enclosure material | Die cast aluminium, painted |
| • Wall mounting | Wall mounting bracket enclosed for remote version |
| Dimensional drawings | See dimensional drawings |
| Weight | See dimensional drawings |
| **Power supply** | • Non Ex d: 18 ... 90 V DC; 115 ... 230 V AC; 50 ... 60 Hz<br>• Ex d: 18 ... 30 V DC<br>• Ex d: 115 ... 230 V AC; 50 ... 60 Hz |
| Power consumption | • 230 V AC: 21.5 VA<br>• 24 V DC: 12 W, $I_N$ = 380 mA, $I_{ST}$ = 1 A (3 ms) |
| **Certificates and approvals** | |
| MAG 6000 I | • CE<br>• C-tick<br>• FM Class 1, div 2<br>• FM Class 1, Zone 2<br>• CSA Class 1, div 2<br>• CSA Class 1, Zone 2 |
| MAG 6000 I Ex (to be used with ATEX 2G D sensors) | • SIRA 03 ATEX 2072X<br>• EX II 2 (1) (2) G D<br>• EEx d e [ia] ia [ib] ib IIC, T6 |
| **Cable entries** | Remote installation<br>• MAG 6000 I: 2 x M25(for supply/output) and 2 x M16 (for sensor connection) or 2 x ½" NPT (for supply/output) and 2 x M16 (for sensor connection)<br>• MAG 6000 I Ex ATEX 2G D: 2 x M20 (for supply/output) and 2 x M16 (for sensor connection) |
| **Communication** | |
| Non ATEX versions | HART, MODBUS RTU/RS 485, FOUNDATION Fieldbus H1, DeviceNet, PROFIBUS PA, PROFIBUS DP add-on modules |
| ATEX 2G D | HART, PROFIBUS PA, FOUNDATION Fieldbus H1 available as integrated version |

## Selection and Ordering data

Order No.

**SITRANS F M Transmitter MAG 6000 I / Ex d** — **7ME6930-**

Remote, local display, die cast aluminium — **2BA■■-1■A■**

| | |
|---|---|
| **Supply voltage** | |
| 115 ... 230 V AC, 50 ... 60 Hz; 18 ... 90 V DC | **2** |
| ATEX 2G D, 18 ... 30 V DC | **4** |
| ATEX 2G D, 115 ... 230 V AC, 50 ... 60 Hz | **5** |
| **Ex approval** | |
| None ATEX; FM/CSA class1 div 2 | **0** |
| ATEX 2G D (For ATEX sensors: 7ME6110, 7ME6120, 7ME6140, 7ME6310, 7ME6320, 7ME6340) | **2** |
| **Communication** | |
| None (add-on modules can be ordered separately, see below) | **A** |
| HART | **B** |
| PROFIBUS PA Profile 3 | **F** |
| PROFIBUS DP Profile 3 (not Ex version) | **G** |
| MODBUS RTU/RS 485 (not Ex version) | **E** |
| FOUNDATION Fieldbus H1 | **J** |
| **Cable gland entries** | |
| Metric | **0** |
| ½" NPT | **2** |

### *Communication modules for MAG 6000 I (All standard outputs can still be used)*

| Description | | Order No. |
|---|---|---|
| HART (only for MAG 6000 I/Ex) | ▶ | **FDK-085U0321** |
| MODBUS RTU/RS485 | ▶ | **FDK-085U0234** |
| PROFIBUS PA Profile 3 | ▶ | **FDK-085U0236** |
| PROFIBUS DP Profile 3 | ▶ | **FDK-085U0237** |
| DeviceNet | ▶ | **FDK-085U0229** |
| FOUNDATION Fieldbus H1[1)] | ▶ | **A5E02054250** |

▶ Available ex stock

1) Pending for MAG 6000 I ATEX

4

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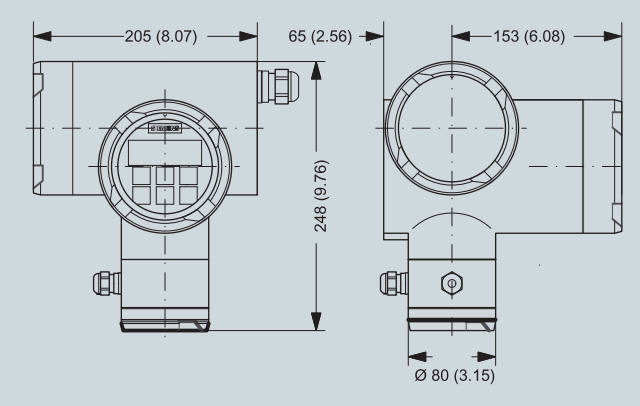
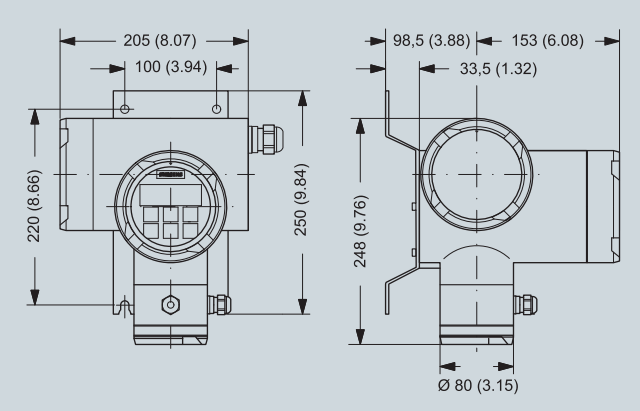
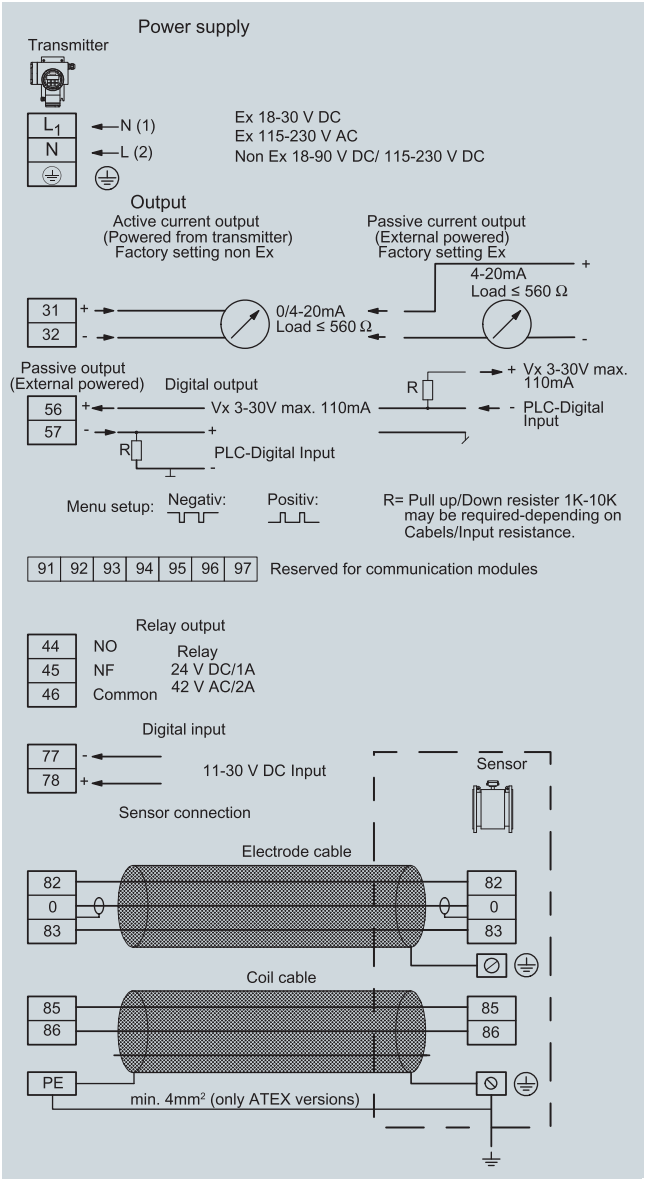
## Dimensional drawings




Dimensions in mm (inch), weight: 6 kg (13.5 lbs)

## Schematics



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## MAG 5100 W



### Overview

The SITRANS F M MAG 5100 W is an electromagnetic flow sensor designed to meet ground water, drinking water, waste water, sewage or sludge applications.

### Benefits

- DN 25 to DN 1200 (1" to 48")
- Connection flanges EN 1092-1 (DIN 2501), ANSI, AWWA and AS.
- NBR Hard Rubber liner for all water applications
- Drinking water EPDM liner with approvals
- Hastelloy integrated grounding and measuring electrodes
- Increased low flow accuracy for water leak detection, due to coned liner design.
- Drinking water approvals
- Suitable for direct burial and constant flooding
- Build-in length according to ISO 13359
- Easy commissioning, SENSORPROM unit automatically uploads calibration values and settings.
- Designed that patented in-situ verification can be conducted. Using SENSORPROM fingerprint.

### Application

The main applications of the SITRANS F M electromagnetic flow sensors can be found in the following fields:

- Water abstraction
- Water treatment
- Water distribution network (leak detection management)
- Custody transfer water meters
- Irrigation
- Waste water treatment
- Filtration plant (e.g. reverse osmosis and ultra filtration)
- Industrial water applications

### Mode of operation

The flow measuring principle is based on Faradays law of electromagnetic induction were the sensor converts the flow into an electrical voltage proportional to the velocity of the flow.

### Function

- Highly resistant to a wide range of chemicals
  - Pattern approval OIML R 49 (Denmark, Germany)
  - conforms to ISO 4064 and EN 14154
  - MI-001 Custody Transfer approval for billing (EU)
- Meets EEC directives: PED, 97/23/EC pressure directive for EN1092-1 flanges
- Simple onsite or factory upgrade to IP68/NEMA 6P of a standard sensor.

### Integration

The complete flowmeter consists of a flow sensor and an associated transmitter SITRANS F M MAG 5000, MAG 6000 or MAG 6000 I.

The flexible communication concept USM II simplifies integration and update to a variety of fieldbus systems, e.g. HART, FOUNDATION Fieldbus H1, DeviceNet, PROFIBUS DP and PA, MODBUS RTU/RS485.

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## Technical specifications

| Design | Full bore sensor | Coned bore sensor | Full bore sensor |
|---|---|---|---|
| Nominal size | DN 25 ... 40 (1" ... 1½") | DN 50 ... 300 (2" ... 12") | DN 350 ... 1200 (14" ... 48") |
| **Measuring principle** | Electromagnetic induction | | |
| Excitation frequency | 12.5 Hz | • DN 50 ... 65 (2" ... 2½"): 12.5 Hz<br>• DN 80 ... 150 (3" ... 6"): 6.25 Hz<br>• DN 200 ... 300 (8" ... 12"): 3.125 Hz | 1.56 Hz |
| **Process connection** | | | |
| Flanges | Raised face flanges | Flat face flanges | Raised face flanges |
| • EN 1092-1 | PN 40 (580 psi) | • DN 50 ... 300: PN 16 (2" ... 12": 230 psi)<br>• DN 200 ... 300: PN 10 (8" ... 12": 145 psi) | • PN 10 (145 psi)<br>• PN 16 (230 psi) |
| • ANSI B16.5 | Class 150 lb | Class 150 lb | Class 150 lb (≤ 24") |
| • AWWA C-207 | -- | -- | 28" ... 48": Class D |
| • AS4087 | PN 16 (230 psi) DN 50 ... 1200 (2" ... 48"), 14 bar (232 psi) | | |
| **Rated Operation conditions** | | | |
| Ambient temperature | | | |
| • Sensor | -40 ... +70 °C (-40 ... +158 °F) | | |
| • With compact transmitter MAG 5000/6000 | -20 ... +50 °C (-4 ... +122 °F) | | |
| • With compact transmitter MAG 6000 I | -20 ... +60 °C (-4 ... +140 °F) | | |
| Operating pressure (Abs) | 0.01 ... 40 bar (0.15 ... 580 psi) | 0.03 ... 20 bar (0.44 ... 290 psi) | 0.01 ... 16 bar (0.15 ... 232 psi) |
| Enclosure rating | | | |
| • Standard | IP67 to EN 60529 / NEMA 4X/6 (1 m$H_2O$ for 30 minutes) | | |
| • Option | IP68 to EN 60529 / NEMA 6P (10 m$H_2O$ continuously) | | |
| Pressure drop at 3 m/s (10 ft/s) | As straight pipe | Max. 25 mbar (0.36 psi) | As straight pipe |
| Medium conditions | | | |
| Temperature of medium | | | |
| • NBR | -10 ... +70 °C (14 ... +158 °F) | | |
| • EPDM | -10 ... +70 °C (14 ... +158 °F) | | |
| EMC | 89/336 EEC | | |
| **Design** | | | |
| Weight | See dimensional drawings | | |
| Material | | | |
| • Housing and flanges | Carbon steel, St 37.2 | | |
| • Terminal box | Fibre glass reinforced polyamide | | |
| • Measuring pipe | AISI 304 (1.4301) | | |
| • Liner | NBR Hard Rubber (hydro carbon resistant)<br>EPDM | | |
| • Electrodes | Hastelloy C276 | | |
| • Grounding electrodes standard | Hastelloy C276 | | |
| **Certificates and approvals** | | | |
| Custody Transfer (only together with MAG 5000/6000 CT), order as special | OIML R 49 pattern approval cold water (Denmark and Germany): DN 50 ... 300 (2" ... 12")<br>MI 001 cold water (EU): DN 50 ... 300 (2" ... 12") | | |
| Approvals | FM Class 1, Div 2 | | |
| Drinking water approvals | | | |
| • EPDM | NSF/ANSI Standard 61 (Cold water, US)<br>WRAS (WRc, BS6920 cold water, GB)<br>ACS listed (F),<br>DVGW W270 (D)<br>Belaqua (B) | | |
| • NBR | NSF/ANSI Standard 61 (Cold water, US, only ANSI B16.5 flanges) | | |
| Approvals | PED – 97/23 EC[1)], CRN | | |

[1)] For sizes larger than 600 mm (24") in PN 16 PED conformity is available as a cost added option. The basic unit will carry the LVD (Low Voltage Directive) and EMC approval.

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## MAG 5100 W

| Selection and Ordering data | Order No. |
|---|---|
| **SITRANS F M Flowsensor MAG 5100 W** | 7ME6520- |
| Hastelloy electrodes, carbon steel flanges | ■■■1■-2■■■ |
| **Diameter** | |
| DN 25 (1“) ▶ | 2D |
| DN 40 (1½“) ▶ | 2R |
| DN 50 (2“) ▶ | 2Y |
| DN 65 (2½“) ▶ | 3F |
| DN 80 (3“) ▶ | 3M |
| DN 100 (4“) ▶ | 3T |
| DN 125 (5“) ▶ | 4B |
| DN 150 (6“) ▶ | 4H |
| DN 200 (8“) ▶ | 4P |
| DN 250 (10“) ▶ | 4V |
| DN 300 (12“) ▶ | 5D |
| DN 350 (14“) | 5K |
| DN 400 (16“) | 5R |
| DN 450 (18“) | 5Y |
| DN 500 (20“) | 6F |
| DN 600 (24“) | 6P |
| DN 700 (28“) | 6Y |
| DN 750 (30“) | 7D |
| DN 800 (32“) | 7H |
| DN 900 (36“) | 7M |
| DN 1000 (40“) | 7R |
| 42“ | 7U |
| 44“ | 7V |
| DN 1200 (48“) | 8B |
| **Flange norm and pressure rating** | |
| to EN 1092-1 | |
| PN 10 (DN 200 ... 1200/8“ ... 48“) ▶ | B |
| PN 16 (DN 50 ... 1200/2“ ... 48“) ▶ | C |
| PN 16, non PED (DN 700 ... 1200/28“ ... 48“) | D |
| PN 40 (DN 25 ... 40/1“ ... 1½“) ▶ | F |
| to ANSI B16.5 | |
| class 150 (1“ ... 24“) ▶ | J |
| to AWWA C-207 | |
| Class D (28“ ... 48“) | L |
| to AS 4087 | |
| PN 16 | N |
| **Liner material** | |
| EPDM ▶ | 2 |
| NBR Hard Rubber ▶ | 3 |
| **Transmitter** | |
| Sensor for remote transmitter (Order transmitter separately) ▶ | A |
| MAG 6000 I, Aluminum, 18 ... 90 V DC, 115 ... 230 V AC ▶ | C |
| MAG 6000, Polyamid, 11 ... 30 V DC/11 ... 24V AC ▶ | H |
| MAG 6000, Polyamid, 115/230 V AC ▶ | J |
| MAG 5000, Polyamid, 11 ... 30 V DC/11 ... 24V AC ▶ | K |
| MAG 5000, Polyamid, 115/230 V AC ▶ | L |

| Selection and Ordering data | Order No. |
|---|---|
| **SITRANS F M Flowsensor MAG 5100 W** | 7ME6520- |
| Hastelloy electrodes, carbon steel flanges | ■■■1■-2■■■ |
| **Communication** | |
| None ▶ | A |
| HART ▶ | B |
| PROFIBUS PA Profile 3 (only MAG 6000/MAG 6000 I) ▶ | F |
| PROFIBUS DP Profile 3 (only MAG 6000/MAG 6000 I) ▶ | G |
| MODBUS RTU/RS 485 (only MAG 6000/MAG 6000 I) ▶ | E |
| FOUNDATION Fieldbus H1 (only MAG 6000/MAG 6000 I) ▶ | J |
| **Cable glands/terminal box** | |
| Metric ▶ | 1 |
| ½" NPT ▶ | 2 |

▶ Available ex stock

| Selection and Ordering data | Order code |
|---|---|
| ***Additional information*** | |
| Please add **“-Z“** to Order No. and specify Order code(s) and plain text. | |
| Customer specific converter setup | **Y20** |
| Tag name plate, stainless steel fixed with SS wire (add plain text) | **Y17** |
| Tag name plate, plastic (self adhesive) | **Y18** |
| Factory certificate according to EN 10204-2.1 | **C15** |
| Factory certificate according to EN 10204-2.2 | **C14** |
| Sensor cables wired (specify cable order no.) | **Y40** |
| Sensor for remote transmitter's junction box potted to IP68 with wired cable (specify cable order no.) | **Y41** |
| Other postproduction requirements (add desired text) | **Y99** |

| Description | Order No. | |
|---|---|---|
| Potting kit for terminal box of SITRANS F M sensors for IP68/NEMA 6P (Not ATEX) | **FDK-085U0220** | |

MAG 5000/6000 transmitters and sensors are packed in separate boxes, the final assembly takes place during installation at the customer's place. MAG 6000 I transmitters and sensors are delivered compact mounted from factory. Communication module will be pre-mounted in the transmitter.

Please use online Product selector to get latest updates.

Product selector link:
www.pia-selector.automation.siemens.com

Please also see www.siemens.com/SITRANSFordering for practical examples of ordering

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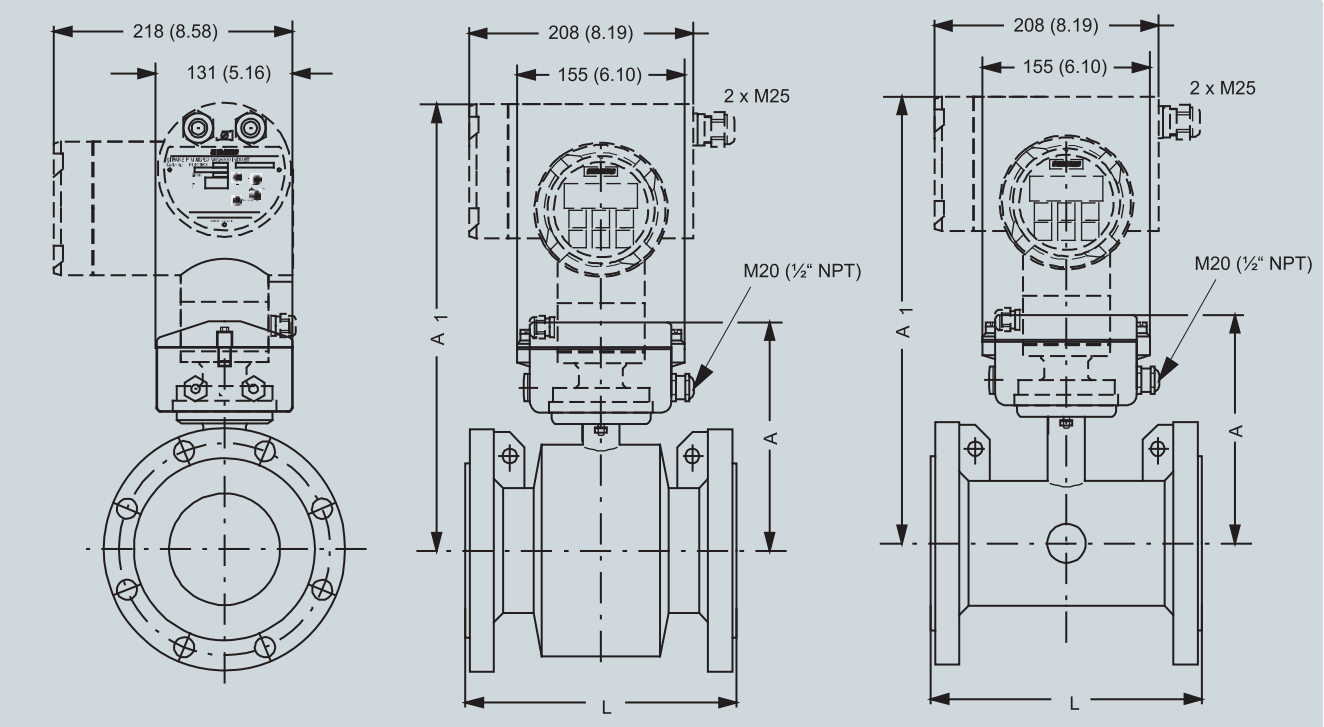
## MAG 5100 W

MAG 5100 W / 6000 I Compact






| Nominal size | | A | | $A_1$ | | L | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | PN 10 | | PN 16 | | PN 40 | | Class 150/AWWA | | AS | |
| [mm] | [inch] | [mm] | [inch] | [mm] | [inch] | [mm] | [inch] | [mm] | [inch] | [mm] | [inch] | [mm] | [inch] | [mm] | [inch] |
| 25 | 1 | 187 | 7.4 | 340 | 13.4 | - | - | - | - | 200 | 7.9 | 200 | 7.9 | 200 | 7.87 |
| 40 | 1½ | 197 | 7.8 | 350 | 13.8 | - | - | - | - | 200 | 7.9 | 200 | 7.9 | 200 | 7.87 |
| 50 | 2 | 188 | 7.4 | 341 | 13.4 | - | - | 200 | 7.9 | - | - | 200 | 7.9 | 200 | 7.87 |
| 65 | 2½ | 194 | 7.6 | 347 | 13.7 | - | - | 200 | 7.9 | - | - | 200 | 7.9 | 200 | 7.87 |
| 80 | 3 | 200 | 7.9 | 353 | 13.9 | - | - | 200 | 7.9 | - | - | 200 | 7.9 | 200 | 7.87 |
| 100 | 4 | 207 | 8.1 | 360 | 14.2 | - | - | 250 | 9.8 | - | - | 250 | 9.8 | 250 | 9.84 |
| 125 | 5 | 217 | 8.5 | 370 | 14.6 | - | - | 250 | 9.8 | - | - | 250 | 9.8 | 250 | 9.84 |
| 150 | 6 | 232 | 9.1 | 385 | 15.2 | - | - | 300 | 11.8 | - | - | 300 | 11.8 | 300 | 11.81 |
| 200 | 8 | 257 | 10.1 | 410 | 16.1 | 350 | 13.8 | 350 | 13.8 | - | - | 350 | 13.8 | 350 | 13.78 |
| 250 | 10 | 284 | 11.2 | 437 | 17.2 | 450 | 17.7 | 450 | 17.7 | - | - | 450 | 17.7 | 450 | 17.72 |
| 300 | 12 | 310 | 12.2 | 463 | 18.2 | 500 | 19.7 | 500 | 19.7 | - | - | 500 | 19.7 | 500 | 19.69 |
| 350 | 14 | 382 | 15.0 | 535 | 21.1 | 550 | 21.7 | 550 | 21.7 | - | - | 550 | 21.7 | 550 | 21.65 |
| 400 | 16 | 407 | 16.0 | 560 | 22.1 | 600 | 23.6 | 600 | 23.6 | - | - | 600 | 23.6 | 600 | 23.62 |
| 450 | 18 | 438 | 17.2 | 591 | 23.3 | 600 | 23.6 | 600 | 23.6 | - | - | 600 | 23.6 | 600 | 23.62 |
| 500 | 20 | 463 | 18.2 | 616 | 24.3 | 600 | 23.6 | 600 | 23.6 | - | - | 600 | 23.6 | 600 | 23.6 |
| 600 | 24 | 514 | 20.2 | 667 | 26.3 | 600 | 23.6 | 600 | 23.6 | - | - | 600 | 23.6 | 600 | 23.6 |
| 700 | 28 | 564 | 22.2 | 717 | 28.2 | 700 | 27.6 | 700 | 27.6 | - | - | 700 | 27.6 | 700 | 27.6 |
| 750 | 30 | 591 | 23.3 | 744 | 29.3 | - | - | - | - | - | - | 750 | 29.5 | 750 | - |
| 800 | 32 | 616 | 24.3 | 779 | 30.7 | 800 | 31.5 | 800 | 31.5 | - | - | 800 | 31.5 | 800 | 31.5 |
| 900 | 36 | 663 | 26.1 | 826 | 32.5 | 900 | 35.4 | 900 | 35.4 | - | - | 900 | 35.4 | 900 | 35.4 |
| 1000 | 40 | 714 | 28.1 | 877 | 34.5 | 1000 | 39.4 | 1000 | 39.4 | - | - | 1000 | 39.4 | 1000 | 39.4 |
| | 42 | 714 | 28.1 | 877 | 34.5 | - | - | - | - | - | - | 1000 | 39.4 | - | - |
| | 44 | 765 | 30.1 | 928 | 36.5 | - | - | - | - | - | - | 1100 | 43.3 | - | - |
| 1200 | 48 | 820 | 32.3 | 983 | 38.7 | 1200 | 47.2 | 1200 | 47.2 | - | - | 1200 | 47.2 | 1200 | 47.2 |

- not available

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*Weight*

| Nominal size | | PN 10 | | PN 16 | | PN 40 | | Class 150/AWWA | | AS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [mm] | [inch] | [kg] | [lbs] | [kg] | [lbs] | [kg] | [lbs] | [kg] | [lbs] | [kg] | [lbs] |
| 25 | 1 | - | - | - | - | 4 | 9 | 4 | 9 | 4 | 9 |
| 40 | 1½ | - | - | - | - | 7 | 15 | 6 | 13 | 7 | 15 |
| 50 | 2 | - | - | 9 | 20 | - | - | 8 | 20 | 9 | 20 |
| 65 | 2½ | - | - | 10.7 | 24 | - | - | 11 | 24 | 10.7 | 24 |
| 80 | 3 | - | - | 11.6 | 26 | - | - | 13 | 28 | 11.6 | 26 |
| 100 | 4 | - | - | 15.2 | 33 | - | - | 19 | 41 | 15.2 | 33 |
| 125 | 5 | - | - | 20.4 | 45 | - | - | 24 | 52 | 20.4 | 45 |
| 150 | 6 | - | - | 26 | 57 | - | - | 29 | 64 | 26 | 57 |
| 200 | 8 | 48 | 106 | 48 | 106 | - | - | 56 | 124 | 48 | 106 |
| 250 | 10 | 64 | 141 | 69 | 152 | - | - | 79 | 174 | 69 | 152 |
| 300 | 12 | 76 | 167 | 86 | 189 | - | - | 110 | 243 | 86 | 189 |
| 350 | 14 | 104 | 229 | 125 | 274 | - | - | 139 | 307 | 115 | 254 |
| 400 | 16 | 119 | 263 | 143 | 314 | - | - | 159 | 351 | 125 | 277 |
| 450 | 18 | 136 | 299 | 173 | 381 | - | - | 182 | 400 | 141 | 311 |
| 500 | 20 | 163 | 359 | 223 | 491 | - | - | 225 | 495 | 189 | 418 |
| 600 | 24 | 236 | 519 | 338 | 744 | - | - | 320 | 704 | 301 | 664 |
| 700 | 28 | 270 | 595 | 314 | 692 | - | - | 273 | 602 | 320 | 704 |
| 750 | 30 | - | - | - | - | - | - | 329 | 725 | - | - |
| 800 | 32 | 346 | 763 | 396 | 873 | - | - | 365 | 804 | 428 | 944 |
| 900 | 36 | 432 | 951 | 474 | 1043 | - | - | 495 | 1089 | 619 | 1362 |
| 1000 | 40 | 513 | 1130 | 600 | 1321 | - | - | 583 | 1282 | 636 | 1399 |
| | 42 | - | - | - | - | - | - | 687 | 1512 | - | - |
| | 44 | - | - | - | - | - | - | 763 | 1680 | - | - |
| 1200 | 48 | 643 | 1415 | 885 | 1948 | - | - | 861 | 1896 | 813 | 1789 |

- not available
With transmitter MAG 5000 and MAG 6000 compact, weight is increased by approximately 0.8 kg (1.8 lbs), with MAG 6000 I, weight is increased by 5.5 kg (12.1 lb).

**Orleans, MA**
**BDP Job Number 1529**
**Dual 4' x 10' Rotary Drum Thickener**

DATE: 8/13/2019
REV: 0

| ITEM # | UNIT QTY | MANUFACTURER | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| SPARES | | | | |
| | | | | No Special Tools Required |
| | 4 | Carter | SC-64-SBEU | Cam Follower Bearings, 2" |

354 State Route 29, Greenwich, New York 12834
Phone No 518-695-6851
Fax No. 518-695-5417
mike@bdpindustries.com

# ORLEANS WARRANTY

BDP Industries, INC., warrants the equipment manufactured by it to be free from defects in materials and workmanship for a period of 12 months from startup acceptance. BDP will repair or replace, at its' option, FOB Greenwich Factory, any defective part or material provided prompt notification is rendered.

BDP will warrant the RDT roller bearings, motors etc for the warranty period. The buyout items will be replaced at no cost to the owner as long as the equipment is operated and maintained per the maintenance manual provided by BDP.

The repair or replacement of items such as light bulbs, grease, oil, drive belts or chains, pump seals, etc., are not covered by this warranty and are considered normal consumption and routine maintenance. In addition to the replacement of defective parts, BDP will also provide such labor as it deems necessary to repair a defect in the main frame structure.

BDP will not assume the cost of any modification or repair of its equipment, unless it specifically gives authority for such action. BDP disclaims any responsibility as a result of changes or additions by others made to its' equipment after shipment from the factory.

In no event shall BDP be responsible for special or consequential damages of any nature, including, but not limited to loss of profits or revenues, loss of any equipment, cost of capital, cost of temporary facilities, downtime costs, or other claims brought as a result of breach of contract, warranty, or negligence.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHERS. BDP MAKES NO WARRANTY AS TO FITNESS OF ITS' PRODUCT(S) FOR ANY PARTICULAR PURPOSE OF MERCHANTABILITY.

**ATTACHMENT B**

**SBR and Effluent Disk Filter Proposal**

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**SECTION 11600**

**SEQUENCING BATCH REACTORS**

PART 1 - GENERAL ..... 2
1.01 SCOPE ..... 2
1.02 MEASUREMENT AND PAYMENT ..... 2
1.03 DEFINITIONS ..... 2
1.04 SUBMITTALS ..... 3
1.05 PRODUCT HANDLING ..... 5
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## PART 1 - GENERAL

### 1.01 SCOPE

A. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the SBR System along with all other equipment and accessories as indicated and specified herein.

B. The installation of the equipment furnished by the SBR manufacturer shall be the responsibility of the installing contractor in accordance with all requirements of the contract documents.

C. Provide and test sequencing batch reactor (SBR) process treatment equipment and appurtenances as indicated and specified.

D. All equipment shall be from a single source supplier.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section will be made in accordance with the provisions the RFP.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the SBRs. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

**1.04 SUBMITTALS**

A. Submit material for review in accordance with the RFP.

B. List of operating installations in New England and as required in the RFP.

1. Provide current (verified) contact information for each installation.

2. Identify commonality with the proposed WWTF processes, design flows and loads, seasonality and other relevant information.

C. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

D. Shop Drawings: Submit the following in accordance with the RFP and as specified.

1. Certified shop and working drawings including complete motor characteristics and performance data for all equipment.

a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

b. Electronic files shall conform to the following minimum requirements:

(1) Files shall be AutoCad 2013 or Higher.

(2) Files shall be submitted as part of the Shop Drawing submittal.

(3) Submit Files on CD or DVD.

(4) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

(7) Drawings shall be in conformance with all other requirements as specified in this specification.

3. Factory work sheets as specified herein identifying each piece of equipment.

4. System piping schematic.

5. Manufacturer’s literature and specifications. Show catalog dates.

6. Manufacturer’s process design calculations.

7. For Motors:

a. Descriptive literature and motor characteristics.

b. Shop drawings and descriptive data to include:

(1) Outlines, weights, and wiring diagrams.

(2) Efficiency and power factory at ½, ¾ and full load.

(3) Bearing life data and grease requirements.

(4) NEMA standard nameplate data.

(5) Shop tests.

(6) Field acceptance tests.

(7) Operating and maintenance instructions and parts lists.

(8) Listing of reference installations as specified with contact names and telephone numbers.

(9) A written statement on the guaranteed oxygen transfer rate and power usage.

(10) Certified results of hydrostatic testing.

(11) Certified results of dynamic balancing.

(12) List of parts without prices.

(13) Shop and field inspection reports.

(14) Bearing Life.

(15) Control Panels:

(a) Bill of Materials and annotated catalog sheets on devices in the control panel.

(b) Front elevations, with and without door showing dimensions and locations in internally and externally mounted components.

(c) Electrical wiring schematics and wiring diagrams clearly indicating all required field wiring and terminations. Submit wiring diagrams using project specific equipment tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.

(d) Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.

(e) Use NEMA device designations and symbols for electric circuit diagrams. Make contents of elementary connection diagrams in accordance with NEMA ICS 1.

(f) System control description.

(16) Operating and maintenance instructions and parts list.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.
9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.
10. Paint manufacturer's product data and specifications. Provide data to indicate conformance to shop painting requirements specified including statement of compliance for compatibility.
11. Manufacturer's literature as needed to supplement certified data.
12. Shop test results.
13. Motor shop test results.
14. Qualifications of field service technician.
15. Schematic control and power wiring diagrams.
16. Shop and Field inspections reports.
17. Bearing Life: Certified by manufacturer.
18. List of recommended spare parts other than those specified. Provide a list of all parts with unit prices.
19. Recommendations for short and long term storage.
20. Special tools.
21. Bearing temperature operating range for service conditions specified.
22. Equipment grounding requirements and details.
23. Shop and field testing procedures and equipment to be used.

24. Number of service technician days provided and per diem field service rate.
25. Manufacturer's product data, specifications, and color charts for shop painting.
26. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
27. The most recent ISO 9001 series certification or Quality Control Plan.
28. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and similar effluent objectives indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of ten (10) installations in operation for a minimum of ten (10) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

E. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
   1. If deviations and clarifications from the drawing are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

F. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping
   1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
   2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
   3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.
2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

**1.06 DESIGN CRITERIA**

A. Sequence Batch Reactor equipment and operating data as specified herein.

B. The SELECTED PROPOSER will design and furnish the following equipment/systems for installation by the CONTRACTOR.

1. SBR process equipment package to be supplied for dual basins as shown of the drawings.
2. Aeration system and retrievable diffused air equipment shall be designed to accommodate Phase 1 conditions and future Phase 2 flows/loads as specified.
3. Diffused air equipment for each SBR basin shall be expandable to accommodate Phase 1 and Phase 2 conditions with the wet installation of additional diffuser racks.
4. Mechanical mixers for each SBR basin, to provide a minimum power density under Phase 2 MWL condition of 25 HP/MG (not including air power).
5. Level instruments and transmitters for each SBR basin.
6. DO instruments and controls for each SBR Basin.
7. Decanter assemblies for each SBR basin to accommodate the range of flow from Phase 1 to Phase 2 without modification, and designed with a mechanism for excluding foam/floatables as well as entrained mixed liquor.
8. SBR system control system with local operator interface panel to interface with the WWTF SCADA system.
9. Cycle configuration/duration shall be operator adjustable.
10. Electric motor operated raw water valves.
11. Two electrically actuated flow control valves to be supplied with a single common magnetic flow meter to regulate decant rates under low influent flow conditions to utilize full duration of decant cycle.
12. All retrievable components (Type 316 stainless steel) shall be supplied with guiderail assembly, lifting chain/cable, hoist, etc.
13. Any other equipment and controls required by the PROPOSER to meet the system performance requirements.
14. The ENGINEER will specify in the project construction documents that the CONTRACTOR will install the SBRs that is to be furnished by the SELECTED PROPOSER.

C. The ENGINEER will design and/or the CONTRACTOR will provide and install the following equipment and systems related to the SBR system

1. Common wall SBR basin design with input from the SELECTED PROPOSER.
2. Administration Building, and all reinforced concrete structures; including all piping to and from the SBR basins, based on the sizing and load criteria provided by the SELECTED PROPOSER.
3. All yard piping and civil site requirements.
4. The chemical make-up facilities as well as storage and feed pumps and piping for chemical dosing upstream of the SBR basins, if required.
5. All power and control wiring including local power disconnect power switches.

D. Influent Conditions

1. Influent wastewater flow and influent design parameters to the SBR system are summarized below.

| Phase 1 | Min Month | Annual Average | Max Month | Max Day | Peak Hour |
|---|---|---|---|---|---|
| Flow, gpd | 224,713 | 264,368 | 374,649 | 689,120 | 792,500 |
| BOD, lbs/d | | 626 | 800 | 1,022 | |
| TSS, lbs/d | | 725 | 948 | 1,359 | |
| TKN, lbs/d | | 136 | 172 | 199 | |
| Design Temp, $^{o}$C | 10 | 15 | 20 | 24 | |

| Phase 2 | Min Month | Annual Average | Max Month | Max Day | Peak Hour |
|---|---|---|---|---|---|
| Flow, gpd | 321,163 | 377,839 | 535,928 | 957,417 | 1,101,000 |
| BOD, lbs/d | | 884 | 1,127 | 1,446 | |
| TSS, lbs/d | | 1,030 | 1,346 | 1,940 | |
| TKN, lbs/d | | 188 | 238 | 276 | |
| Design Temp, $^{o}$C | 10 | 15 | 20 | 24 | |

2. Note that based on the seasonal location and weather conditions, the Max Month loads and Min design temperature will not be coincident.

E. Effluent Conditions

1. Effluent design parameters from the SBRs are summarized below.

| Constituent | SBR Effluent Requirements |
|---|---|
| BOD, mg/L | 20 |
| TSS, mg/L | 20 |
| TN, mg/L | 7 |

2. Note that the Biological process shall be sized to meet effluent requirements under Max Month conditions.

3. Note that the SBR system (i.e. tank size, tank volume, aeration requirements, etc.) shall be sized and controls be programed to be able to achieve a TN of 7 mg/L without the addition of a supplemental carbon source and a TN of 3 mg/L with the addition of a supplemental carbon source that would be provided by others in the future.

F. Equipment

1. The following equipment list is intended to establish a level of quality, not to be an all-inclusive list of equipment to be furnished or not to be furnished. The proposal shall contain an itemized list of all equipment, instrumentation and controls determined by the proposer to allow the SBR to perform in the manner in which it is intended. The proposal must clearly identify which equipment, instrumentation and controls are part of the Lump Sum Price and which are not part of the Lump Sum Price. All equipment shall be required to meet all OSHA requirements.
2. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
3. The SBR manufacturer shall provide SBR process equipment package as indicated in the scope of supply and supplemented below:
   a. Valves and Actuators
      1) All system actuated valves shall be supplied.
      2) All actuated valves shall be furnished with motor operators so that the disc filtration filter system can operate automatically.
      3) Valves and Actuators shall meet the minimum requirements specified hereon.
   b. Bolts, Nuts, Jack Studs
      1) Furnish bolts, nuts, jack studs as required for mounting pipe, equipment, and appurtenances.
      2) Material type for bolts, nuts, jack studs to be Type 316L Stainless Steel.
   c. Miscellaneous Equipment - Provide ancillary equipment, controls, etc. required to provide a complete advanced treatment system.
   d. Support Equipment - Support equipment including, but not limited to, gates, valves, weirs, baffles, and appurtenances shall be listed in the submittal proposal as to type, size, quantity, location, and specific requirements
   e. PLC Based Control System
      1) The SBR system is to be designed as an automatic system monitored and controlled using a PLC based control system which is to be compatible and interconnected with the WWTF control system architecture. The control system shall include a local control panel for each SBR. All instrumentation and control required for the SBR system control and monitoring system shall be designed and furnished including all necessary programming.
      2) Furnish interface software that allows the PLC-based controls for the SBR system to communicate with the WWTF main PLC system. The process cycle configuration/duration shall be operator adjustable.
      3) Furnish a PLC based control system designed specifically to control and monitor the SBR treatment system. Each SBR unit shall be provided with a UL-listed local control panel that will have ethernet data communication to a main SBR system control panel. The control system shall be designed to control the following systems, as a minimum:
         a) Floating mixers for each SBR basin. Monitor and control mixers with and without aeration based on cycle mode during SBR process operation.
         b) Aeration Blowers. Monitor and control speed of aeration blowers based on process mode and DO requirements.
         c) Submersible pressure transducers and back-up level float switches to monitor tank level in each tank.

f. Instrumentation

1) All instrumentation items and controls required for SBR system to perform in the manner in which it is intended shall be included in the Proposal as part of the Lump Sum Price. Minimum requirements for selected equipment are listed below:

a) The PLC-based Control panel and instrumentation components shall consist of the following:

- NEMA 4X Wall Mount Control Panel.
- PLC CPU Card
- PLC I/O Racks
- PLC Field Interface Cards
- Operator Interface Display
- Uninterruptable Power supply
- Circuit breakers
- Terminal Strips
- Transient Voltage Surge Suppressors
- Miscellaneous wire

b) The instrumentation and control system equipment will meet the minimum requirements specified herein.

2) The PROPOSER is also responsible for the instrumentation and control system to achieve the effluent requirements as stated herein including level and pressure/vacuum instruments. The general contractor will be responsible for the performance and warranty of the all ancillary items to the SBRs not furnished by the selected manufacturer.

g. Proposal Submittal - The following information is to be submitted with the Proposal.

1) Completed Life-Cycle Cost Data Entry Forms.

2) Complete SBR process design including all calculations and justification for the recommended values for the following:

a) Tank volume sizing including tank dimensions.

b) Design food to Mass ratio (F/M).

c) Actual Oxygen Requirement (AOR), Alpha and Beta for all specified load conditions.

d) Certified Design Standard Oxygen Transfer Efficiency (SOTE) for all load conditions.

e) Decanter sizing calculations; velocity pattern, flow rate as a function of liquid level in the SBRs.

f) Mixer sizing to provide complete mix without the introduction of air.

g) Design calculations stamped by a Professional Engineer in the registered in the State were the project is located.

h) Design Sludge Retention time.

i) Reaction rates for nitrification and denitrification, along with oxygen demand, including kinetic values to support cycle times and motor operation requirements.

j) Complete Mix at High Water Level shall be achievable at 4,500 mg/l minimum MLSS with no introduction of air.

3) Complete process design submittal with support calculations shall be presented showing effluent quality expected under the following conditions for the SBR effluent:
   a) Design Year Phase 1 and Phase 2 Annual Average Flow/Loading
   b) Design Year Phase 1 and Phase 2 Maximum Month Flow/Loading
   c) Design Year Phase 1 and Phase 2 Peak Flow/Loading
4) Provide any ancillary equipment, controls, etc. required to provide a complete SBR system, and to furnish this equipment and controls, not otherwise specifically specified herein.
5) Provide preliminary equipment manufacturer's names covering all process and control equipment items to be supplied as part of the offering. Provide cut sheets of key components along with the model, horsepower, major components, and performance curves.
6) For the following equipment, provide complete design basis including number of units, flow, head or pressure, motor horsepower, equipment sizes, and other information to provide a complete description of the required equipment:
   a) Aeration system including diffusors and appurtenances
   b) Tank Mixing equipment
   c) Decanter system.
   d) Retrieval systems for all equipment
   e) Online analyzer(s).
   f) Control valves (if required).
   g) Instrumentation and control systems.
   h) Supplemental chemical dosing control system (if required).

**1.07 REFERENCES**

A. American National Standards Institute (ANSI):
   1. B16.1: Standard for Cast-Iron Pipe Flanges and Flanged Fittings, 125 lb.
B. American Society for Testing Materials (ASTM):
   1. A36: Specification for Structural Steel
C. National Electric Code.
D. American Bearing Manufacturers Association (ABMA):
   1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.
   2. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings)
E. American Gear Manufacturers Association (AGMA).
F. National Electrical Manufacturers Association (NEMA).

**1.08 QUALITY ASSURANCE**

A. Provide in accordance with the RFP and as specified herein.
B. Equipment shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.
C. Welding: In accordance with American Welding Society Code D1.1.
D. Submit copies of AWS certificates.
E. Provide shop tests as specified.

F. The manufacturer of the SBR system shall provide equipment, panels, and controls regardless of manufacturer, as a complete integrated package to ensure proper coordination, compatibility and operation of the system.

G. The manufacturer of the SBR system shall be responsible for the proper design of their system, including but not limited to; diffused aeration equipment, foam suppressing mixers, decanters, DO instrumentation and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

H. If system proposed is different than specified, provide all structural, architectural, electrical and mechanical revisions at no additional cost to the Owner.

I. Provide Services of Manufacturer's Representative as stated in the RFP and as specified herein.

J. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment specified.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve the Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections: 3 person-days.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 5 person-days.

c. Field Performance Testing: Field performance test equipment specified. 5 person-days.

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 2 person-days.

e. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

f. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

K. Manufacturer of equipment shall have at least ten (10) operating installations with units of the size specified and in the same service as specified operating for not less than ten (10) years. Proposer’s who do not meet the Manufacture’s Experience shall provide with their Technical Proposal a Certified Letter stating that they will provide to the OWNER, with the shop drawing submittal, an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall extend for a period of three years beyond the completion date for the project and shall be retained by the OWNER until the installed equipment has passed the specified performance testing and the equipment has been accepted by the OWNER. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

L. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.09 SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings and as specified herein.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements as indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and as indicated.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

A. Aqua Aerobic Systems, Inc.

B. Xylem/Sanitaire

C. ADI Systems / Evoqua Water Technologies

D. Or Equal.

### 2.02 SYSTEM DESCRIPTION

A. The following is a general description of the equipment to be supplied and coordinated by the SBR Supplier:

1. SBR process equipment package to be supplied for basins as indicated.
2. Fine bubble diffuser equipment for each SBR basin.
3. Floating foam suppressing mixers for each SBR basin.
4. Level instruments and transmitters for each SBR basin.
5. DO probes and transmitters to be tied to SBR DO control system
6. Decanter assemblies for each SBR basin to accommodate the range of flow from Phase 1 to Phase 2 without modification.
7. SBR process control system.
8. Two electrically actuated flow control valves to be supplied with a single common magnetic flow meter to regulate decant rates under low influent flow conditions to utilize full duration of decant cycle.
9. Cycle configuration/duration shall be operator adjustable.
10. Electric motor operated influent feed plug valve to each basin: (a) Valve to be flanged end connection, ASTM A-126 Class B cast iron with 80 percent port opening, assembled and tested with an electric actuator; and (b) Actuator shall include manual override and limit switch feedback and include local push-button controls, selector switch and lights.
11. Provide all other items as indicated and specified.

B. Provide the system designed for operation in true batch mode.

C. Pertinent Site Conditions

1. Site Elevation: 60 ft. above MSL
2. Intermittent Low Air Temperature: 0 deg. F
3. Intermittent High Air Temperature: 100 deg. F

D. Provide a SBR system with the following characteristics

1. Number of SBR Tanks: 2
2. SBR Tank Inside Dimensions: 45 ft. by 65 ft.
3. SBR Tank Depth: 22.5 ft. overall, 20.0 ft. above grade elevation.
4. SBR Tank Design Low Water Depth: 14.5 ft.
5. SBR Tank Design High Water Depth: 20.5ft.
6. SBR Cycles Per Day at Average Flow: 4
7. SBR Cycles Per Day at Maximum Day Flow: 4
8. SBR Maximum Decant Rate: 1,700 GPM

E. Motors within the SBR Tanks: Rated for temperature code T2A (280 deg. C)

F. Provide a SBR system designed to operate in rectangular tanks with dimensions and sidewater depths as specified and indicated.

G. The wastewater treated in the SBR system will be decanted directly to the disk filter process then continue by gravity into a Post Equalization tank for effluent discharge after UV disinfection.

H. Tank and process design shall be sized to accommodate Phase 2 maximum day flows/loads utilizing normal SBR operating cycle. The use of a compressed cycle (i.e. – "Storm mode") is not allowable unless flows exceed specified Phase 2 Maximum Day flows.

I. Note that based on the seasonal location and weather conditions, the Max Month loads and Min design temperature will not be coincident.

J. Provide a aeration distribution system based on the following minimum requirements.

1. Minimum SOR at Max Day Flows/Loads
    a. Alpha (maximum value allowed): 0.85
    b. Beta (maximum value allowed): 0.95
2. Minimum Standard Oxygen Transfer Efficiency
    a. Annual Average: 2 percent/ft submergence
    b. Max Month: 1.8 percent/ft submergence
    c. Max Day: 1.6 percent/ft submergence
3. Maximum headloss in Aeration System: 1.4 psi
4. The aeration system for the SBR tanks shall be capable of providing mixing such that when operated under any combination of the specified design conditions it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in the basin.
5. Minimum Cycle Times at Maximum Daily Flow.
    a. Minimum Aeration Time: 2.60 hrs/cycle
    b. Minimum Mixing Time: 4.00 hrs/cycle
    c. Minimum Settling Time: 0.75 hrs/cycle
6. Provide a SBR system that will operate with the design conditions indicated below.
    a. SBR mixed Liquor Suspended Solids: 4,500 mg/l at LWL
    b. SBR Sludge Age: 22 – 26 days

**2.03 SBR EQUIPMENT**

A. SBR Valves

1. SBR Influent Valves: Provide one 8-inch electrically operated plug valve per SBR.
2. SBR Decant Valves: Provide one 10-inch electrically operated butterfly valve per SBR.
3. Provide all valves and electric motor operator.

B. Mixer

1. Provide one mechanical floating mixer and related equipment accessories as indicated and specified for each SBR.
2. Provide each mixer consisting of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute.

3. Performance:
    a. Each mixer shall have a zone of complete mix of the tank inside diameter at the maximum water depth. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids without the introduction of air.
    b. Mixer shall include the ability to reduce foam and scum by providing direct passage to the center intake.
    c. Recirculation rate: 253,000 gpm.
    d. Mechanical mixer to provide a minimum power density under Phase 2 MWL condition of 25 HP/MG (not including air power).
4. Mixer Drive Motor
    a. Horsepower: 10, 900 rpm, 460 V, 60 cycle, three phase.
    b. Provide motors in accordance with Specification 16220 – Electric Motors and as specified herein.
    c. Vertical P base design, TEFC, and generally rated for severe duty. Submerged motors are not acceptable.
    d. The motor shall in all cases equal or exceed standard NEMA specifications.
    e. Motor Winding insulation shall equal/exceed NEMA class F design, minimum service factor of 1.15, and be nonhygroscopic.
    f. All motor end bells shall be deep registered and Permatex sealed.
    g. All through bolts, nuts and screws shall be Type 18-8 SS.
    h. Each motor will have a rain cap constructed of cast iron or non-corrosive 304 ss. Painted or plated carbon steel will not be acceptable.
    i. Motor shall be Centaur model supplied by Reliance Electric or Endura model supplied by Teco-Westinghouse.
    j. Provide a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the impeller.
        (1) Shaft 2.25-inch dial: 17-4 PH stainless steel.
    k. Motor bearings: Regreasable type, sealed bearings are not acceptable.
        (1) Provide the top bearing shielded on the bottom side only.
        (2) Bottom bearing: Open.
        (3) Top and bottom motor bearings: Combined radial and axial thrust type.
        (4) Provide the lower motor bearing inner race locked to the motor shaft via a special washer and locking nut arrangement. Provide the shaft threaded just below the lower bearing and a keyway cut into the motor shaft. Provide the key to accept a tab from the inner diameter of the locking washer, and the locking nut recessed to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers are not acceptable.
5. Motor Mounting Base
    a. Provide the motor mounted onto a solid Type 304L stainless steel base integral with the motor base extension. All Submersed wetted motor mounting base components to be Type 304 stainless steel.
    b. The motor base shall contain a machined recess to permit the use of a free running, anti-deflection insert. The anti-deflection insert shall not require lubrication. The provision for this insert shall be located in the lower extremity of the motor base extension immediately above the impeller.
    c. Provide the upper portion of the motor mounting base, immediately below the lower motor bearing with two independent acting air seals. Provide the two seals capable of sealing off the flow of air from the suction action of the pumped flow, and prevent backflow of liquid during impeller reversal.

d. Provide the lower end of the motor base extension with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

6. Intake/Discharge Volute

a. The center intake/discharge structure of the mixer shall be fabricated of Type 304 stainless steel and shall be designed to support the motor and motor base and align the impeller with the volute. Supports shall be included to connect the entire power section assembly to the deployed float assembly.

b. The center structure shall also contain rigid vertical support gussets that connect the top and bottom alignment flanges that support and connect the motor support base and the submerged impeller volute assembly.

c. All power section connecting bolts shall be Type 316 stainless steel and have drilled heads, and shall be safety wired in place with stainless steel safety wire.

7. Flotation

a. Equip each unit with a separate self-deploying, segmented float support system consisting of four (4) float segments and a center support bracket suitable for installation through a 44-inch opening. The float shall be designed to bring surface scum and foam directly to the mixer center. Solid round floats are not acceptable. Each float segment to be fabricated from 14 gauge, Type 304 stainless steel and shall attach to the center support bracket with a Type 316 stainless steel shoulder bolt. Fiberglass floats are not acceptable.

b. Fill internal void of each float segment with closed cell polyurethane having a minimum density of 2.0 lbs/cu. ft. and seal watertight.

c. The center support bracket shall have a connection for each float segment. It shall have an opening in the center for installation, after full deployment, of the complete power section with intake volute assembly.

d. When deployed, floats to have minimum width of 151-3/4-inch and minimum thickness of 10-1/2-inch, and minimum reserve buoyancy of 650 lbs.

e. Connecting bolts shall be used to secure power section, center support bracket and floats. Provide Type Type 316 stainless steel connecting bolts.

f. Provide electric cable connectors, supports, etc. as indicated on the Drawings.

8. Impeller

a. Provide the impeller designed to pump the liquid from near the surface and direct it down toward the basin bottom.

b. Impeller: Two blade marine type precision casting of Type 316 stainless steel 14.5-inch in diameter. designed for the application specified and indicated.

c. Impeller shall be streamlined to prevent cavitation and reduce drag and shall have 180o trailback blades to insure non-clog operation.

d. The impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings.

e. The impeller shall be securely attached to the motor shaft in such a manner so that reversal operation for liquid backflushing will not loosen its connection; therefore, impellers requiring the threading of the shaft for attachment will not be allowed.

f. The impeller shall be "pitch balanced" to insure equalization of load under full flow operation. Each blade's pitch and rake shall not vary more than 2.0 percent from the other.

g. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed at any time.

9. Intake Volute Assembly
    a. Material: Type 304L stainless steel plate, minimum 3/16 inch thick with a minimum volute diameter of 15-inch.
    b. No plastic, fiberglass, carbon steel or cast iron materials shall be acceptable.
    c. The volute shall be welded to and aligned concentrically with the motor base and float without ships or external adjustment.
10. Vibration
    a. Dynamically balance the impeller and rotor unit as a completed assembly and as an integral unit with the motor mounting base to a vibration level not to exceed two mils at the motor rpm.
    b. Dynamically balance the entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor rpm. Transducer pickup points shall be at the motor bearings on the motor frame perpendicular to the motor shaft. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.
    c. Submit certified copies of the balance inspection for each mixer.
11. Cable Mooring System
    a. Provide each unit with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors, and extension springs as shown on the drawings.
    b. Mooring cable, anchors, and hardware: Type 304 stainless steel.
    c. Contractor to field attach the mooring points to the tank.
12. Cable Mooring Electrical Service Cable
    a. Each unit shall include #8-4-four conductor power cable wired into the motor conduit box and terminating at the basin wall.
    b. Provide the electrical cable with kellems grips at the motor and basin wall terminations. Provide electrical cable floats for flotation of electrical service.
    c. Contractor to attach cable and supply of junction box/disconnect at the basin wall.

C. Decanter Assembly
1. Provide one mechanical floating decanter and related equipment accessories as indicated and specified for each basin.
2. Provide each decanter consisting of an integral flotation unit, a stainless steel movable weir assembly, and a hydraulic motor-driven actuator to open and close the weir.
3. Performance
    a. Provide each decanter capable of withdrawing decant fluid from 4 to 6 inches beneath the liquid surface, regardless of liquid depth, from the maximum down to the minimum allowable water level specified.
    b. Decanter to accommodate the range of flow from Phase 1 to Phase 2 without modification, and designed with a mechanism for excluding foam/floatables as well as entrained mixed liquor.
    c. Provide the system to draw decant liquid through an adjustable weir opening of 2 to 6 inches.
    d. Provide the weir in a circular configuration to permit liquid to enter the decanter from the entire 360 degrees without obstruction.
    e. Locate the centerline of each decant pipe 1.6 ft. below the low water level specified herein or as recommended by the manufacturer.

4. Weir Actuator
    a. Weir actuator: Reversible hydraulic motor operated linear actuator.
    b. Provide the actuator capable of operating with a closing force of 1500 lbs.
    c. 115 volt, single phase, 60 hertz.
    d. Provide adjustable limit switches to permit adjustment of the weir opening.
    e. Provide a coil spring to provide for travel after the weir has closed and provide desired closure pressure.
    f. Provide a corrosion resistant removable cover to protect the actuator and motor during normal operation.
5. Decanter power section
    a. Painted steel
    b. Provide an aluminum band clamp heater.
    c. Provide #14 AWG ten conductor power cable from the NEMA 4X junction box of the unit to the basin wall.
    d. Contractor to provide junction box/disconnect at the basin wall.
6. Weir
    a. Type 304L stainless steel
    b. Circular in shape
    c. Provide vortex control baffles permanently affixed to the weir.
    d. Attach the weir to the actuator through a removable single shaft which shall also function as the torque restraint.
7. Decanter Discharge Pipe
    a. Provide each decanter with a Type 304L stainless steel elbow with 16-inch diameter Schedule 80 PVC discharge pipe complete with 16-inch fiber-loc backing ring and cast iron backing ring and Vanstone flange and Type 304 stainless steel flanged flexible joints.
    b. Provide each decanter assembly terminating with a flanged Type 304L stainless steel elbow at the basin wall. All piping, pipe supports, gaskets, and hardware beyond the terminating flange of the elbow shall be provided by the Contractor.
8. Decanter Restrained Mooring System
    a. Provide each decanter with a galvanized steel mooring frame attached to the float.
    b. Provide one 4-inch diameter Schedule 40 galvanized steel mooring post assembly with base plate to assure consistent location of the decanter in the basin.
    c. Contractor to fill mooring post with concrete.
    d. Provide galvanized steel dewatering support posts consisting of three 4-inch diameter Schedule 40 vertical pylons with base plates and one 4-inch diameter Schedule 40 pipe dewatering support post with pipe saddle and base plate.
    e. Contractor to provide anchors and attach each support with base plate to the basin floor with Type 304 stainless steel anchors field.
    f. Provide top and bottom mooring post supports of galvanized steel for attachment to the basin wall by the Contractor.

D. Fine Bubble Diffuser System

1. Performance Requirements

a. Fine bubble aeration system: Provide retrievable air diffuser assemblies in the SBR basins as specified and indicated. The design shall provide for additional aeration assemblies and blower (by others) for Phase 2 conditions as specified in the RFP.

b. Each air diffuser assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. The 4-inch diffuser manifold shall be stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

2. Design Criteria

a. Air Supply System: The SBR's will receive air supply from aeration blowers located in the lower level of the Administration Building and will be supplied by others. Three blowers (2 duty/1standby) shall be supplied by others for Phase 1 conditions with a fourth blower supplied by others for Phase 2 conditions.

b. The diffuser system in each SBR shall be installed with enough capacity to support Phase 1 standard oxygen requirement conditions as outlined below while meeting the minimum SOTE requirements listed.

**Phase 1 Oxygen Requirements (Std Conditions)**

| | Annual Average | Maximum Month | Maximum Day |
|---|---|---|---|
| SOR, lbs/hr-tank | 165 | 212 | 259 |
| Ave Water Depth, ft | 15.8 | 16.1 | 17.0 |
| Minimum Required SOTE at Ave Water Depth, percent | 32 | 29 | 27 |

c. The diffuser system shall be designed such that with the use of guiderails, retrieval accessories, etc. already installed under Phase 1, the wet installation of additional diffuser racks under Phase 2 will meet the Phase 2 standard oxygen requirement conditions as outlined below while meeting the minimum SOTE requirements listed.

**Phase 2 Oxygen Requirements (Std Conditions)**

| | Annual Average | Maximum Month | Maximum Day |
|---|---|---|---|
| SOR, lbs/hr-tank | 231 | 296 | 362 |
| Ave Water Depth, ft | 16.1 | 16.6 | 17.8 |
| Minimum Required SOTE at Ave Water Depth, percent | 32 | 30 | 28 |

d. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Each membrane shall be held in place by two Type 304 stainless steel band clamps, and cleanable with a high pressure wash water.

e. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. The membrane shall include UV inhibitor and be designed for resistance to chemicals, weathering.

f. Each diffuser assembly shall include a 3-inch diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, a threaded flange, elbow and quick disconnect adapters. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

g. Each assembly shall include a 3-inch diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor.

E. Pressure Transducer

1. Provide one Keller PSI Model 700 submersible pressure transducer unit (or equal) constructed of stainless steel for each SBR.
2. Transducer to utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid.
3. Transducer output: 4-20 mA.
4. Electrical connection: Two wire, 24 gauge polyethylene shielded cable, minimum 35 feet of cable per unit, and as required for installation and servicing connected equipment without splicing.
5. Suspend the transducers using 1/8-inch Type 304 stainless steel suspension cables and bracket. Contractor to attach cables and brackets to the basin with Type 304 stainless steel anchors provided by the con tractor for anchoring the pressure transducer suspension cables and mounting bracket.

F. Level Sensors

1. Provide one level sensor assembly consisting of a polypropylene cased liquid level sensor with a smooth, chemical resistant polypropylene casing, and Type 316 stainless steel mounting bracket for each SBR.
2. Provide each float switch with a three conductor electrical cable.
3. Electrical cable to terminate at a junction box/disconnect located at the basin wall.
4. Contractor to provide field wiring and junction box/disconnect. Contractor to provide adhesive Type 304 stainless steel anchors for anchoring the level sensor, mast and mounting bracket.

## 2.04 MOTORS

A. Provide in accordance with Specification 16220 – Electric Motors and as specified herein.

B. Enclosure: NEMA 4X. Motors shall be capable of being washed down with a hose stream during operation.

C. Insulation: Minimum “Class F” with “Class “B” temperature rise, 40 deg. C ambient unless otherwise indicated or specified.

D. Service Factor: 1.15.

E. L-10 Bearing Life: 100,000 hours.

F. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

G. Rating: 460V, 3 ph, 60 Hz

## 2.05 SPARE PARTS

A. Provide as specified herein.

B. Provide the following:

1. One (1) 16 point input card
2. One (1) 16 point output card

C. Provide a list of parts with unit prices.

## 2.06 CONTROL SYSTEM

A. Provide the control system designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures.

B. Provide the control software program factory tested prior to installation at the jobsite.

C. Control System: Timer based system with level overrides providing control, sequence, monitoring, and alarm annunciation capabilities.

D. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility.

E. Provide the control system designed to automatically accommodate the plant's full range of loads and flows.

F. Provide a complete control system as specified herein and as indicated in the RFP

G. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for all mixers and aeration blowers.

1. SBR Mixers
2. Blowers
3. Influent Valves
4. Decanter Actuators
5. Decanter Valves
6. Sludge Valves
7. 4-20 mA Pressure Transducers
8. Level Sensors
9. Common Alarm

H. In addition, controls as indicated for the following equipment shall be included within the SBR control panel:

1. 4-20 mA D.O. Signals
2. Oxidation Reduction Potential Signal

I. Programmable Logic Controller

1. Automatic controls for operation of Sequencing Batch Reactors (SBRs) and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide each control panel with a panel-mounted Human Machine Interface (HMI):
2. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.
3. Provide NEMA 4X 316 Stainless Steel enclosure.
4. Panel shall be labeled UL 508A.
5. Provide motor starters, and VFDs internal to the control panel as required. Provide VFDs in accordance with Specification 16260 – Low Voltage Variable Frequency Drives.
6. Heaters or AC units required for the control panel shall be powered from the control panel.
7. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC and separate from 480VAC Equipment.
8. Provide the control panel enclosure with the following:
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Control buttons and selector switches as specified herein.
    c. LED type indicating lights.
    d. Emergency stop (ESTOP) maintained pushbutton to shut down the SBR system.

9. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide RAM memory protected by backup battery.
11. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
12. Provide fully documented ladder logic on a CD-Rom.
13. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a 9 x 14 inch color display. Provide Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.
14. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
15. Provide control a monitoring of the system as shown on the contract drawings.
16. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
17. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
18. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
19. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.
20. The SBR vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
21. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.
22. Operation - The PLC shall be configured to provide the following control:
    a. PHASE CONTROL, the regulation of the process cycles of the SBR up to the maximum daily flow of the plant.
    b. AERATION CONTROL, the regulation of the aeration and mixing systems to achieve optimum process control.
    c. COMPONENT MONITORING, the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

**2.07 PAINTING**

A. All painted equipment shall be painted as specified below.

B. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces two part epoxy paint in accordance with the following:

1. Solids by Volume: Minimum 57 percent (percent $\pm$2).
2. Type: Polyamide epoxy, self-priming.
3. Dry Film Thickness; 4 to 6 mils per coat.
4. No. of Coats Required: Three.
5. V.O.C. Requirement: 3.06 lbs/gallon
6. Conform to AWWA D102 Inside Systems No. 1 and No. 2

7. Use thinners that are acceptable to ANSI NSF Std 61

8. Color: As specified for piping system of same service or as selected by the Engineer.

C. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions for immersion or non-immersion service as required.

D. Ferrous surfaces which are not to be painted shall be given a ship applied coat of grease or rust resistant coating.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. Install items in accordance with manufacturer's printed instructions, as specified, and indicated.

B. Manufacturer's representative to perform inspection of all equipment and conduct check-out and training as specified herein.

**3.02 FIELD TESTING**

A. Perform field testing of all equipment functions and alarms.

1. Make all adjustments necessary to place equipment in specified working order at time of above tests.

2. Remove all replaced equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

**3.03 PROCESS PERFORMANCE GUARANTEE**

A. The SBRs will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the SELECTED PROPOSER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

3. Name Manufacturers - SELECTED PROPOSER shall be responsible for the process performance of the SBRs and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

4. Or Equal Manufacturers – SELECTED PROPOSER shall be responsible for the process performance of the SBRs and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a an irrevocable Letter of Credit in the amount of 100 percent of the purchase order price for the equipment. The irrevocable Letter of Credit shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. The SELECTED PROPOSER agrees to furnish the irrevocable Letter of Credit in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a financial company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such irrevocable letter of credit shall be paid by the SELECTED PROPOSER.

B. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

## 3.04 WARRANTY

A. The SELECTED PROPOSER shall be provide an warranty of the SBRs warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of this RFP. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract or 54 months from delivery, whichever comes first. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

   The start of construction is estimated to occur in June 2020 and Substantial Completion is estimated to occur in June 2022.

C. It is the SELECTED PROPOSER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

## 3.05 ACCEPTANCE TESTING

A. The specified system will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, in order to protect the client's interests, the SELECTED PROPOSER shall provide to the Owner, through the Contractor, with the shop drawing submittal, a Performance Test Guarantee in the form of an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

B. The Acceptance Test shall demonstrate performance under design loading conditions. This might be accomplished through simulating higher loading conditions by operating only one SBR, or by lowering MLSS levels to simulate design maximum F:M ratios for example. It is the manufacturer's responsibility to develop a test protocol for approval by the Engineer. The test protocol at a minimum should demonstrate compliance with the SBRs performance requirements under Maximum Month or Simulated Maximum Month Loading as follows:

   - Average SBR Effluent BOD <= 20 mg/l
   - Average SBR Effluent TSS <= 20 mg/l
   - Average SBR Effluent TN <= 7 mg/l

C. All sampling will be based on flow weighted 24-h composites.

D. Testing shall be conducted such that compliance with the above requirements is demonstrated for a minimum of (7) consecutive days with the system operating in (or simulating) design process control parameters such as design SBR cycle allocation times, design max MLSS, Design Max SRT, Design Min F:M, etc. Operation of the WWTF to include sampling during the Acceptance Test shall be the responsibility of the owner. The system supplier may provide oversight of the test at its discretion.

E. Should the system pass the Acceptance Test, the Letter of Credit will be released following approval of the Engineer. Should the system fail the Acceptance Test, the manufacturer will be given up to two opportunities to make adjustments and retest. Should the system fail all Acceptance Tests - maximum of three (3), even if before the

three (3) year term, the Owner reserves the right to call the letter of credit. None of the above releases the system supplier to making such modification as necessary to bring the system into compliance with the performance requirements of this specification.

**3.06 FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

END OF SECTION

**SECTION 11399**

**EFFLUENT DISK FILTERS**

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## PART 1 - GENERAL

### 1.01 SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for tertiary Effluent Disk Filters Work and, where appropriate, applying or installing such materials for the various items of tertiary Effluent Disk Filters Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. All equipment shall be from a single source supplier.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section will be made in accordance with the provisions the RFP.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Effluent Disk Filters. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 SUBMITTALS

A. Submit material for review in accordance with the RFP.

B. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

C. Shop Drawings: Submit the following in accordance with the RFP and as specified.

1. Certified shop and working drawings including complete motor characteristics and performance data for all equipment.
    a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

b. Electronic files shall conform to the following minimum requirements:

(1) Files shall be AutoCad 2013 or Higher.

(2) Files shall be submitted as part of the Shop Drawing submittal.

(3) Submit Files on CD or DVD.

(4) Drawings shall include plan views, sectional views, piping and instrumentation diagrams, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

(7) Drawings shall be in conformance with all other requirements as specified in this specification.

2. Control Panels

a. Bill of Materials including manufacturer, model number and quantities.

b. Annotated product cut sheets for enclosures and control panel components.

c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.

d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.

e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.

3. Factory work sheets as specified herein identifying each piece of equipment.

4. System piping schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references. Provide elevation views of interior and exterior of all panels.

5. Manufacturer’s literature and specifications. Show catalog dates.

6. Operating and maintenance instructions and parts list.

7. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

8. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

9. List of five (5) operating installations of similar design and following SBR process as outlined in the RFP. Provide current (verified) contact information for each installation.

10. Paint manufacturer’s product data and specifications. Provide data to indicate conformance to shop painting requirements specified including statement of compliance for compatibility.

11. Manufacturer’s literature as needed to supplement certified data.

12. Shop test results.

13. Motor shop test results.

14. Qualifications of field service technician.

15. Schematic control and power wiring diagrams.

16. Shop and Field inspections reports.

17. Bearing Life: Certified by manufacturer.

18. List of recommended spare parts other than those specified including a list of all parts with unit prices.
19. Recommendations for short and long term storage.
20. List of special tools.
21. Bearing temperature operating range for service conditions specified.
22. Equipment grounding requirements and details.
23. Shop and field testing procedures and equipment to be used.
24. Number of service technician days provided and per diem field service rate.
25. Manufacturer's product data, specifications, and color charts for shop painting.
26. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
27. The most recent ISO 9000 series certification or Quality Control Plan.
28. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

D. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include all drawings, or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

E. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping:

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's written recommendations and instructions.

**1.06 DESIGN CRITERIA**

A. The Effluent Disk Filter equipment is intended to complement the SBR activated sludge treatment process and provides tertiary filtration of the SBR effluent to meet MassDEP requirements regarding coliform limits and for the protection of the effluent discharge Wick Wells. The Effluent Disk Filter design provides tank capacity with modifications to meet both Phase 1 and Phase 2 design conditions identified herein.

B. Equipment Limitations, per unit:

1. Maximum Total Weight: 9,500 lbs. dry, 40,500 lbs. operating.

2. Maximum Length: 12 ft., inlet to outlet flange.

3. Maximum Width: 10 ft.

4. Maximum Height: 12 ft.

C. The Effluent Disk Filter design by the SELECTED PROPOSER is to include media with a nominal 10 um pore size to provide solids removal for the purposes of providing tertiary filtration prior to UV disinfection. Cloth filter shall be chlorine resistant. If a media with a nominal pore size lower than 10 um is proposed, it should be noted in the PROPOSER’s submittal.

D. The Effluent Disk Filters shall be designed to hydraulically treat the peak flow at the design year with one of the supplied disk filter units (full set of disks not individual disks) out of service.

E. All piping/equipment internal to the Effluent Disk Filter shall be furnished by the SELECTED PROPOSER. All piping external to the filter cells shall be provided by OTHERS. All actuated valves required for the automatic operation of the disk filters (if required) shall be furnished by the SELECTED PROPOSER and shall have motor actuators. All manual isolation valves external to the filter cells shall be provided by OTHERS.

F. Each Effluent Disk Filter should be capable of operating and backwashing independently of the other filter units. The system shall be designed by the PROPOSER so that the disk filters will continue to provide filtration during backwash periods.

G. The Effluent Disk Filters are to be provided with drive motors and variable frequency drives (VFD’s) furnished by the SELECTED PROPOSER.

H. Provide a Effluent Disk Filter backwash cleaning system with backwash pumps. The backwash cleaning system shall include spray headers and/or suction shoes if required, backwash collection trough for removing solids (if required), piping, valves and all ancillary equipment to accomplish disk filter backwash. Provide one (1) backwash pump for each disk filter provided (as required), each sized for 100 percent of the maximum backwash capacity. In the proposal, the PROPOSER shall identify the pump sizing including flow, head, and horsepower required.

I. Proposal Submittal - The following information is to be submitted with the Proposal.

1. Completed Life-Cycle Cost Data Entry Forms.
2. Complete Effluent Disk Filter process design including all calculations for the following:
    a. Tank sizing, dimensions and disk arrangement.
    b. Backwash system including pump sizing for 100 percent of maximum capacity.
    c. Backwash cleaning system.
3. Complete process design submittal with support calculations shall be presented showing effluent quality expected under the following conditions:
    a. Design Year Phase 1 and Phase 2 Annual Average Flow/Loading
    b. Design Year Phase 1 and Phase 2 Maximum Month Flow/Loading
    c. Design Year Phase 1 and Phase 2 Peak Flow/Loading

    Refer to paragraph 2.01.B.1 for flow and loading data.
4. Provide any ancillary equipment, controls, etc. required to provide a complete SBR and Effluent Disk Filters system, and to furnish this equipment and controls, not otherwise specifically specified herein.
5. Provide preliminary equipment manufacturer's names covering all process and control equipment items to be supplied as part of the offering. Provide cut sheets of key components along with the model, horsepower, major components, and performance curves.
6. For the following equipment, provide complete design basis including number of units, flow, head or pressure, motor horsepower, equipment sizes, and other information to provide a complete description of the required equipment:
    a. Tank sizing, dimensions and disk arrangement.
    b. Backwash system including pump sizing for 100 percent of maximum capacity.
    c. Backwash cleaning system.

## 1.07 REFERENCES

A. Hydraulic Institute (HI): Current Standards.

B. American National Standards Institute (ANSI):

1. B16.1: Standard for Cast-Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. American Society for Testing Materials (ASTM):

1. A36: Specification for Structural Steel

D. National Electric Code.

E. American Bearing Manufacturers Association (ABMA):

1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.
2. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings)

F. American Gear Manufacturers Association (AGMA).

G. National Electrical Manufacturers Association (NEMA).

## 1.08 QUALITY ASSURANCE

A. Provide as specified herein.

B. Equipment shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

C. Welding: In accordance with American Welding Society Code D1.1 or ASME IX. Submit copies of AWS or ASME certificates.

D. Provide shop tests as specified.

E. Equipment manufacturer shall provide filters, panels, and controlsas a complete integrated package.

F. Filter shall be factory tested and ready for operation.

G. Provide Services of Manufacturer's Representative as stated in the RFP and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment specified.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not releive the Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections: 1 person-days.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 2 person-days.

c. Field Performance Testing: Field performance test equipment specified. 3 person-days.

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1 person-days.

3. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

4. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of equipment shall have at least ten (10) operating installations with units of the size specified and in the same service as specified operating for not less than ten (10) years. Proposer’s who do not meet the Manufacture’s Experience shall provide with their Technical Proposal a Certified Letter stating that they will provide to the OWNER, with the shop drawing submittal, an irrevocable letter of credit or dual obligee bond in the amount of 100 percent of the purchase order price for the equipment. The irrevocable letter of credit or dual obligee bond shall extend for a period of three years beyond the completion date for the project and shall be retained by the OWNER until the installed equipment has passed the specified performance testing and the equipment has been accepted by the OWNER. Submittals which do not include the required irrevocable letter of credit or dual obligee bond will be summarily rejected and returned to the Contractor without further review and consideration.

J. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

**1.09 SEISMIC REQUIREMENTS**

A. Provide certification and computations related to anchorage of the equipment via an independent Registered Structural Professional Engineer (P.E.) registered in the State of Massachusetts.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements as indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and as indicated.

## PART 2 - PRODUCTS

### 2.01 EFFLUENT DISK FILTERS

A. Manufacturers:

1. Aqua Aerobics Systems Inc.
2. Kruger Hydrotech.
3. Or Equal

B. Performance and Design Parameters:

1. Provide filters for filtering decanted effluent from an SBR activated sludge process at the conditions defined below.

| Condition | SBR Effluent TSS, mg/l | Effluent Disk Filter Effluent TSS, mg/l |
|---|---|---|
| Average Conditions (Q = 650 gpm for 75 min) | 30 | 5 |
| Max Day Conditions (Q = 1700 gpm for 75 min) | 50 | 10 |

The Max day condition is defined at 1,700 gpm for a period of 75 mins. This is the peak flow at design year.

2. Each disk filter unit should be capable of operating and backwashing independently of the other filter units. The system shall be designed so that the Effluent Disk Filters will continue to provide filtration during backwash periods.

3. The disk filtration system shall be designed to hydraulically treat the peak flow at the design year with one of the supplied disk filter units (full set of disks not individual disks) out of service. The total backwash discharge volume produced by the disk filter system shall be no more than 2 percent of the treated flow on a daily basis.

The max day (i.e. – peak) condition of 1700 gpm must be met with one unit out of service. Note: Two units shall be supplied (1 duty/1 standby).

4. Each filter shall have a total of 323 square feet of minimum effective submerged filtration area.

5. The disk filter system shall be self-contained in a painted steel vessel.

6. Pipe Connection

   a. Inlet: 12-inch

   b. Outlet: 14-inch

C. Filter Cloth Assemblies

1. The disk filtration system to be provided shall utilize a surface filtration technology arranged in a vertical disk configuration with a cloth designed to be chlorine resistent.

2. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation.

3. Replacement of filter media must be possible from outside of the disk filter tank.

4. Cloths shall be of woven nylon fiber pile chlorine resistant cloth construction with polyester backing material having a nominal filtration rating of 10 microns. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depths shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss.

5. Each cloth disk assembly shall have a minimum of 54 square feet of effective submerged filtration area. Effluent filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into segments and each section shall be easily removable for service.
6. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk to the inside.
7. Backwash Cleaning System
    a. Each backwash/waste pump assembly shall include one (1) backwash/waste pump, header, valves and gauges, and interconnecting piping and controls required for initiation and termination of backwash.
    b. Backwash header shall have two (2) flanged connections for connecting to backwash pump suction piping as indicated on the drawings.

D. Solids Removal System
1. A solids removal sump or trough shall be incorporated into the tank. Control and operation of the solids removal system will be by field adjustable timer and also be automated through the filter control system.

E. Drive Mechanism
1. A drive assembly shall be incorporated to rotate the center tube/disk assembly during the backwash cleaning cycles.
2. The adjustable drive assembly shall consist of a gear motor, non-corrosive chain and sprockets.
    a. Chain: Nylon with 18-8 stainless steel link pins.
    b. Chainguard: Type or stainless steel.
    c. Drive Sprockets: Nylon.
    d. Centertube Driven Sprocket: U.H.M.W Polyethylene.
3. Reducer design and rating equal or exceed AGMA requirements. Speed reducers shall be selected for not less than AGMA Class II service.
4. Motor HP: ½, 460 V, 3 ph, 60 Hz

F. Tanks and Weirs
1. The disk filter system shall be self-contained in a painted steel vessel (min 10 gauge, finished with interior: near white sandblast (SSPC-SP10) painted with Tnemec N69 polamide epoxy, 2 coats 4-6 mils each for 8-12 DFT. Exterior; SSPC-SP6, painted TnemecN69 Hi-Build Epoxoline, 2 coats 3-4 mils each and 1 coat Tnemec 1075 Endura shield II 2-3 mils for 8-11 mils DFT) or Type 304 Stainless Steel vessel.
2. Tank shall include influent, effluent, and overflow weirs.
3. Provide low point tank drain with ball valve and plug. Provide valves in accordance with the RFP.

G. Center Tube
1. The center tube or drum shall be fabricated of minimum ¼” thick Type 304L stainless steel with all machined surfaces true to the center line. All fastener and machined thread materials shall be 316 stainless steel. All support bearings shall be stainless steel or stainless steel shaft in a low friction plastic bearing. All supports and brackets attached to the tank shall be Type 304 stainless steel.
2. Piping & Manufacturing: All in tank backwash piping: Minimum schedule 80 PVC designed for ease of maintenance. Backwash vacuum head must be easily removable from the backwash manifold.

**2.02 MOTORS**

A. Provide in accordance with the RFP and as specified herein.

B. Maximum 1,800 rpm.

C. Enclosure: TEFC. Motors shall be capable of being washed down with a hose stream during operation.

D. Insulation: Minimum Class "F" with "Class "B" temperature rise, 40 deg. C ambient unless otherwise indicated or specified.

E. Service Factor: 1.15.

F. Provide capacity to start drive at maximum solids on disks without exceeding nameplate ratings for current and power and without operating in the service factor.

G. L-10 Bearing Life: 100,000 hours.

H. Premium efficient motors, nominal and minimum motor efficiencies per NEMA MG1.

I. Rating: 460V, 3 ph, 60 Hz.

**2.03 BACKWASH PUMPS**

A. Provide a backwash cleaning system with backwash pumps. The backwash cleaning system shall include spray headers and/or suction shoes, backwash collection trough for removing solids, piping, valves and all ancillary equipment to accomplish disk filter backwash. Provide one (1) shelf-spare backwash pump sized for 100 percent of the maximum backwash capacity.

B. Pump operating data including flow, head and horsepower to be defined by the supplier.

C. Type: Horizontal self-priming.

D. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.

E. Provide lifting devices on casings as required for ease of handling.

F. Provide ribs or other suitable reinforcing if required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to adequately support the motor.

G. Design pump bearing frame to support shaft and impeller and to contain stuffing box and bearings.

H. Fit high point of casing with an air vent and low point with a drain.

I. Suction/Discharge Connection: ANSI 150 lb Flanges faced and drilled in accordance with ANSI B16.5.

J. Bearings

1. Grease lubricated anti-friction type or oil lubricated.
2. Bearing shall be in a dust and moisture proof enclosures.
3. Provide means in bearing housing, such as removable plug diametrically opposite grease fitting, to prevent over greasing or bearing.
4. Provide bearings with minimum B-10 life rating of 100,000 hours at specified operating conditions based on latest ABMA and ANSI Standards.

K. Pump Shaft

1. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.
2. Sleeves
   a. Extend sleeves through stuffing box.
   b. ASTM A743 Grade CA-15 stainless steel.
   c. 300-350 BHN.

L. Seals

1. Split mechanical seal
    a. Manufacturers: John Crane; Chesterton; or acceptable equivalent product.
    b. Materials
        (1) Gland: Type 316 stainless steel.
        (2) Rotary Holder: Type 316 stainless steel.
        (3) Hardware: Type 316 stainless steel.
        (4) Springs: Hastelloy C or Elgiloy.
        (5) Rotating Faces: 99.5 percent Alumina ceramic.
        (6) Stationary Faces: Pure unfilled P8412 carbon.
        (7) Elastomers: Viton.
        (8) Restriction Bushing: Split type, glass filled teflon.

M. Materials

1. Casing, Front Head, Back Head and Impellers: Cast-iron ASTM A48 Class 30.
2. Shaft: Steel ASTM A332 – C4140
3. Main Frame/Bearing Housing: Cast-Iron ASTM A48 Class 30
4. Internal and Exterior Hardware: Type 316 Stainless Steel.

N. Drain and Vent Piping

1. Provide drains from packing drip reservoirs and baseplate gutters to discharge into gutters, sumps, or floor drains as indicated on the drawings.
2. Install casing vent piping as described for drains.
3. Drain and vent piping shall be Type 316 stainless steel.

O. Drive

1. Direct connected with couplings as specified herein.
2. Motors: Provide as specified herein and in accordance with Specification Section 16220, Electric Motors

P. Couplings

1. All-metal flexible couplings, designed for both angular and parallel misalignment, fully housed, and provided with means of lubrication.

Q. Baseplate

1. ASTM A36 Structural Steel.
2. Build with at least one 4-in. grout hole or equivalent in top, a circumferential gutter with tapped drain connections and provisions for anchor bolts.
3. Design baseplate to have adequate strengths to support pump and drive.
4. Provide planed surfaces of bearings pads for pumps and drives.

R. Provide pressure gauge assemblies as required and specified in the RFP or herein.

## 2.04 VALVES

A. All actuated valves requried for the automatic operation of the Effluent Disk Filters (if required) shall be furnished by the equipment supplier and shall have motor actuators.

B. Each filter shall include two 2" backwash valve(s) and one 2" solids waste valve) and shall be 3 piece, grooved end ASTM A351 Grade CF8M SS body, 316 SS ball and stem, fullport with a 115 V, single phase open/close service electric actuator. Valve actuator shall include a compartment heater and limit switch feedback. Future expansion of 2 disks will include one additional backwash valve.

C. Each filter shall include a solids waste removal system in filter tank floor designed to remove settled solids for discharge through the backwash/waste pump. The waste removal system shall be automatic with user adjustable intervals and duration through the operator interface.

D. Provide all other valves as indicated on the drawings and as specified.

E. All manual isolation valves external to the filter cells shall be provided by the Contractor.

## 2.05 SPARE PARTS

A. Provide as specified herein.

B. Provide one set of chains.

C. Provide a list of parts with unit prices.

D. One set of all special tools.

## 2.06 CONTROL SYSTEM

A. Automatic controls for operation of the Effluent Disk Filters and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide one control panel for each disk filter. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACT LOGIX 5370 L1, L2 or L3 processor.
2. Provide NEMA 4X 316 Stainless Steel enclosure for installation in the Process Area
3. Panel shall be labeled UL 508A.
4. Provide motor starters and Variable Frequency Drives (VFD) internal to the control panel as required. The VFDs shall be heavy duty, industrial type and as manufactured by Allen-Bradley, Danfos or Toshiba.

   The VFDs shall be UL508A Listed solid-state type in a filtered enclosure and blower cooled. The filter element shall be of the removable and replaceable type for each drive unit. Front access shall be provided. Top, rear and side access shall not be required. The enclosure shall be coated with an epoxy resin base and acrylic resin enamel finish.

   The drive shall meet applicable provisions of the National Electric Code and NEMA. The drive shall be arranged for 480 Volts plus 10 percent to minus 5 percent, 3 phase, 57 to 63 Hertz input converted into adjustable frequency/Voltage output in an ambient temperature of -10 to 40 degrees C. The VFD shall be capable of sustaining operation with a line voltage dip of 15 percent of normal operating voltage on a constant or variable torque load. During line dip the VFD shall automatically provide a speed drop allowing maximum capable speed for the duration of the input voltage dip. Each individual drive shall be mounted in a separate enclosure. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads. Each individual drive shall be mounted in a separate enclosure unless otherwise specified. The following features shall be included with each adjustable frequency drive:

a. Control. The control method shall be sinusoidal Pulse Width Modulation. Output Voltage shall be 3 phase 480 Volts and output frequency shall be 0.1 to 66 Hz when shipped. Frequency shall be selectable by a digital keypad. The frequency resolution shall be 0.1 Hz and the accuracy shall be within 1.0 percent of the maximum frequency at 25° + 10°C. Voltage/frequency (V/f) characteristics shall be characterized by selectable patterns. Up to 82 control functions shall be programmed. The constant torque overload capacity shall be 110 percent continuous and a minimum two-minute rating of 120 percent of the rated current. The variable torque overload capacity shall be 100 percent continuous and 110 percent for two minutes. The frequency setting signal shall be 4 to 20 mA. The VFD shall employ a full wave rectifier to prevent input line notching with a DC bus choke, DC bus capacitors, and Insulated Gate Biplar Transistors (IGBT's) as the output-switching device. SCRs, GTOs and Darlington transistors are not acceptable.

b. Function. The adjustable parameters consisting of: accelerating time, decelerating time, upper and lower limit of output frequency, and 4 to 20 mA reference bias and reference gain shall be indicated on a digital display. Braking shall be achieved through capacitor charging and starting shall be achieved by external contact. The VFD shall be software configurable to automatically restart following power outage, overcurrent and overvoltage detection. Soft stall shall occur when motor runs continuously at overload.

c. Protection. The drive shall be protected from stalling, overcurrent, overload, short circuit, overvoltage, undervoltage, loss of one (1) phase of input power, instantaneous power failure (approximately 30 msec), overheating, fuse burnout protection and earth (ground) fault detection. The fault cause shall be displayed (flickering) for overcurrent, short circuit, overload, overvoltage, overheating and earth (ground) fault. There shall be a main capacitor charging indicator for internal circuit. Fault shall be reset by a reset push button on the printed circuit board and an external reset contact.

d. Displays. The digital display shall be a 2 line, 40 character unit with readout in plain English. A separate LED indicator shall be provided for capacitor charge. Display shall be located on the door of the VFD enclosure.

e. Internally mounted set point control shall be provided to receive 4 to 20 mAdc signals from process detector to control equipment functions. An external digital display shall be provided outside of the inverter. The following control devices shall be made available for external control of the inverter; frequency meter, frequency setting variable resistor, knob for frequency setting variable resistor and drive switch.

f. A lockable main molded case circuit breaker disconnect switch interlocked with the enclosure door through the door handle to provide positive disconnect of incoming AC power shall be furnished for each individual drive and enclosure. The circuit breaker shall be rated 42,000 amperes at 480 volts, RMS symmetrical.

g. Enclosure mounted indicating lamps shall be LED type, heavy duty, with "Push-To-Test" features.

h. Enclosure

- The enclosure shall be designed to prevent unfiltered air from entering within 12 inches from the bottom of the enclosure.
- All openings used for ventilation within 12 inches of the bottom shall have removable replacement filters provided. All openings for cooling air shall be provided on the front of the enclosure.
- Enclosures with auto transformers shall be designed such that the heat is removed from the auto transformer section and not drawn through the electronics and control portion of the enclosure.

i. Each drive shall be provided with the following accessories:

- Local/remote selector switches or keypad switch for local/remote speed control. In the "Remote" mode, the motor speed shall be adjusted in response to the related remote speed control via SCADA or 4-20 mA pacing signal.
- Provide a 4-20 mA speed feedback output signal.
- Provide four (4) Type C dry contacts for remote indication of equipment running status.
- Provide two (2) Type C dry contacts for remote indication of equipment failure. These contacts shall close upon any fault condition in the VFD or as listed below.
- Hand-off-Auto switch controls located on the door of the VFD enclosure. Provide a Type C dry contact for indication of Hand-Off-Auto switch in "Auto" position.
- Accept a remotely generated contact closure to start the VFD when the Hand-Off-Auto switch is in the "Auto" position.
- Accept a remotely generated contact closure to run the VFD at a preset user-configurable speed when the Hand-Off-Auto switch is in the "Auto" position.

5. Elapsed time meters located on the door of the VFD enclosure.
6. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
7. Provide the control panel enclosure with the following:
   a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
   b. Control Buttons and Selector Switches.
   c. Emergency stop (ESTOP) maintained pushbutton.
   d. LED type indicating lights.
8. All instruments, valves, and ancillary devices provided as part of the system shall be powered by the panel.
9. Provide control panels with integral surge protection devices (SPD):
   a. 120VAC, 10kAIC rated.
   b. Visual indication of plug status.
   c. UL listed.
10. Provide RAM memory protected by backup battery.
11. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
12. Provide fully documented ladder logic on a CD-ROM.
13. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide Allen-Bradley PanelView Plus 7 product with a 9 x 14 inch Color display and touch screen that is compatible with Ethernet communication net work. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.
14. Provide control a monitoring of the system as shown on the contract drawings.
15. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
16. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.

17. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
18. The configured HMI display shall be operator friendly and shall include at a minimum an overview page, cycle start-stop page, parameter page, loop display page, sludge pump control loop page, polymer control page, alarm page and manual operation page.
    a. The OIT shall allow the operator to adjust the following parameters.
        1) Backwash interval and duration.
        2) Sludge waste interval and duration.
        3) Number of backwashes between sludge waste.
        4) Time, date, year.
    b. The OIT shall provide, at minimum, the following information:
        1) Filter waste level.
        2) Time since last backwash.
        3) Time since last sludge wasting.
        4) Backwash time.
        5) Sludge wasting time.
        6) Flapsed time or filter drive motor.
        7) Flapsed time on backwash pumps.
        8) Alarm history, including the time and date of the 25 most recent alarms.
        9) Time between backwashes for the most recent 40 backwashes.
19. The disk filter vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
20. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.

F. Level Sensors and Transmitter

1. The pressure-type level transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal. Unit shall monitor the water level of each filter tank.Transmiter shall be flush mounted to the tank wall and be an IFM Effector PX series or approved equial.
2. A float switch shall be furnished in each tank to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equial. The float shall contain a non-mercury switch, chemical resistent polypropylene casing hermetically sealed and a PVC#18 AWG three conductior cable. Switch rating shall be minimm 4.5 amps non-inductive at 120 VAC.
3. Level measurements shall be available for input to the plant control system from the filter panel.

## 2.07 PAINTING

A. Painted steel vessels shall be min 10 gauge, finished with interior: near white sandblast (SSPC-SP10) painted with Tnemec N69 polamide epoxy, 2 coats 4-6 mils each for 8-12 DFT. Exterior; SSPC-SP6, painted TnemecN69 Hi-Build Epoxoline, 2 coats 3-4 mils each and 1 coat Tnemec 1075 Endura shield II 2-3 mils for 8-11 mils DFT.

B. All equipment, excluding disk filter tank shall be painted as specified below.

C. Primer and Finish Paint: Shop apply to all extrior ferrous surfaces two part epoxy paint in accordance with the following:

1. Solids by Volume: Minimum 57 percent (percent $\pm$2).
2. Type: Polyamide epoxy, self priming.
3. Dry Film Thickness: 4 to 6 mils per coat.
4. No. of Coats Required: Three.
5. V.O.C. Requirement: 3.06 lbs/gallon.
6. Conform to AWWA D102 Inside Systems No. 1 and No. 2.
7. Use thinners that are acceptable to ANSI NSF Std 61.
8. Color: As specified for piping system of same service or as selected by the Engineer.

D. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions for immersion or non-immersion service as required.

E. Ferrous surfaces which are not to be painted shall be given a ship applied coat of grease or rust resistant coating.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Install items in accordance with manufacturer's printed instructions, as specified, and indicated.

B. Manufacturer's representative to perform inspection of all equipment and conduct check-out and training as specified herein.

### 3.02 FIELD TESTING

A. Perform field testing of all equipment functions and alarms.

B. Make all adjustments necessary to place equipment in specified working order at time of above tests.

C. Remove all replaced equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

### 3.03 PROCESS PERFORMANCE GUARANTEE

A. The Effluent Disk Filters will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the SELECTED PROPOSER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

1. Name Manufacturers - SELECTED PROPOSER shall be responsible for the process performance of the Effluent Disk Filters and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. Or Equal Manufacturers – SELECTED PROPOSER shall be responsible for the process performance of the Effluent Disk Filters and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a an irrevocable Letter of Credit in the amount of 100 percent of the purchase order price for the equipment. The irrevocable Letter of Credit shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. The SELECTED PROPOSER agrees to furnish the irrevocable Letter of Credit in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a financial company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such irrevocable letter of credit shall be paid by the SELECTED PROPOSER.

B. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

**3.04 WARRANTY**

A. The SELECTED PROPOSER shall be provide an warranty of the Effluent Disk Filters warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of this RFP. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract or 54 months from delivery, whichever comes first. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

The start of construction is estimated to occur in June 2020 and Substantial Completion is estimated to occur in June 2022..

C. It is the SELECTED PROPOSER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

**3.05 ACCEPTANCE TESTING**

A. The Acceptance Test shall demonstrate performance of the Effluent Disk Filters under design loading conditions. This might be accomplished through simulating higher loading conditions by operating only one SBR (to increase decant volumes) or storage of SBR effluent through manipulation of SBR decant cycles. Testing of elevated solids concentration may require dosing the SBR effluent with a measured amount of WAS from the WAS storage tank. It is the manufacturer's responsibility to develop a test protocol for approval by the Engineer. The test protocol at a minimum should demonstrate compliance with the filters' performance requirements described herein to include but not be limited to the following with one filter on and one filter in standby mode. Testing should be conducted to prove performance on each filter independently:

| Condition | SBR Effluent TSS, mg/l | Effluent Disk Filter Effluent TSS, mg/l |
|---|---|---|
| Average Conditions (Q = 650 gpm for 75 min) | 30 | 5 |
| Max Day Conditions (Q = 1700 gpm for 75 min) | 50 | 10 |

All results shall be based on grab samples taken at 15 min intervals, which will then be composited at the end of the test to represent average performance during the decant cycle. The average of a minimum of 8 decants/tests shall be used to determine compliance for each filter.

B. Operation of the WWTF to include sampling during the Acceptance Test shall be the responsibility of the owner. The system supplier may provide oversight of the test at its discretion.

C. Should the system pass the Acceptance Test, the Performance Bond or irrevocable Letter of Credit will be released following approval of the Engineer. Should the system fail the Acceptance Test, the manufacturer will be given up to two opportunities to make adjustments and retest. Should the system fail all Acceptance Tests (maximum of three (3)), even if before the three (3) year term expires, the Owner reserves the right to call the Performance Bond or irrevocable Letter of Credit. None of the above releases the system supplier to making such modification as necessary to bring the system into compliance with the performance requirements of this specification.

**3.06 FIELD TOUCH-UP PAINTING**

A. After installation and approved testing by the Engineer. Contrator shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

END OF SECTION

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

December 13, 2019

Correspondence ID#: AAL-40379

AECOM Technical Services, Inc.
Attn: Jeff Reade
9 Jonathan Bourne Drive
Pocasset, Massachusetts 02559
USA
Ph# 508-833-6955
Fax# 508/888-6689
Email: jeffrey.reade@aecom.com

Project: ORLEANS MA

RE: EFFLUENT DISK FILTERS &
SEQUENCING BATCH REACTORS
FOR THE DOWNTOWN AREA WWTF

Enclosed please find our price proposal package for the AquaSBR® Sequencing Batch Reactor and AquaDisk® Cloth Media Filter equipment, freight, and supervision services for the above referenced project.

Aqua-Aerobic Systems, Inc. is offering the equipment proposed per the ongoing collaboration between Aqua-Aerobic Systems and AECOM, subject to approval by the Owner or the Consulting Engineer. Please take a moment to review our proposal notes and drawings for Aqua-Aerobic Systems' equipment terminations and items not included in Aqua-Aerobic Systems' scope of supply which are to be provided by the Buyer or Buyer's Installation Contractor.

We appreciate the opportunity to submit our proposal for this project and look forward to discussing it with you in detail. Please feel free to contact me (phone: 815-639-4493; email: tknapp@aqua-aerobic.com), or our Regional Sales Manager or Sales Representative firm listed below if you have any questions regarding our proposal offering.

You will be contacted by our local Sales Representative, listed below, on or before

the day of the bid. Please contact them if you have any questions prior to that time, or if we can provide additional information.

Sincerely,

Tamera Knapp
Applications Engineering Manager

CC: Technology Sales Associates / ph#: 978/838-9998 (TSA Office) / fx#: 978/838-9897 (TSA Office)
Mike Caso / mcaso@techsalesne.com

Aqua-Aerobic Systems, Inc.
Tom Miles / TMiles@aqua-aerobic.com

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

**Proposal#: 156532-R2**

**TO:** **AECOM Technical Services, Inc.**
**9 Jonathan Bourne Drive**
**Pocasset**
**Massachusetts 02559**
**USA**

**PROJECT: ORLEANS MA**

**ATN: Jeff Reade**

**PROPOSAL DATE: December 13, 2019**

**CC: Technology Sales Associates / ph#: 978/838-9998 (TSA Office) / fx#: 978/838-9897 (TSA Office)**
**Mike Caso**

**Aqua-Aerobic Systems, Inc. / ph#: 815-639-4463 / fx#: N/A**
**Tom Miles**

**The following Notes apply to Aqua-Aerobic Systems' proposal:**

- Equipment will be furnished by Aqua-Aerobic Systems, Inc. with unloading of goods, civil work, and installation by the Buyer.

## AquaSBR

### Mixers

**2 AquaDDM Direct Drive Mixer(s) will be provided as follows:**

- 10 HP Aqua-Aerobic Systems Endura Series Model FAF (Fold-A-Float) DDM Mixer(s). Motor base, folding float and float volute will be 304 stainless steel. Float will be filled with closed cell polyurethane foam. Intake volute will be 304 stainless steel. Impeller will be stainless steel and one-piece impeller shaft will be 17-4 PH stainless steel. The entire rotating assembly is dynamically balanced. Motor will be TEFC, three phase, 60 hertz, 900 RPM with 1.15 service factor and Class F nonhygroscopic insulation. Motor will be rated suitable for severe chemical duty.
- Motor will be nameplated for Class I Division II Group D.
- Local control station(s) with local/remote switch, on/off switch, on indicating light, in a NEMA 4X enclosure.

### Mixer Mooring

**2 Mixer restrained mooring assembly(ies) consisting of:**

- #12 AWG-four conductor electrical service cable(s).
- Stainless steel hardware.
- 4" Schedule 40 galvanized restrained mooring post(s) with base plate.
- Stainless steel anchors.

### Decanters

**2 Decanter assembly(ies) consisting of:**

- 8x7 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 7 junction box with terminal strips for the single phase, 60 hertz actuator and limit switches rated for use in Class 1 Division 2 environments.
- Aluminum band clamp heater integral to the decanter power section(s).
- Decant pipe(s) with integral elbow, 304L stainless steel.
- 14 inch diameter 90 degree 304 stainless steel elbow.
- 14 inch gasket kit(s).
- 14 inch diameter stainless steel flanged flexible joints.
- Stainless steel anchors.
- 4" schedule 40 galvanized steel mooring post.


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- Galvanized steel dewatering support post(s).
- Galvanized steel top mooring post supports.
- Galvanized steel bottom mooring post supports.
- Local control station(s) with local/remote switch, open/close push buttons, open/closed indicating lights, in a NEMA 4X enclosure.

**Retrievable Fine Bubble Diffusers**

**6 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:**

- 25 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- 316 stainless steel vertical support beam.
- 316 stainless steel vertical air column assembly.
- 316 stainless steel upper vertical beam and pulley assembly.
- 316 stainless steel top support bracket.
- 3" EPDM flexible air line with quick disconnect end fittings.
- 316 stainless steel threaded flange.
- Ny-glass quick disconnect cam lock adapter.
- 316 stainless steel adhesive anchors.
- 304 stainless steel brace angles.

**2 Diffuser Beam Track and Valve Assembly(ies) for addition of future diffuser banks consisting of:**

- 316 stainless steel vertical support beam.
- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one piece stainless steel shaft.
- 316 stainless steel anchor kit(s).

**1 Diffuser Electric Winch(es) will be provided as follows:**

- Portable electric winch with 8 feet of electrical cable for connection to single phase, 60 hertz power supply rated for 12.6 full load amps. Power supply and electrical wiring for winch is to be provided by the purchaser.

**Level Sensor Assemblies**

**2 Pressure Transducer Assembly(ies) each consisting of:**

- KPSI Model 700 stainless steel submersible pressure transducer(s) with shielded cable.
- 304 stainless steel mounting bracket weldment(s).
- 304 stainless steel transducer mounting pipe weldment(s).
- Stainless steel anchors.

**2 Level Sensor Assembly(ies) will be provided as follows:**

- Float switch(es).
- 316 stainless steel float switch mounting bracket(s).
- Stainless steel anchors.

**2 Junction Box(es) for Level Controls with Intrinsically Safe Relays consisting of:**

- NEMA 4X 304 stainless steel junction box(es).
- Intrinsically safe relay(s).
- Intrinsically safe analog barrier(s).

**Instrumentation**

**2 Dissolved Oxygen Assembly(ies) consisting of:**

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly.
- Hach SC200 controller and display module(s).

**Misc/Spare Parts**

**1 Set(s), Spare Parts will be provided as follows:**


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- (1) Input card(s)
- (1) Output card(s).

## Controls

### Controls wo/Starters

**1 Controls Package(s) will be provided as follows:**

- NEMA 4X 316 stainless steel enclosure(s).
- Uninterrupted power supply.
- Fuse(s) and fuse block(s).
- PanelView plus 7 15 inch with color touch screen display.
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Remote access ethernet modem.
- Control relay(s).
- Power supply(s).
- 115 V power line filter(s).
- Selector switch(es).
- Pilot light(s).
- GFI convenience outlet(s).
- Panel will be UL listed and labeled.

## Engineering: AquaSBR

### Engineering

**6 Set(s) Documentation will be provided as described:**

- Engineer's Approval Data (English language).

**6 Set(s) Documentation will be provided as described:**

- Operation & Maintenance Manuals (English language).

## Supervision/Freight

### Supervison/Freight Domestic

**1 Supervision Services and Freight Package(s) will be provided as follows:**

- 3 Day(s) On Site for INSTALLATION SUPERVISION
- 1 Trip(s) for INSTALLATION SUPERVISION
- 5 Day(s) On Site for FUNCTIONAL TESTING SUPERVISION
- 2 Trip(s) for FUNCTIONAL TESTING SUPERVISION
- 5 Day(s) On Site for PERFORMANCE TESTING SUPERVISION
- 2 Trip(s) for PERFORMANCE TESTING SUPERVISION
- 2 Day(s) On Site for VENDOR TRAINING
- 1 Trip(s) for VENDOR TRAINING
- FREIGHT TO JOBSITE

## Cloth Media Filters

### AquaDisk Tanks/Basins

**2 AquaDisk Model # ADFSP-54x6E-PC Package Filter Painted Steel Tank(s) consisting of:**


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- 6 disk tank(s) will be painted steel, estimated dry weight is 9,500 lbs., and estimated operating weight is 40,500 lbs. Each tank will include an integral solids waste collection manifold. The tank will be painted with Tnemec N69 and Tnemec 1075.
- 3" threaded brass ball valve(s).

**AquaDisk Centertube Assemblies**

**2 Centertube(s) consisting of:**

- 304 stainless steel centertube weldment(s).
- U.H.M.W. polyethylene multi segment driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- 304 stainless steel effluent seal plate(s).
- Centertube bearing kit(s).
- Viton V-ring effluent port\centertube seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Cloth will be chlorine resistant.
- Disk segment 304 stainless steel support rods.
- Neoprene media sealing gaskets.

**AquaDisk Drive Assemblies**

**2 Drive System(s) consisting of:**

- Gearbox(es) with three phase 3/4 HP drive motor(s).
- Nylon drive sprocket(s).
- Acetal drive chain(s) with 304 stainless steel link pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

**AquaDisk Backwash/Sludge Assemblies**

**2 Backwash System(s) consisting of:**

- 304 stainless steel backwash shoe weldments.
- UHMW polyethylene backwash shoe nozzle plates.
- 304 stainless steel backwash shoe support weldment(s).
- Flexible hose(s).
- Stainless steel backwash shoe springs.
- Stainless steel hose clamps.

**2 Backwash/Solids Waste Pump(s) consisting of:**

- Gorman Rupp model 12B20-B, 2HP, premium efficient, 3 phase externally mounted centrifugal backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Bronze throttling gate valve(s).
- 2" bronze 3 way ball valve(s).

**AquaDisk Instrumentation**

**2 Pressure Transmitter(s) consisting of:**

- Level transmitter(s).

**2 Float Switch(es) consisting of:**

- Float switch(es).

**2 Vacuum Transmitter(s) consisting of:**

- Vacuum transmitter(s).


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**AquaDisk Valves**

**2 Set(s) of Backwash Valves consisting of:**

- 2" full port, three piece, ASTM A351 Grade CF8M stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be manufactured by TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- Flexible hose(s).
- Painted cast iron victaulic end couplers.

**2 Solids Waste Valve(s) consisting of:**

- 2" full port, three piece, ASTM A351 Grade CF8M stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be manufactured by TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- Flexible hose(s).
- Painted cast iron victaulic end couplers.

**AquaDisk Misc/Spare Parts**

**1 Lot of Recommended Spare Parts consisting of:**

- (1) Gorman Rupp model 12B20-B, 2HP backwash/waste pump(s).
- (1) Drive chain(s).

**AquaDisk Controls w/Starters**

**2 Conduit Installation(s) consisting of:**

- PVC conduit and fittings.

**2 Control Panel(s) consisting of:**

- NEMA 4X 304 stainless steel enclosure(s).
- Circuit breaker with handle.
- 2 KVA Transformer(s).
- Uninterrupted power supply.
- Fuses and fuse blocks.
- Single phase circuit breaker(s).
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Push-To-Test pilot light(s).
- E-stop button(s).
- PanelView plus 7 15 inch with color touch screen display.
- Compactlogix Processor.
- End cap(s).
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Power supply(ies).
- Motor starter(s).
- Panel heater.
- Terminal blocks.
- UL label(s).

**AquaDisk Engineering**

**6 Set(s) Documentation for the AquaDisk will be provided as described:**

- Engineer's Approval Data (English language).

**6 Set(s) Documentation for the AquaDisk will be provided as described:**


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- Operation & Maintenance Manuals (English language).

**AquaDisk Supervision/Freight Domestic**

**1 Supervision Services and Freight Package(s) for the AquaDisk will be provided as follows:**

- 1 Day(s) On Site for INSTALLATION SUPERVISION
- 1 Trip(s) for INSTALLATION SUPERVISION
- 2 Day(s) On Site for FUNCTIONAL TESTING
- 1 Trip(s) for FUNCTIONAL TESTING
- 3 Day(s) On Site for FIELD PERFORMANCE TESTING
- 1 Trip(s) for FIELD PERFORMANCE TESTING
- 3 Day(s) On Site for FIELD PERFORMANCE TESTING SUPERVISION
- 1 Trip(s) for FIELD PERFORMANCE TESTING SUPERVISION
- 1 Day(s) On Site for VENDOR TRAINING
- 1 Trip(s) for VENDOR TRAINING
- FREIGHT TO JOBSITE

**The Following General Notes apply to Aqua-Aerobic Systems' Proposal:**

- THE CONSOLIDATED APPROPRIATIONS ACT of 2014: The goods proposed are in compliance with the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014 as mandated in EPA's State Revolving Fund Programs as of the date of this proposal.
- SCHEDULE: We expect submittals to be completed and in transit to you within 4-8* weeks after receipt of order with acceptable terms and conditions and guarantee of payment. We expect receipt of approved engineer's submittal with release for manufacture within 4-8 weeks of our transmittal of submittal data. We expect shipment of equipment (transit time excluded) to be approximately 16-18* weeks from our receipt of approved engineer's submittal data and release for manufacture. Schedules may be adjusted at time of order placement, depending upon existing order backlog. *Weeks quoted are actual working weeks.
- Aqua-Aerobic Systems will be closed for the Christmas Holidays beginning approximately December 24, through approximately January 2nd.
- PRICE ESCALATION INDEX: Aqua-Aerobic Systems, Inc. reserves the right to re-evaluate the pricing quoted prior to order acceptance if; 1) a purchase order is received after the validity date stated in this proposal or, 2) the lead times stated in this proposal are exceeded. Any pricing adjustments required shall be based on a published materials cost index specific to the materials proposed.
- TARIFF PRICE ESCALATION NOTE: The proposed goods may be affected by the recent U.S. Government proposed tariffs on imported steel and aluminum. Because of this, Aqua-Aerobic Systems reserves the right to re-evaluate the pricing quoted prior to order acceptance if; 1) a purchase order is received past the validity date stated in the proposal or, 2) the total of the quoted lead times stated in this proposal are exceeded. Any pricing adjustments required due to tariff impacts will be based on published material cost indices specific to the affected materials.
- CONTROLS NON-DISCLOSURE / CONFIDENTIALITY AGREEMENT: If applicable, Aqua-Aerobic Systems will provide information relating to software documentation to control the treatment system supplied using Aqua-Aerobic Systems' proprietary and/or trade secret information subject to execution of an Aqua-Aerobic Systems "Controls Non-Disclosure / Confidentiality Agreement".
- Additional supervision services can be provided for an additional charge of $1200/day plus travel and living expenses.

**The Following Mechanical and/or Electrical Notes apply to Aqua-Aerobic Systems' Proposal:**

- Blower discharge manifold and piping losses are assumed at 0.3 PSI for coarse bubble and 0.5 PSI for fine bubble from the blower termination flange to the diffuser assembly termination flange. Engineer to verify actual piping losses do not exceed the above. Inlet losses are assumed at 0.25 PSI for inlet silencer and a clean filter. No inlet losses have been assumed for inlet filter piping, and it is assumed that the filter is located on each blower package.
- Decanter and mixer local control stations, diffuser winch, defined here-in are not rated for use electrically classified (Class 1 Division 1 or 2) areas and are expected to be mounted above the classified area envelope.
- Valve and line sizes are to be verified by the engineer based on actual line losses.
- Electrical cables for the SBR equipment only provided by Aqua-Aerobic Systems, as stated in our proposal, will terminate at the basin wall at the termination point as shown on the drawings or (if undefined) at the point nearest the powered equipment.


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- Filter flow hydraulics and plant's capability to handle the intermittent backwash flow is to be confirmed by the purchaser/purchaser's consulting engineer. The filter pump has a capacity of 130 gpm at a maximum allowable discharge head of 12 feet of water.
- Three phase motors will be 460 volt.
- Single phase motors will be 115 volt.
- All motors of this proposal are rated for across-the-line starters only. Blower VFDs shall be provided by others.

**The Following Scope Exclusion Notes apply to Aqua-Aerobic Systems' Proposal:**

- Materials and Services not specifically described/itemized in this proposal are not included in the quoted total price, and are to be supplied by the installing contractor/purchaser.
- Freeze protection may be required for outdoor installation in cold weather climates. All such protection, including but not limited to, heat tracing and insulation of pumps and piping, as well as protection against internal tank freezing, shall be provided and installed by the installing contractor.
- If steel tanks are utilized for the SBR application, field welding/attachment of equipment and/or components to the steel tank is the responsibility of the installing contractor/purchaser. Tank bosses, if applicable, are to be provided by the installing contractor/purchaser.
- If basins with sloped floors are utilized for the SBR application, supply of minimum 4000 psi type grout pads beneath the proposed equipment (such as base plates, brackets, mooring posts, diffuser supports/racks, etc.) are required to provide for a level installation elevation for the equipment. Grout pads are not included in Aqua-Aerobic Systems' scope of supply or price, and are to be provided by the installing contractor/purchaser.
- Equipment vault(s) (if applicable) must be supplied with drain and/or sump.

SCOPE BY PURCHASER/CONTRACTOR:

*Note this is not intended as a complete listing and is provided as a courtesy.
- Unloading and storage.
- Provisions for equipment access.
- Concrete, handrail and all civil works.
- All air and process piping, spool pieces, supports, gaskets and hardware beyond Aqua-Aerobic's equipment terminations.
- Interconnecting piping, wiring and installation.
- All flanges and/or unions in the piping to service the equipment.
- Electrical conduit, hardware, supports, attachment of cables, wiring and j-boxes (if any) between motors, electrical valves, instruments and the control panel.
- Installation/field wiring of the control panel(s) that ship loose.
- Electrical wiring and supply power.
- Concrete, volumes as required, to fill mooring posts.

**The Following Commercial Notes apply to Aqua-Aerobic Systems' Proposal:**

- WARRANTY AMENDMENT: Aqua-Aerobic Systems, Inc. warrants the goods provided by Aqua-Aerobic Systems, Inc. in accordance with the "Warranty; Limitation Of Liability; And Disclaimer" as amended herein:

In accordance with Specification Section 11600 - SEQUENCING BATCH REACTORS, 3.04 WARRANTY and Specification Section 11399 - EFFLUENT DISK FILTERS, 3.04 WARRANTY;

A. Aqua-Aerobic Systems warrants the equipment provided is new and of recent manufacture.

B. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract or 54 months from delivery, whichever comes first.

C. Freight costs for goods repaired or replaced is included.

- F.O.B. JOBSITE; TITLE AND RISK OF LOSS: All prices and all shipments of goods are F.O.B. Jobsite City Location. It is the responsibility of the Buyer to unload shipments and utilizing the packing list and bill of lading provided with the shipment notate shortages/damages upon receipt of the shipments and notify Aqua-Aerobic Systems in writing within 7 days of the shortages/damages to facilitate filing of a freight claim. Delivery of the goods sold hereunder by the carrier shall be deemed delivery to Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.


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- PROCESS GUARANTEE: A company backed process performance guarantee in accordance with the terms stated on Aqua-Aerobic Systems' process guarantee will be provided.

- PERFORMANCE BOND: A Performance Bond for 100% of the purchase price of the equipment and services as surety for Aqua-Aerobic Systems' equipment warranty will be provided.

- PAYMENT BOND: A Payment Bond for 100% of the purchase price of the equipment and services will be provided.

- TAXES: State and/or local taxes are not included in the price but will be charged unless we receive a valid sales exemption certificate, direct pay permit, or other documentation required specifically by the taxing entity prior to shipment.

- PAYMENT TERMS: Subject to credit approval and guarantee of payment, the following progress payments will be due at the designated event:

10% of total purchase price payable upon Aqua-Aerobic Systems receipt of approved engineer's submittal data.
65% of total purchase price payable 30 days from date of shipment of equipment.
5% of total purchase price payable Net 30 days from start-up and training or 90 days from date of shipment, whichever first shall occur.
15% of total purchase price payable Net 30 days from Substantial Completion
5% of total purchase price payable Net 30 days from Successful Completion of the Performance Test.

-SCOPE OF SUPPLY NOTE: Aqua-Aerobic Systems' scope of supply and pricing is as described in this proposal including the listed Integral Documents, terms and conditions of sale, and is based upon the REQUEST FOR PROPOSAL FOR SEQUENCING BATCH REACTORS DOWNTOWN AREA WASTEWATER TREATMENT FACILITY, ORLEANS, MA, including Modification No. 1, and REQUEST FOR PROPOSAL FOR EFFLUENT DISK FILTERS DOWNTOWN AREA WASTEWATER TREATMENT FACILITY, ORLEANS, MA, including Modification No. 1, unless otherwise stated on Aqua's Exceptions/Clarifications document. Please refer to the proposal notes for equipment terminations and items not included in the proposal which are to be provided by the Buyer. Engineer's submittal data will be prepared using these proposed goods and services, and the submittal approved by the Consulting Engineer will become an integral part of the scope of supply under the contract resulting from this offer. Any additions or deletions to the scope of supply will be presented as change orders.

- TRADEMARKS: Aqua-Aerobic®, Aqua-Jet®, Aqua-Jet II®, AquaDDM®, ThermoFlo®, Endura Series®, OxyMix®, Fold-a-Float®, Aqua MixAir®, AquaCAM-D®, AquaSBR®, Aqua MSBR®, AquaPASS®, Aqua BioMax®, AquaEnsure®, Aqua EnduraTube®, Aqua EnduraDisc®, Aqua CB-24®, AquaDisk®, AquaDiamond®, AquaDrum®, Aqua MiniDisk®, Aqua MegaDisk®, AquaPrime®, AquaStorm™, OptiFiber®, OptiFiber PES-13®, OptiFiber PA2-13, OptiFiber ACR-13®, OptiFiber PES-14®, OptiFiber PF-14®, OptiFiber UFS-9®, Trust the Tag®, AquaABF®, AquaMB Process®, Aqua-Aerobic® MBR, Aqua UltraFiltration™, Aqua MultiBore®, Aqua Multibore® C-Series, Aqua Multibore® P-Series, Aqua ElectrOzone®, Aqua ElectrOzone® M-Series, IntelliPro®, AquaNereda® Aerobic Granular Sludge Technology and the Aqua-Aerobic logo are registered trademarks or pending trademarks of Aqua-Aerobic Systems, Inc. Nereda® is a registered trademark of Royal HaskoningDHV. All other products and services mentioned are trademarks of their respective owners.

**GOODS QUOTED ABOVE WILL BE SOLD SUBJECT ONLY TO THE TERMS AND CONDITIONS OF SALE SET FORTH HEREIN. ANY DIFFERENT OR ADDITIONAL TERMS ARE HEREBY OBJECTED TO.**

**Total Price:**


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**TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)**
**Page 1 of 2**

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles.

**PAYMENT**
Unless specifically stated otherwise, quoted terms are Net 30 Days from shipping date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office.

**DURATION OF QUOTATION**
This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

**SHIPMENT**
Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal.

**TITLE AND RISK OF LOSS**
All prices and all shipments of goods are F.O.B. Aqua-Aerobic Systems, Inc.'s plant at Loves Park, Illinois unless specifically stated otherwise. Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

**TAXES**
Prices quoted do not include any taxes, customs duties, or import fees. Buyer shall pay any and all use, sales, privilege or other tax or customs duties or import fees levied by any governmental authority with respect to the sale or transportation of any goods covered hereby. If Aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc. is required to pay.

**INSURANCE**
Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage.

**SECURITY**
If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

**LIMITATION OF ACTION**
No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

**CANCELLATION CLAUSE**
No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be cancelled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefore: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.

**PROPRIETARY INFORMATION**
This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.


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**TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)**


**QUALIFIED ACCEPTANCE AND INDEMNITY**

In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua-Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

**WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER**

In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an "Endura Series" motor, the complete Endura Series unit shall be warranted by Aqua-Aerobic to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

**OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED** to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business at or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

**THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.**

**UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.**

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

**Accepted by:**

**Company:** _____

**By:** _____ **Date:** _____

**Offer Respectfully Submitted,**

Tamera Knapp

**Tamera Knapp, Applications Engineering Manager**
**Aqua-Aerobic Systems, Inc.**



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**ATTACHMENT C**
**Septage Receiving Proposal**

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**SECTION 11333**

**SEPTAGE RECEIVING STATION**

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## PART 1 - GENERAL

### 1.01 SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for Septage Receiving Station Work and, where appropriate, applying or installing such materials for the various items of Work as shown on the Contract Drawings and/or as specified herein and evidently required.

B. All equipment shall be from a single source supplier.

### 1.02 MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section will be made in accordance with the provisions the RFP.

B. An allowance in the amount of the Proposal Price of the equipment will be specified in the Contract Documents which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the Septage Receiving Station. A paid invoice from the equipment supplier shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

### 1.03 DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

### 1.04 SUBMITTALS

A. Submit the following in accordance with the RFP and as specified herein:

1. Certified shop and working drawings including complete characteristics and performance data for all equipment.
    a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.
        (1) Provide complete dimensional and performance data for screens, bearings, drives, motors, and all appurtenances.
        (2) Provide complete electrical and control schematics with interconnecting wiring diagrams.

b. Electronic files shall conform to the following minimum requirements:

(1) Files shall be AutoCad 2013 or Higher.

(2) Files shall be submitted as part of the Shop Drawing submittal.

(3) Submit Files on CD or DVD.

(4) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

c. Drawings shall be in conformance with all other requirements as specified in this specification.

d. Provide a scaled drawing showing the equipment, drives, and motors including equipment weights, lifting points and attachments, and clearances for equipment removal and maintenance.

2. Data regarding septage screening equipment, motor, and drive characteristics and performance:

a. Prior to fabrication and testing, include in data guaranteed performance curves based on actual shop tests of mechanically duplicate equipment, showing they meet specified requirements for head loss, capacity, and horsepower.

b. Results of certified performance and witness tests as specified.

c. Submit curves for guaranteed performance, certified test and witness tests on 8-1/2-inch. by 11-inch. sheets, one curve per sheet.

3. Control Panels:

a. Bill of Materials including manufacturer, model number and quantities.

b. Annotated product cut sheets for enclosures and control panel components.

c. Front elevations of control panels showing dimensions, locations of panel internal and external mounted components. Provide elevations with and without doors.

d. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.

e. Submit wiring diagrams using project specific tags as indicated on the Contract mechanical process, electrical, and instrumentation drawings.

4. Shop drawing data for accessory items.

5. Submit data from a minimum of three (3) separate tests showing compliance with the “Paint Filter Test” as described in EPA Publication SW-486 Method 9095. Photos shall also be submitted in order to document compliance with each test. The manufacturer must also state which facility the tests were performed at, when the tests were performed, and who witnessed the tests.

6. Printed installation manual.

7. Certified setting plans, with tolerances, for anchor bolts.

8. Manufacturer's literature as needed to supplement certified data.

9. Operating and maintenance instructions and a list of recommended spare parts other than those specified.

10. Listing of reference installations as specified with verified contact names and telephone numbers.

11. Bearing temperature operating range for the service conditions specified.

12. Shop and field inspection reports.

13. Bearing Life.

14. Motor and Drive shop test results.
15. Qualifications of field service technician that will perform site services. Manufacturer shall submit two candidates. Non-approved candidates will be disallowed from performing any site services.
16. Recommendations for short and long-term storage.
17. Shop and field testing procedures and equipment to be used.
18. Special tools.
19. Number of service person-days provided and per diem field service rate. A minimum of two days shall be provided.
20. Location and contact information for the nearest parts and service center.
21. Manufacturer's product data and specifications for painting.
22. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
23. Latest ISO 9001 Series Certification, AISC Category 1 Certification, or Quality Control Plan.
24. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. If deviations and clarifications from the drawings are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include all drawings, or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked and indexed to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Manufacturer, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

**1.05 PRODUCT HANDLING**

A. Provide as specified herein.

B. Shipping:

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the manufacturer at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturers written recommendations and instructions.

**1.06 DESIGN CRITERIA**

A. Septage Receiving Station shall comply with the service conditions outlined in paragraph 2.02 and consist of a cylindrical fine screen complete with screen basket, cleaning mechanism, concentric screw conveyor, dewatering screw, screening press with drive unit and pre-engineered housing complete with hinged and gasketed cover with vent, tank spray wash system, quick disconnect coupling inlet, grit trap with grit classifier, rock trap, manual inlet isolation valve, hydraulic inlet valve, inlet flow meter, inlet full-port sampling ball valve, outlet connection, and a ultrasonic liquid level sensing system, pH probe/transmitter, insulation and appurtenances as specified and indicated. The unit shall be complete with electrical control panel card reader and motor starter and mounted on a common fabricated steel base.

B. The Septage Receiving Station shall include:

1. Rock Trap; Type 316L stainless steel construction

a. Class 150 ANSI 4-inch inlet flange and 8-inch outlet flange

b. Full diameter hinged cover

2. Screen Tank with washing unit including washing nozzle, solenoid valve, 1-inch, Class1 Division 1, 120VAC, Class 150 ANSI 4-inch screen inlet flange.

3. Type 316L Stainless Steel Construction; including tank covers, tank supports and adjustable support legs for field leveling.

4. Type 316L Stainless Steel shafted horizontal grit conveyance screw with constant speed gear motor, 0.75 HP, 460 VAC, 3 phase gear motor, Class1 Division1

5. Type 316L Stainless Steel shafted inclined grit discharge screw with constant speed gear motor, 1.5 HP, 460 VAC, 60 Hz, 2 phase gear motor, Class 1 Division 1.

6. Closed grit discharge chute; Type 316L stainless steel.

7. Plant water strainer, type 316L stainless steelbodied Y-type with washable SS filter insert, 20 mesh.

8. Ball valve with electrical actuator.

9. Magnetic flow meter and transmitter for recording and totalizing each hauler load.

10. pH probe and transmitter to monitor incoming pH levels and to close the inlet valve and initiate an alarm if the pH level is out of the control range setpoints:

11. Fine Screen; Type 316L stainless steel construction with shafted screw and integrated maintenance free bearing;
    a. Inclined auger tube and screen basket
    b. Screen Drive; Class 1 Division 1 Motor, 2 Hp, 480 VAC, 60 Hz, 3ph, VFD
    c. Spray bar cleaning system
    d. Integrated screenings washing system with automatic press zone
    e. 3 solenoid valves, 1-inch Class1 Division 1 120VAC, 60 Hz, Brass body
    f. Screenings discharge chute; Type 316L stainless steel
    g. Screenings bagger
12. Hauler Access Station to be provided with the following features:
    a. Enclosure: Type 316L stainless steel, NEMA 4X, access door with locking handle
    b. Industrial display with card reader and keypad
    c. Receipt printer; kiosk-style printer, illuminated chute, large capacity paper roll
    d. User magnetic cards, pre-programmed or ID Code
    e. Station with sufficient I/O to provide for control of garage door.
13. Control Panels
    a. PLC-Based control panel as specified herein.
    b. NEMA 4, Type 316L stainless steel operator interface/control station.
    c. NEMA 4X, Type 316L stainless steel local control station.
14. Any other equipment and controls required to meet the Equipment performance requirements.

**1.07 REFERENCES**

A. American Institute of Steel Construction (AISC).
B. American Society of Testing and Materials (ASTM).
C. American Welding Society (AWS).
D. Steel Structures Painting Council (SSPC).
E. American Gear Manufacturers Association (AGMA).
F. Environmental Protection Agency (EPA) Publication SW-846 Method 9095.

**1.08 QUALITY ASSURANCE**

A. Provide as specified herein.
B. Welding: In accordance with latest applicable American Welding Society Code.
C. Provide shop and field tests as specified.

D. Provide services of factory-trained Service Technician, specifically trained on type of equipment as follows:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect installation of grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical, control and miscellaneous utility connections: 1/2 person-day.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 1/2 person-day.

c. Field Performance Testing: Field performance test equipment specified. 1/2 person-day.

d. Manufacturer Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1/2 person-day. The owner reserves the right to video record training events to train new staff in the future.

3. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

4. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

E. Provide a list of five references with verified contact names and numbers. References shall be in the same service as specified.

F. If equipment proposed is heavier or taller than specified, provide all structural, architectural, electrical and mechanical revisions at no additional cost to the Owner.

**1.09 SEISMIC REQUIREMENTS**

A. Conform to the requirements indicated on the structural drawings.

B. The Contractor and the manufacturer shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS OF SEPTAGE RECEIVING STATION**

A. Lakeside Equipment Corporation.

B. Huber Technology, Inc.

C. Or equal.

**2.02 SERVICE CONDITIONS**

A. Screen capacity and other operating data shall be as follows:

1. Number of units: 1
2. Minimum Hydraulic Capacity, gal/min: 400 at 3% solids concentration
3. Screen Opening, inches: ¼
4. Screening Basket Diameter, inches: 31
5. Minimum Screenings Screw Conveyor Diameter, inches: 9
6. Drive Motor Size, hp: 2
7. Inlet Pipe Size, inches: 6
8. Outlet Pipe Size, inches: 8
9. Inlet Height above Tank Base, inches: 29.5
10. Maximum Headloss at Minimum Hydraulic Capacity, inches: 11

B. The Septage Receiving Station will screen septic tank sludges containing significant quantities of sand, grit, rags, debris, and gravel. Screenings shall be washed, transported, compressed and dewatered by a single mechanism with only one motorized moving part.

C. The cylindrical fine screen shall be designed to handle the septage flow rate specified.

D. All electrical components mounted on the equipment shall be rated Class 1, Division 1.

**2.03 OPERATION**

A. The operation of the screen handling equipment shall be automatically initiated at a preset high liquid level after manually opening a motorized inlet valve via the vendor supplied control system. The screen cleaning mechanism shall remove solids from a screenings basket and deposit them into a screw conveyor. The screenings shall be transported up the screw conveyor and through a compression chamber.

B. The screening equipment shall wash the screenings prior to compaction in an enclosed tube to prevent spray and aerosols and shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in Method 9095 of EPA Publication SW-846.

C. The screen shall be capable of picking up rocks and objects 3-1/8 inches in diameter and depositing them for washing and passage through the compaction/dewatering zone.

D. A rock trap shall precede the Septage Receiving Station.

E. The control system shall be designed so that the cleaning characteristics of the screen can be changed via a selector switch to handle both "normal" septage/scavenged sludge loads and "grease" loads or through the use of an automatically initiated two speed drive system. Systems utilizing variable frequency drives (VFDs) shall be acceptable.

**2.04 SEPTAGE SCREENINGS EQUIPMENT CONSTRUCTION**

A. Cylindrical Fine Screen

1. The cylindrical fine screen shall be designed and built to withstand the maximum possible static hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized to prevent deflections or vibrations which may impair the screening, conveying and pressing operations. All submerged components and all components of the cylindrical fine screen in contact with the screened solids shall be of stainless steel construction.

2. The diameter of the screening basket shall be as specified.

B. Screen Cleaning Mechanism

1. The screen basket shall be of a cylindrical shape that shall be open at the top. The screen bars shall be perpendicular to the centerline of the screen. The basket ring support bars shall have adequately machined slots so that the rake teeth can penetrate the basket ring bars to ensure proper cleaning of the full basket depth.
2. The nominal bar spacing shall be as specified. Each ring shall be fabricated from sections that have been cut from flat stainless steel sheet to minimize warping of the rings. Each basket ring shall be provided with integral strengthening gussets at each welded attachment point for added basket strength. To ensure basket strength and to maximize screenings capture, the minimum ring heights for the 3-plane cylindrical basket shall be as follows:
   a. ¾ inch
   b. 1 inch
   c. 1-1/2 inch
3. The main screen basket upper support ring shall be a minimum of 5/8-inch thick and shall be machined to match the transport tube main support flange to ensure proper alignment of the basket and the rotating rake arm. The main screen basket lower support ring shall be 7/8-inch minimum.
4. The minimum diameter of the screening basket shall be as specified. The basket diameter shall be matched with a sufficient number of bar spacings to ensure that the septage flow rate specified is achieved and to provide less than the maximum headloss specified.
5. Side seal plates shall be provided to enclose the circular screen and the rectangular tank. Side seal plates shall be two-piece fabricated of 10 gauge minimum stainless steel and shall be of sufficient height to prevent bypassing of flow around the screen at the septage flow rate specified.

C. Rotating Rake and Cleaning Comb

1. The rotating rake assembly shall penetrate the depth of the bar screen to ensure positive solids removal. Rake shall be Type 316L cast stainless steel or water-jet cut Type 316L stainless steel for superior life. Rake tooth root design shall match the design of the basket rings to ensure proper cleaning of the screen bars.
2. The rake shall reverse at least once during the cleaning cycle to pass through the topmost position where it shall be cleaned by a cast Type 316L stainless steel or water-jet cut Type 316L stainless steel hinged cleaning comb installed at the top of the screen basket. Cleaning comb shall be supported at both ends by a nylon bearing and shall pivot and return to the standby position.
3. The rotating rake and the screw conveyor shall be fixed to the same shaft and driven by a common drive.
4. A stainless steel backed nylon brush shall be attached to the rake arm and positioned to make contact with the screening trough to sweep material caught on the edges of the trough. Two sets of spare brushes shall be provided.

D. Screenings Conveyor and Screenings Dewatering Press

1. The screen screw conveyor transport tube nominal diameter shall be as specified with a minimum Schedule 10S wall thickness. A minimum of three (3) equally spaced anti-rotation bars with 1/4-inch minimum thickness shall be welded to the inside of the transport tube along the longitudinal axis from the compaction zone to the beginning of the screenings collection trough.
2. A basket support plate flange shall be a minimum of 3/4-inch and shall be welded to the screen transport tube to attach the screen basket and to provide for attachment of the screenings collection hopper. A 1/2-inch minimum thick drive support flange shall be welded to the upper end of the screen transport tube for attachment of the drive assembly. After all welding of components to the screen transport tube have been completed the fabrication shall be placed in a lathe to machine the face of the upper drive flange, to machine the face of the lower basket support plate flange for mating the basket and to machine the lower bearing housing.
3. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be all AISI Type 316L stainless steel construction with a minimum thickness of 3/16-inch with increased thickness in the screenings collection trough and at the beginning of the compaction and dewatering zone.

4. The upper and lower screenings conveyor torque tube shall be accurately machined and fitted with a solid stainless steel shrink-fit welded design.
5. The lower end of the screenings conveyor shall be supported by a sealed, water-flushed, self-lubricated lower bearing with stainless steel wear sleeve. The lower bearing shall not take any thrust load from the screw conveyor. Flush water shall be furnished with a stainless steel water feed line connected to the lower bearing housing to maintain a positive pressure in the bearing cavity. A minimum of two seals shall be provided each with a UHMW polyethylene seal retainer plate. The stainless steel bearing housing shall be field replaceable and shall be machined to mate with the screenings collection housing by a bolted connection.
6. Rake arm attachment hub outer diameter shall match the outer diameter of the stationary bearing housing to minimize material wrapping around the shaft. A seal plate shall be furnished to mate between the stationary lower bearing support and the rotating arm to prevent material intrusion into the bearing seals. Rake arm mounting hub shall be split to provide a compression fit only on the shaft.
7. Drainage holes shall be provided along the entire length of the screenings collection trough invert to allow for gravity drainage of washwater without flushing screenings out of the trough. Drainage hole diameter shall be smaller than the bar spacing specified. The width of the drainage section shall be based upon a minimum 65-degree arc. The entire drainage section shall have a minimum 50% open area for free water drainage.
8. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design and shall be fabricated of 12 gauge minimum stainless steel welded to the transport screw housing for a water-tight design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the wastewater channel through circular holes that are machined into the screenings transport tube.
9. Compaction zone housing shall be furnished with a bolted and gasketed access cover as well as a bolted dewatering section panel inside the dewatering chamber to allow direct access to the screw conveyor should the compaction zone ever become plugged.
10. Water that is released from the screenings shall be returned via a reinforced rubber hose attached to the dewatering section. Drain design shall allow for removal and cleaning of the drain hose should it ever become plugged without removing the drive, discharge head or screw conveyor.

E. Drive Assembly

1. The rake mechanism and transport screw shall be driven by a direct-connected cycloidal-helical hollow-shaft high-thrust speed reducer. The speed reducer shall have a minimum service factor of 1.56 with a minimum torque rating of 15,700 in.-lb and a minimum thrust rating of 5,800 lbf at a design maximum speed of 12 rev/min.
2. The speed reducer shall be bolted to the upper end of the transport tube shaft that has been machined.
3. Motor
    a. Provide motors in accordance with Specification 16220 – Electric Motors.
    b. Class 1, Division 1, Group D explosion proof.
    c. 1800 RPM
    d. 460 Volt, Phase, 60 Hertz
    e. 1.15 S.F. (1.0 Inverter Duty)
    f. Premium Efficiency, Continuous Duty
    g. Class F insulation, 40ºC Temperature

h. NEMA C-face motor design

(1) Explosion-proof motor shall be furnished with over-temperature thermostats in the windings designed for cutout at approximately 160°C.

4. Proximity sensor for locating the rake position shall be mounted to the outer drive housing with a fabricated stainless steel bracket.

F. Screen Spray Wash Systems

1. Provide a minimum of three (3) spray systems. Each spray wash system shall be furnished with a control solenoid valve, flow adjustment ball valve, Type 316L stainless steel piping and fittings, flexible reinforced PVC hose and nozzles. Piping, fittings and valves shall be 3/4-inch diameter minimum. A plant water strainer shall be provided for the incoming plant water supply. The wash water flow requirements shall be a maximum of 25 gal/min with a pressure of 60 to 75 psig. Provide the duration of the wash cycle. The three (3) spray wash systems shall include:

a. Lower spray wash system shall be located near the upper end of the screenings basket just prior to where screenings enter the screw conveyor transport tube. The lower wash system shall have the minimum of nine (9) spray nozzles.

b. Screenings spray wash system shall be located in the upper section of the transport tube no more than 17 inches from the beginning of the compaction zone to break up and return organic materials to the flow stream and to ensure maximum screenings washing. A minimum of two (2) spray nozzles shall be provided. The screenings spray wash system and screenings screw conveyor shall be designed to prevent washing screenings down the center of the screw conveyor.

c. The dewatering chamber flush water system shall periodically clean the compaction and dewatering zone via a stainless steel wash header located in the upper end of the compaction/dewatering chamber. Header shall be of a circular design located in the uppermost end of the compaction zone dewatering chamber. Header shall have multiple orifices to wash the entire perimeter of the dewatering chamber.

2. The three (3) solenoid valves shall be 3/4-inch minimum, Type 316L stainless steel body suitable for 120 VAC operation. Solenoid valves shall be normally closed and rated for up to 100 psig. Solenoid valves shall be slow close type to minimize water hammer.

3. The three (3) flow adjusting ball valves shall be provided.

4. Solenoid valves and matching ball valves shall be connected to a 4-inch square tubing manifold with 1/4-inch thick minimum wall to ensure even pressure distribution to each spray wash system. The solenoid valve wiring shall be factory pre-wired to a junction box on a common spray wash manifold for wire connection to external power to the control panel. Junction box, conduit and fittings shall be rated NEMA 7 for Class I, Division I locations.

5. Main isolation ball valve for 4-inch square tubing manifold shall be provided.

6. Water strainer shall be provided suitable for a 1-inch connection and a maximum flow rate of 25 gal/min and suitable for an operating pressure of 60 to 75 psig. Water filter shall be a stacked filter element design with washable 80-mesh (200 micron) polyethylene or polypropylene disc elements, polypropylene head and bowl and Buna N gaskets.

G. Housing

1. The screen housing shall be constructed of stainless steel with 10 gauge minimum sides and bottom and 3/16 inch minimum end plates. Housing shall be adequately stiffened to prevent distortion due to the liquid sludges. Support legs shall be provided for anchoring to a base slab and lifting lugs shall be furnished for unloading the tank. Support legs shall be adjustable + 3/4 inches in vertical height for allowing leveling of the unit.

2. A stainless steel connect coupling shall be provided for the inlet connection. Coupling and inlet piping size shall be as specified. Inlet connection shall be Schedule 40S pipe. Inlet piping centerline above grade shall be as indicated and specified to allow for complete gravity unloading of a septage tanker and to maximize the flow capacity from the tanker to the septage acceptance plant. The tank shall be provided with an inlet baffle that shall extend the entire width of the tank to help contain splash and spray.
3. An inlet pinch-type valve, of the size indicated and specified, shall be provided for controlling flow into the unit. Valve shall be equipped with a Type 316 Stainless Steel water based hydraulic actuator. Valve shall operate at a minimum pressure of 45 psig and shall use approximately 0.5 cubic feet of water per open or close cycle. A 3/4-inch 3-way solenoid valve shall be provided to control the pinch valve operation. Hydraulic actuator, piping and fittings shall be pre-piped and furnished with the valve.
    a. Piping, valves and fitting for hydraulic system shall be Type 316L stainless steel.
    b. Water for the hydraulic actuator shall be provided through the screen wash water supply system.
4. Outlet diameter shall be provided as specified and shall accept an ANSI 125 lb. flanged bolt pattern.
5. Housing shall be provided with a 10-gauge minimum stainless steel hinged access cover complete with gaskets and a quarter turn hold down hasp. A minimum of two (2) stainless steel pneumatic cylinders shall be provided to assist in opening and closing the cover. Cover shall be an inset design to ensure that no leakage occurs should the gasket material fail.
6. Cover shall be provided with a permissive sensor such that when the cover is opened, its signal shall shut down operation of the screen for safety purposes. The cover sensor wiring shall be run to junction box on the fixed portion of the tank cover for wire nut connection to external power. Conduit and fittings shall be included between the sensor and junction boxes along with flexible conduit to allow the cover to open. Junction box, conduit and fittings shall be rated NEMA 7 for Class 1, Division 1 locations.
7. A 1-1/2-inch full-port sampling ball valve and connection shall be provided for septage sampling.

H. Odor Containment

1. The septage screenings equipment shall be completely containerized and enclosed from the inlet quick connect, through the motorized inlet valve, rock trap, flow meter, screen basket, screenings washing system, screenings compaction and dewatering system, and discharge. The only components open to the atmosphere shall be the screenings discharge chute, the tank vent and rock trap vent.
2. Provide the tank enclosure with a 4-inch flanged vent so that an external odor control duct system can be provided. Connect vent piping to Septage Screening Equipment housing vent.

I. Inlet Flow Meter

1. A 4-inch diameter magnetic flow meter shall be provided and installed in the inlet piping. The flow tube shall be a wafer style, Danfoss or Krohne with an integrally mounted transmitter. The flow tube shall include alignment and grounding rings for mounting between ANSI Class 150 flanges, furnished by others. All process-wetted materials in the body of the flow tube shall have a Tufnell liner. Two standard electrodes, AISI Type 316L stainless steel, shall be provided. The transmitter shall include an operator interface, and shall produce an analog output signal of 4-20 am. The magnetic flow meter assembly shall be FM approved Class I, Division 1 explosion proof areas.
2. Provide Flow Rate Indication and Totalization displayed on the front face of the Control Panel.

J. Rock Trap

1. Provide a rock trap that incorporates the use of a removable basket.
    a. Basket shall be removable from the side.
    b. Materials of Construction:
        (1) Housing: Type 316L Stainless Steel
        (2) Baskets and Hardware: Type 316L Stainless Steel

2. Rock trap shall remove large rocks and heavy objects that can damage the Septage Acceptance Plant.
3. Drawings depict the used of a separate inline rock trap. Designs incorporating the use of integral rock traps shall also be acceptable.
4. Provide vent and vent piping.
5. Provide interconnectionpiping.
    a. Connect piping to invert of rock trap.
    b. Provide minimum 1-1/2 inch drain with isolation Ball Valve.
    c. Provide Type 316L Stainless Steel pipe and fittings as specified.

K. Inlet Isolation Knife Valve.

L. Automated Inlet Pinch Valve.

M. Ultrasonic Level Element

**2.05 HOUSING WASHING SYSTEM**

A. Provide a wash system for the housing which shall be constructed with stainless steel piping and fittings, flexible reinforced Type 316 stainless steel hose and stainless steel rotary spray nozzle.

1. Provide solenoid valves for control of wash water flow.
2. Provide isolation ball valves.
3. Solenoids shall be rated NEMA 4X for Class 1, Division 1 areas.

B. The system shall automatically clean the inside of the housing after an adjustable preset idle period.

C. All outdoor spray water piping and hydraulic lines to pinch valve and valves shall be heat traced and insulated. The insulation shall be such that it can be easily removed for repair of water line.

**2.06 CONTROL SYSTEM**

A. Automatic controls for operation of the Septage Receiving Station and associated appurtenances shall be provided in a Programmable Logic Controller (PLC)-based control panel. Provide each control panel with a panel-mounted Human Machine Interface (HMI).

1. In order to achieve an integrated PLC control platform, provide Allen Bradley COMPACTLOGIX 5370 L1, L2 or L3 processor.
2. Provide NEMA 4, Type 316L Stainless Steel enclosure. The Control Panel for the Septage Receiving Station will be located in the garage (Room 102).
3. Panel shall be labeled UL 508A.
4. Provide motor starters, and variable frequency drives (VFDs) internal to the control panel as required. Provide VFDs in accordance with Specification 16260 – Low Voltage Variable Frequency Drives.
    a. VFDs shall be UL listed drives
    b. VFDs shall be 6-pulse type provided with 5% impedance line reactors and dedicated main VFD circuit breakers.
5. Control panel shall operate on 480VAC/3PH power and be powered with integral step down transformers as required. Control voltage shall be 24VDC or 120VAC as required and separate from 480VAC Equipment.
6. Heaters or AC units required for the control panel shall be powered from the control panel.

7. Provide the control panel with an integral surge protection device (SPD):
    a. 120VAC, 10kAIC rated.
    b. Visual indication of plug status.
    c. UL listed.
8. Provide the control panel enclosure with the following
    a. Through-the-door main disconnecting circuit breaker rated a minimum of 65 kAIC.
    b. Emergency stop (ESTOP) maintained pushbutton to shut down all system equipment.
    c. LED type indicating lights for the following:
        (1) Control power on pilot light (White)
        (2) Screen running pilot light (Green)
        (3) High level pilot light (Amber)
        (4) Overload shutdown pilot light (Red)
        (5) Screen fault pilot light (Red)
    d. Screen re-set push button (Black)
    e. Hand-Off-Auto selector switches for the following:
        (1) Screen drive
        (2) Lower wash system solenoid valve
        (3) Screenings wash system solenoid valve
        (4) Dewatering wash system solenoid valve
        (5) Tank wash system solenoid valve
    f. Forward-Off-Reverse selector switches (spring return to center) for screen drive.
    g. Elapsed time meter.
    h. Remote 120VAC dry contact outputs for the following:
        (1) Screen Running
        (2) Malfunction alarm
        (3) High water level alarm
9. All instruments, valves and ancillary devices provided as part of the system shall be powered by the panel.
10. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
11. Provide RAM memory protected by backup battery.
12. Provide UPS sized to provide at least 15 minutes of backup power to PLC.
13. Provide fully documented ladder logic on a CD-Rom.
14. Provide an Operator Interface Terminal (OIT) mounted on the front of the panel. This Unit will provide graphic display of the process parameters and equipment status on a color display. Provide 10 inch Allen-Bradley PanelView Plus 7 product with Color display and touch screen that is compatible with Ethernet communication network.
15. Provide a fully documented Panel View program on CD-ROM. The operation of panel mounted HMI shall be provided with security password entry ability.

16. Provide control and monitoring of the system as shown on the contract drawings.
17. Provide the quantity of I/O points and controls in accordance with manufacturer's requirements and P&ID drawings.
18. Provide an industrial Ethernet switch with at least four (4) ports installed within the panel in order to be connected to the plant SCADA system.
19. The program for the control system shall be written in a way that will allow the system to integrate into a SCADA system. All status and alarm data shall be placed in PLC registers so that data can be exchanged with the SCADA system without going into the control program. The SCADA computer shall be able to read or write into these registers.
20. The configured HMI display shall be operator friendly and shall include at a minimum a process overview page, cycle start-stop page, parameter page, loop display page, alarm page and manual operation page.
21. The Septage Receiving Station vendor shall provide all the configured HMI displays and ladder logic to the plant SCADA system integrator selected by the client in order to provide an integrated PLC control system.
22. Control system drawings shall be developed using AutoCAD and all drawing files shall be supplied on CD ROM.
23. White phenol nameplates with black lettering.
24. 480 VAC terminal block.

B. In addition to the Main Control Panel, furnish a NEMA 4X Type 316L stainless steel remote control station for the Septage Receiving Station for mounting locally at the equipment. The local control station will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building. The local control station shall house the following components:

1. Emergency Stop Push Button
2. H-O-A Control Switch
3. LED Indicating Lights: Red "RUNNING" lights and Green "OFF" lights for following equipment:
   a. Station Receiving Drive.
   b. Wash Water Spray Bar Motor.
4. A common FAULT light (LED), panel alarm and acknowledge button with suitable contacts.

C. Septage Hauler Station with Keypad Access.

1. Provide a septage hauler station located adjacent to the hook-up point for the septage receiving station. The system software shall be compatible with the Town's requirements for billing/recordkeeping.
2. Provide the septage hauler station consisting of the following:
   a. A keypad with access for the septage hauler.
   b. Activation via the keypad opens the inlet valve permitting discharge of septage into the unit.
   c. PIN access to permit up to 75 different users. The keypad shall communicate with the PLC in the control panel.
3. Alternatively, the hauler station shall be equipped with a bar code reader identifying the hauler's identity and granting or denying access to the system.
4. A printer terminal with paper cutter and out-of-paper alarm. Provide the system so that the receipt is printed upon each use with a print copy stored on a take-up reel.

**2.07 ANCHOR BOLTS**

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be Type 316L stainless steel unless noted otherwise. Anchor bolts shall be J-type embedded, or expansion-type.

B. Anchor bolts shall be set by template and protected from misalignment by the Contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrink grout. All miscellaneous hardware shall be Type 316L stainless steel.

**2.08 SCREENINGS BAGGER ATTACHMENT**

A. The discharge chute shall be furnished with a bagging device to contain and encase dewatered screenings.

B. The bagging device shall be fabricated of 12 gauge minimum stainless steel.

**2.09 PAINTING**

C. Electric motors, speed reducers, and other self-contained or enclosed components shall be painted.

D. Apply rust preventative compound to all machined, polished, and nonferrous surfaces which are not to be painted.

E. Passivity all stainless steel surfaces by using the following procedure:

1. Wire brush all weld areas to remove weld spatter. Brushes shall be of Type 316L stainless steel.

2. Glass bead blast or chemically treat all external non-wetted stainless steel to a uniform finish.

**2.10 SOURCE QUALITY CONTROL**

A. The equipment manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code - Steel" published by the American Welding Society or equivalent standard.

B. Fabricate all parts and assemblies from sheets and plates of Type 316L stainless steel sheet with a 2D finish conforming to AISI 316L and ASTM A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 and A403.

C. Perform all welding in the factory using shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section and weld metal equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the jointField welding of stainless steel will not be permitted.

D. Bolts, nuts and washers shall be AISI 316L stainless steel furnished in accordance with ASTM A193 unless otherwise specified.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. Contractor shall install all items in accordance with printed instructions of the manufacturers as indicated and specified.

B. The manufacturer's representative shall subsequently inspect the installation by the Contractor and make recommendations for adjustments necessary for proper operation.

**3.02 FIELD TESTING**

A. After installation of equipment and inspection by the manufacturer’s representative test all equipment functionality in the presence of the Engineer to verify the equipment ready for Acceptance testing.

B. During field tests, observe and record capacity, motor inputs, bearing housing temperature, noise and vibration. Immediately correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner. Contractor to provide all labor, piping, equipment, calibrated gauges and flow meters.

## 3.03 PROCESS PERFORMANCE GUARANTEE

A. The Septage Receiving Station will be installed at a new wastewater treatment facility (WWTF) servicing a new collection system. Because of construction sequencing, wastewater in sufficient quantities to simulate design loading conditions may not exist until several years after substantial completion. Because of this, a conventional Acceptance Test shortly after system turn-over is not likely or practical. Therefore, Process Performance Testing will occur three (3) years from Substantial Completion of the construction contract. In order to protect the OWNER's interests, the SELECTED PROPOSER shall provide to the OWNER, through the Contractor, with the shop drawing submittal:

1. Name Manufacturers - SELECTED PROPOSER shall be responsible for the process performance of the Septage Receiving Station and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Performance Bond in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. Or Equal Manufacturers – SELECTED PROPOSER shall be responsible for the process performance of the Septage Receiving Station and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a an irrevocable Letter of Credit in the amount of 100 percent of the purchase order price for the equipment. The irrevocable Letter of Credit shall be retained by the Owner until the installed equipment has passed the specified performance testing and the equipment has been accepted by the Owner. The SELECTED PROPOSER agrees to furnish the irrevocable Letter of Credit in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a financial company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such irrevocable letter of credit shall be paid by the SELECTED PROPOSER.

B. The Performance Bond or irrevocable Letter of Credit shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

## 3.04 WARRANTY

A. The SELECTED PROPOSER shall be provide an warranty of the Septage Receiving Station warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of this RFP. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The SELECTED PROPOSER agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said SELECTED PROPOSER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the SELECTED PROPOSER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

C. It is the SELECTED PROPOSER's responsibility to resolve any and all warranty claims.

D. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

## 3.05 ACCEPTANCE TESTING

A. After installation of equipment and after services of the manufacturer's representative as described in the RFP and herein, test the unit's performance on five consecutive loads of septage. Unit shall be demonstrated to achieve the design septage hydraulic capacity specified, while operating free from vibration, jamming, and overheating. The Contractor shall furnish all temporary equipment required for testing. Should the system fail to achieve the required hydraulic capacity, the manufacturer shall, at its own expense, make all necessary modifications until the design hydraulic capacity is achieved through retesting with five consecutive loads of septage.

B. Prior to final acceptance of the screen, three tests shall be conducted according to the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-846.

Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

C. Contractor shall have responsibility for performing formal Acceptance Testing with support from manufacturer’s representative. Representative shall include technical and operational advice, response to questions, and other assistance as necessary for successfully completing the Acceptance Tests. On-site support from the on-site Representative during all phases of installation and testing shall be as specified in the RFP.

## 3.06 FIELD PREPARATION AND PAINTING

A. Provide field painting as required. One quart of each paint utilized shall be supplied for touch up as required.

B. The CONTRACTOR shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The CONTRACTOR shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components.

D. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the CONTRACTOR.

END OF SECTION

MAY 22, 2019

The City of Orleans, Massachusetts

Submitted by: Huber Technology Inc.

Huber Proposal #442391

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# CONSIDERING THE RO3.3 GRIT AND {9t¢!D9 RECEIVING STATION

HUBER TECHNOLOGY
WASTE WATER Solutions

## CONSIDERING THE RO3.3 GRIT AND SEPTAGE RECEIVING STATION

Thank you for giving Huber Technology the opportunity to provide a grit and septage receiving station for The City of Orleans, MA. Huber Technology is offering our well proven Rotamat® Ro3.3 Sludge Acceptance plant for Septage and Grit removal.

Here at Huber we understand the selection of a manufacturing partner is a critical choice in the design of a wastewater headworks treatment plant. In our experience. Typically the following company characteristics are essential for a project of your magnitude.

A. Has experience producing equipment for large cities and municipalities all over the world.
B. A company with longevity and stability that will be around for years ahead.
C. A record of producing the uncompromising quality and highest performing equipment.
D. Equipment that is optimized to reduce wear and automated to reduce operator attendance or callout.
E. A company committed to supporting customers in the field, for the lifetime of the equipment.

We have prepared the following information package, to provide some background on the Huber Company, some of our guiding principles, financial stability, manufacturing and service capability. We hope to show that Huber is the ideal business partner to design, manufacture and most importantly **support** the equipment that is provided for your upgrade.

Please do not hesitate to contact myself or other members of the team with any questions, we are happy to assist.

Sincerely,

**Brian Baker**
Eastern Regional Sales Director
Huber Technology, Inc.
Email: Brian.Baker@hhusa.net
Phone: (704) 840-3085

## MESSAGE FROM THE PRESIDENT OF HUBER TECHNOLOGY

Thank you for the opportunity to introduce our company HUBER Technology, Inc., a leader in the field of municipal and industrial wastewater treatment market with high quality liquid-solid separation technology.
Headquartered in 36,000 sq. ft. of office and manufacturing space in Huntersville, N.C., Huber Technology, Inc. is a member of the HUBER Group as a wholly owned subsidiary of Huber SE, based in Berching (Bavaria), Germany.

Enclosed with this letter is documentation about our manufacturing facility in Berching (Bavaria) Germany, our Huntersville NC location, our products and services, including brochure, reference list and statements from different teams about their capabilities.

Established in 1872, Huber is a manufacturer with five generations of craftsmanship to its credit. HUBER SE has remained a family owned business since it's foundation in 1834 which has given us financial independence.

One key reason for our continued success is the decentralized manner in which HUBER SE operates their businesses. As President of HUBER Technology, Inc. I have direct responsibility for Sales, Marketing, R&D and Business Development for North America. My teams are laser-focused on our customers' needs, and the teams' entrepreneurial spirit drives sustained, high growth.

We have a talented group of individuals with deep experience in water and wastewater and a diversity of backgrounds and styles. Our mission is to promote the sustainable use of water, energy, and resources measured by the customers in the markets we serve in North America. This mission recognizes our commitment to our clients, our culture, and our sense of purpose in improving water and energy.
These values are hallmarks of HUBER's culture and will remain in place regardless of how we evolve to meet the changing industry.

As you consider our technologies for your wastewater treatment application you have my guarantee that Huber Technology Inc. is committed to support you through the entire process.

We look forward to working with you.

Sincerely,

**Henk-Jan van Ettekoven**
President
HUBER Technology, Inc.

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HUBER TECHNOLOGY
WASTE WATER Solutions

# Scope of Supply

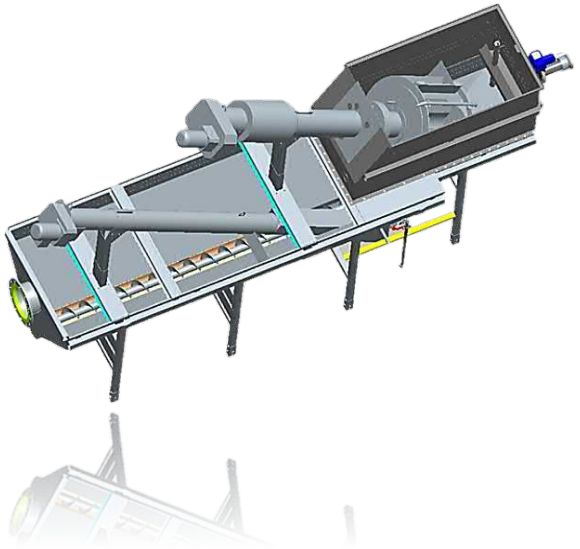
**Huber Technology, Inc.**
9735 Northcross Center Court
Suite A
Huntersville, NC 28078
Office 704-949-1010
Fax 704-949-1020

**Project:** Orleans, MA
**Equipment:** Ro3.3 Septage Receiving Station
**BID Date:** May 22, 2019
**Revision:** 0

# Scope of Supply

## Septage Receiving Station Design Information

| | Ro3.3 Technical Data | |
|---|---|---|
| *Maximum Flow Rate* | 400 | *GPM* |
| *Total Dry Solids by Percent* | 3 | *%* |
| *Bar Spacing* | 6 | *mm* |
| *Diameter of Screen* | 2.56 | *feet* |
| *Flange to Flange Length* | 16.80 | *feet* |
| *Approximate empty weight* | 4730 | *lbs* |
| *Approximate loaded weight* | 7770 | *lbs* |
| *Wash Water Consumption* | 52 | *GPM* |
| *Wash Water minimum pressure* | 75 | *PSI* |
| *Installation Angle of Auger* | 35 | ° |
| *ANSI Inlet Diameter* | 4 | *inch* |
| *ANSI Outlet Diameter - Grit Tank* | 8 | *inch* |



## Ro3.3 Technical Details

| ***Model*** | ***Ro3.3 780 with Grit Removal*** |
|---|---|
| *Quantity* | 1 |
| *Tank Material* | 316L Stainless Steel Construction; picked and passivated in acid bath |
| *Shafted Screw Design* | Shafted screw with integrated maintenance free bearing |
| *Screenings Wash* | Integrated screenings washing system IRGA including a 1'' SST Body solenoid valve, 120 VAC, C1D1 |
| *Screening Compaction* | Automatic compaction flushing system including a 1'' SST Body solenoid valve, 120 VAC, C1D1 |
| *Spray Bar* | Spray bar including a 1'' SST Body solenoid valve, 120 VAC, C1D1 |
| *Tank Washing* | Tank washing system including a 1” SST Body solenoid valve, 120 VAC, C1D1 |
| *Water Strainer* | Water strainer, stainless steel bodied Y-type with washable stainless steel filter insert, 20 mesh |
| *Tank Cover* | Screen tank cover includes two (2) stainless steel pneumatic cylinders for lifting the cover |
| *Discharge with Bagger* | Closed screenings discharge chute is included with bagger |
| *Grit Transport* | 316L stainless steel shafted horizontal grit conveyance screw with constant speed gear motor, 0.75HP, 460VAC, 60Hz, 3 phase gear motor, Class 1 Division 1 |
| *Grit Removal* | 316L stainless steel shafted inclined grit discharge screw with constant speed gear motor, 1.5HP, 460VAC, 60Hz, 3 phase gear motor, Class 1 Division 1 |
| *Drive Motor* | 1.5 HP, 480 VAC, 3ph, 60 Hz, S.F. 1.15, Class 1 Division 1, VFD |
| *Actuator/Valve* | Electric actuator with PVC Ball Valve |
| *Flow Meter* | Magnetic flow meter |
| *Level Sensor* | Ultrasonic Level Sensor |
| *Supports* | 316L Stainless Steel |
| *Anchor Bolts* | M12 316L, Included |

# Scope of Supply

## Control Panel Details

***Control Panel***

| |
|---|
| 1 - Enclosure, NEMA 4X, 316 Stainless Steel, Wall Mount |
| 1 - Disconnect, Circuit Breaker type, with door handle |
| 1 - VFD, Altivar 320 w/ Line Reactor MSP Branch Circuit Protection |
| [Screen - 480VAC, 1.5HP Max] |
| 1 - Motor Starters, NEMA Rated, Reversing, with Overload Relay and Branch Circuit Protection |
| [0.75HP - 480VAC Max, H.Grit] |
| 1 - Motor Starters, NEMA Rated, Reversing, with Overload Relay and Branch Circuit Protection |
| [1.5HP - 480VAC Max, I.Grit] |
| 2 - Current Monitors - Grit Screws |
| 1 - Control Power Transformer, 480-120VAC with Branch Circuit Protection |
| 1 - UPS, Battery Backup, SOLA |
| 1 - TVSS, 120V Single Phase |
| 1 - Programmable Logic Controller: Allen Bradley CompactLogix w/ Ethernet and Required IO |
| 1 - Operator Interface, Allen Bradley PanelView Plus 10", Color Touch Screen |
| 1 - Power Supply, 24VDC |
| 1 - Ethernet Switch, Phoenix, 5-Port, unmanaged type |
| 1 - Lot, Circuit breakers, 120VAC |
| 1 - Lot, Pilot Lights, PTT, LED Type, [As Required] |
| 1 - Lot, Push Buttons, [As Required] |
| 1 - Lot, Selector Switches, [As Required] |
| 1 - Lot, Control Relays, Socket Type, [As Required] |
| 1 - Lot, Terminal Blocks |
| 1 - Lot, Dry Contacts |
| 1 - Lot, Intrinsically Safe Relays, [Home Switch and level sensor] |
| 1 - UL Label |
| 1 - Standard 12/18 Warranty |

***Hauler Access Station***

| |
|---|
| 1- Enclosure, 316 Stainless Steel, 24" x 24", Interior door and sub-panel |
| 1- Enclosure interior insulation package, back and sides |
| 1- Heavy Duty Key Lockable enclosure handle, with 3 Point door mechanism |
| 1- Interior Door, with Cutouts for devices, Type 304 Stainless Steel |
| 1- Circuit Breakers, As Required |
| 1- Panel Heater Kit, Heavy Duty with Thermostat |
| 1- Touchscreen Display, 6 Inch minimum |
| 1- Stainless Steel Keypad for PIN Access |
| 1- Thermal Printer, Large Capacity paper roll and feeder, with illuminated print done chute. |
| 1- UL Label, Industrial Control Assembly |
| 1- Ethernet connection to Equipment Control Panel |

# Pricing

| EQUIPMENT | MODEL | QUANTITY | PRICE |
|---|---|---|---|
| Septage Receiving Station | Ro3.3 780 with Grit Removal | 1 | Included |
| Huber Rock Trap | 316L Stainless Steel | 1 | Included |
| Main Control Panel w/ Hauler Access Station | - | 1 | Included |
| Standard Manufacturer's Services & Freight | | | Included |
| | | **TOTAL:** | **Please See Bid Form** |

Thank you for your interest in Huber Technology, Inc.'s Ro3.3 Sludge Acceptance Plant If you have any questions, please do not hesitate to contact our Regional Sales Director or our local sales representative.


***Huber Sales***

Name: Brian Baker
Title: Regional Sales Director
Phone: (704) 840-3085
Email: brian.baker@hhusa.net

***Representative***

Firm: Walker-Wellington Associates
Name: Henry Russell
Phone: (603) 498-2384
Email: henry@walkerwellington.com


# Technical Clarifications

1. Electrical disconnects required per local NEC code are not included in this proposal.
2. A warranty period of 4 years from Substantial Completion has been provided per Section 3.04 WARRANTY of the RFP Document.
3. The Huber Scope of Supply is based upon RFP Section 11333. Huber is in receipt of no other sections or addenda.
4. The Huber unit uses a 4 inch flange.
5. All piping to and from the equipment is to be supplied by the installing contractor.
6. Any Item not listed above is not considered part of this scope of supply. Please contact our representatives listed above for further clarification.
7. Huber has provided equipment designed to meet performance requirements of the specification, however, it may differ slightly in construction. The differences include: motor horsepower, gearmotor instead of cyclo-helical gear box, material thicknesses and minor dimensional differences.
8. This septage receiving station with grit trap has been provided per Section 11333. The RFP drawings do not show a unit with a grit trap. Please advise if a grit trap is not required and if Huber is to modify its Scope of Supply.
9. 11333 2.04.F.1
   The Huber unit requires 52 gal/min of washwater flow for optimum results.
10. 11333 2.02.A.6
    The Huber Screen Drive Motor is 1.5HP
11. 11333 2.04.E.1
    The Huber Motor is of a Parallel-Shafted Gearmotor Design. Huber has many problem-free installations with this gearmotor. Cycloidal Helical gearboxes are usually found in high shock applications such as centrifuges, and are not necessary for the low speeds found with this application
12. PLC and HMI are only installed on the equipment control panel. No PLC required in Hauler Station.
13. Price includes programming for the equipment outlined in this quote only. No other programming has been included

**Comments and Clarifications to the RFP Terms and Conditions**

1. I. Invitation to Submit, #8 and V. Proposal Security, A. Huber is supplying a Bid Bond for the amount of five percent (5%) of the equipment price.

2. II. Introduction, regarding Liquidated Damages. Please revise to state the following, "Liquidated damages for the Proposer will be set to $500 per day and not to exceed 50% of the equipment price."

3. VII. Method of Payment. Huber would like to clarify that payment terms are as follows:
   - 10% Upon Approval of Submittals
   - 80% Upon Delivery of Equipment
   - 5% Upon Start-up/Commissioning of Equipment
   - 5% Upon Successful Completion of the Performance Testing (but not to exceed 180 days after Start-up date)

**4.** Section 11365, Article 3.04, Warranty. If the Proposer is to provide a Warranty or Maintenance Bond for this project, the Warranty or Maintenance Bond will not be issued until a firm Substantial Completion Date has been established by the Contractor and Owner. No estimation of the Substantial Completion Date will be accepted prior of the issuance of the Warranty or Maintenance Bond. It is not typical practice to provide a pre-dated Warranty or Maintenance Bond during the Submittals. If a date is established and the Warranty or Maintenance Bond has been issued, but there are delays at the fault of the Owner or Contractor which cause the extension of the Warranty or Maintenance Bond, the Proposer shall request a change order for the additional coverage.

**Terms and Conditions**
The Proposal is dependent expressly conditioned upon Purchaser's acceptance of the attached Huber Technology, Inc. Standard Terms and Conditions.

**Special Information and Exceptions**
- Price does not include any unloading or any applicable fees or taxes (Local, Federal, or Final Destination)
- Prices are in U.S. Dollars unless noted otherwise
- Freight is delivered with duty paid (D.D.P.) to Job site
- Price does not include installation or building modifications
- Price Quotation is valid for sixty (60) days from the date of this Proposal. After expiration of validity Huber Technology, Inc. (hereinafter "Huber") reserves the right to adjust pricing to take into account any significant increases in material costs such as steel, stainless steel finished products, stainless steel coil, etc.

**Submittals**
Huber Technology, Inc. will provide documentation to the Purchaser per the following schedule:
- Five (5) copies or the quantity stipulated in the equipment specification of submittal shop drawings 4-6 weeks after acceptance of a written purchase order.
- Three (3) copies or the quantity stipulated in the equipment specification of Huber Technology O&M manuals prior to equipment start-up.

**Shipment**
Huber Technology, Inc. will maintain the following schedule:
- Submittals 4-6 weeks after acceptance of a written purchase order.
- Equipment delivery 22-24 weeks after approved submittals or notice to proceed.
- O&M manuals prior to equipment start-up.
- For any delays in delivery which are beyond Huber's responsibility, a finance charge of 1.5% of the contract value per month will be due and payable to Huber.

**Accessories**
This proposal includes only those items specifically mentioned in the equipment descriptions. Any items which may be necessary for the operation of the equipment, but are not specifically mentioned, such as motors, drives, controls, or supports, are to be supplied via additional quotation separate from this offering.

**Abrasion or Corrosive Materials**
All of Huber's machines and systems are manufactured from 304 grade stainless steel. The environment or materials the equipment may be exposed to may be abrasive or corrosive. This

proposal makes no representation or warranties concerning the service life of the equipment against such abrasion or corrosion. The concentration of chloride and hydrogen sulfide (H2S) in the equipment operating environment shall be kept below the following values:

- Chloride < 200 mg/l
- Hydrogen sulfide H2S < 6 ppm

Machines made from 316 grade stainless steel are available for a price adder for extremely harsh operating environments.

**Purchase Orders**

All purchase orders are to be faxed or mailed to:

Huber Technology, Inc.
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Phone: (704) 949-1010
Fax: (704) 949-1020

All purchase orders are subject to acceptance by Huber Technology, Inc.

**Warranty**

LIMITED WARRANTY: Huber warrants that the equipment and components furnished will be free from defects in workmanship and materials and perform the general process function intended, solely under the conditions defined by Huber for a period of (a) twelve (12) months from completion of installation, start-up or owner acceptance of the equipment assuming the equipment is accepted by the owner within 6 months of delivery or (b) eighteen (18) months from the date of delivery to Purchaser, whichever date comes first. Huber will replace, modify or repair, at its sole option, any such defective component or equipment at no charge provided that Huber is notified promptly in writing of any claimed defect. If requested by Huber, any such defective part or component shall be returned to Huber, freight prepaid. Huber will provide on-site Field Service when reasonably assured of payment therefore if this warranty does not apply or when such service is required in its judgments. This warranty does not apply to any defect or malfunction arising out of failure to store, install, operate or maintain the equipment in accordance with instructions by Huber. Warranty shall be voided for any misuse of equipment; operation under conditions other than those defined by Huber in its operation and maintenance (O&M) manuals for said equipment, or gross operator negligence. Any unauthorized modification or alteration of the equipment or repair or replacement of components may void this warranty, at the sole option of Huber. For any billable repairs completed outside of the initial warranty period, a sixty (60) day guarantee on work performed and parts supplied will apply.

HUBER TECHNOLOGY INC. MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, WITH REGARD TO THE DESIGN, SALE, MERCHANTABILITY OR FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE OR USE EXCEPT AS EXPRESSLY SET FORTH IN HUBER'S TERMS AND CONDITIONS. HUBER IS NOT SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR WARRANTY, TORT CLAIMS INCLUDING NEGLIGENCE AND STRICT LIABILITY,

OR ANY OTHER THEORIES OF LAW. HUBER IS UNDER NO EVENT LIABLE FOR ANY SPECIFIC, INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGES, EXPENSE, INJURY, DISMEMBERMENT, OR DEATH OF ANY KIND WHATSOEVER.

**Exclusions**

- Financing
- Cranes and/or lifting devices
- Unloading and/or storage of equipment on job site
- Local, State or Federal taxes or fees
- Foundation design and engineering
  (Huber will only furnish equipment drawings and data)
- Utilities for erection, installation and operation
- Gauges and instrumentation not specifically described in Huber scope of supply
- Interconnecting wiring, conduit, piping, tubing, valves, fittings, etc. between the equipment and other equipment and/or control devices and control panel.
- Tools, oil, grease, grease gun, dumpster(s), or bins(s).

**Project Management**

Huber will appoint a Project Manager for the duration of the contract. Project Management services are included in this package and are as follows:

- Provision of a complete critical path project schedule for Huber equipment
- Coordination with Huber manufacturing on materials procurement and fabrication to and with Huber shipping/logistics to ensure Huber commitments are maintained.

**Erection, Training and Start-up Assistance**

A certified Huber Service Technician will make every reasonable effort to be at the job site within two (2) weeks after Purchaser's request to Huber for equipment start-up and commissioning assistance. Huber will provide additional erection and start-up supervision, which is not specifically included in the scope of our supply at the Purchaser's written request. For such additional services Purchaser shall pay $1,000.00 per day plus expenses, for eight (8) hours per day.

- At the request of the Purchaser, overtime service will be provided at a rate of 1.5 times the regular rate for weekdays, and 2.0 times the regular rate for weekends.
- "Expenses" are defined as the costs of travel from Huber's location to the point of installation and return; together with accommodation and living expenses during the start-up period of field service.
- Charges for all time involved will be invoiced, including delays which are beyond Huber's control. The full net invoice is payable within thirty (30) days of receipt by Purchaser.

**Equipment Standard**

Any deviations from the Huber standard mechanical and electrical specifications must be discussed with the Purchaser and agreed upon. Huber reserves the right to charge adders to

the equipment price for any non-standard mechanical and electrical components required by the Purchaser and not explicitly stated in Huber's scope of supply.

**Shop Painting**

Gears and motors will receive three (3) layers of painting, two (2) layers of primer and a finishing layer with synthetic resin varnish.

**HUBER TECHNOLOGY, INC. STANDARD TERMS AND CONDITIONS OF SALE**

## 1. ENTIRE AGREEMENT/ORDERS.

This agreement (the "Agreement") is between Huber Technology, Inc., its subsidiaries and its affiliates (collectively "Huber") and Purchaser. No order for Huber's goods or services shall be binding upon Huber until acknowledged in writing by Huber. Such written acknowledgement and these Standard Terms and Conditions of Sale (the "Terms and Conditions") constitute the entire agreement between Huber and Purchaser. Any purchase order, offer or counter-offer made by Purchaser before or after Huber's written acknowledgement is rejected and all documents exchanged prior to Huber's written acknowledgement are merely preliminary negotiations and not part of any agreement between the parties. For example, orders submitted on Purchaser's own purchase order forms modifying, adding to, contrary to, or inconsistent with these Terms and Conditions are expressly rejected and of no force or effect and acceptance is expressly made conditional upon assent to these terms. In no event will Huber be deemed to have in any way changed, enlarged or modified its liabilities or obligations as fixed by these Terms and Conditions including, without limitation, situations in which Huber satisfies an order submitted on Purchaser's own purchase order form. No other terms or conditions or modification of these terms shall be binding upon Huber unless specifically accepted in writing by an Officer of Huber. Merely signing a purchase order or other document as a condition of payment shall not be deemed a specific acceptance of terms therein by Huber.

Purchaser shall have been deemed to agree to these Terms and Conditions upon the earlier of acceptance of Huber's quotation, acceptance of delivery of the goods or services or the issuance of a purchase order to Huber.

## 2. PRICES.

Until acceptance of a purchase order is acknowledged in writing by Huber, all prices are subject to change. Written quotations expire fourteen (14) calendar days from the date of quotation unless specified otherwise. Verbal quotations are non-binding on Huber. Quoted prices do not include sales, excise, municipal, state or any other government taxes. All taxes and other governmental charges upon the production, manufacture, distribution, sale or use of goods or services to the extent required or not forbidden by law to be collected by Huber from Purchaser, shall be paid by Purchaser to Huber unless Purchaser furnishes Huber with exemption certificates acceptable to the relevant taxing authorities. Huber reserves the right to revise final quoted prices of work in process due to any change in the order on the part of Purchaser or any factor beyond the control of Huber. Typographical and/or clerical errors made by Huber are subject to correction.

If Purchaser causes or requests delays in manufacture or shipment beyond six (6) months from acceptance of Purchase Order, Huber shall have the right to increase price based on any actual escalation in labor, material, overhead, and component costs. Huber also reserves the right to charge Purchaser for any reasonable storage costs caused by such delays.

## 3. TERMS OF PAYMENT.

Invoices are net thirty (30) days from the date of invoice, unless specified otherwise and approved in writing by Huber. In the event that the purchase order between Purchaser and Huber requires partial payments to be made by Purchaser, Purchaser shall pay those required amounts in a timely manner or Huber will be permitted to suspend, without penalty or liability of any kind, delivery of future goods and services to the Purchaser even though partial payment for such undelivered goods or services may have already been received by Huber.

Past due accounts will bear interest at the rate of 1.5% per month of the invoiced amount. All invoices are payable in U.S. dollars, unless specified otherwise and approved by Huber in writing. Acceptance of bank drafts, checks or other form of payment shall be subject to immediate collection of the full face amount thereof. Huber may, at its discretion, impose a transaction fee on payments processed via wire transfer or by Letter of Credit.

Huber reserves the right at any time to suspend credit or to change credit terms provided herein when in its sole opinion the financial condition of Purchaser so warrants. In such case, in addition to any other remedies provided herein or by law, Huber may request cash payment or satisfactory security from Purchaser prior to shipment of goods.
In the event of nonpayment of an invoice when due, and without prejudice to other lawful remedies, Huber shall have the right, without penalty or liability of any kind, to suspend further work or the delivery of future goods under this Agreement or any other agreement with Purchaser until such invoice is paid in full; provided, however, that if such invoice remains unpaid for more than five (5) days after written demand by Huber, Huber may terminate this Agreement without penalty.

## 4. RETAINAGE.

Retainage, in any case, is limited to 5% of the contract value and is due upon completion of the terms of the contract.

## 5. TAXES AND OTHER CHARGES.

The prices for Goods and/or Services do not include any sales, use or other taxes or charges payable to state or local authorities. In addition to Huber's invoice price or quote price, Purchaser is also responsible for payment of any use-tax, sales tax, excise tax, VAT tax, duty, custom, inspection or testing fee, and/or any other fee, tax, or charge imposed by governmental or non-governmental authority arising from the Goods and/or Services provided by Huber. Purchaser is responsible for and bears the risk of establishment of a valid exemption from any fee, tax, or charge. In the event Huber is required to pay any of the fees, taxes, or charges listed in this paragraph, Purchaser herewith agrees to immediately reimburse Huber for this cost, or in lieu of such payment by Huber, Purchaser agrees to timely provide an exemption certificate or other comparable document to the entity or authority imposing said fee, tax and/or charge. Purchaser further agrees to waive any and all claims regarding the reasonableness of such payment and will

be liable to Huber for reasonable attorneys' fees and/or court costs incurred by Huber as a result of Purchaser's failure to pay the charges listed in this paragraph.

**6. DELIVERY.**

Huber shall not be liable for any damage as a result of any non-delivery or delay, including, without limitation, an act of God; act of Purchaser; embargo; other government act, regulation or request; fire; accident; strike; war; boycott; slowdown; riot; or delay in transportation or inability to obtain necessary labor, materials, or manufacturing facilities. Huber will use its best efforts to meet promised delivery dates, but under no circumstances shall Huber be liable for any direct, or indirect, consequential, incidental, liquidated or other damages for delay in delivery.

Purchaser will notify Huber within thirty (30) days after order acceptance of the scheduled delivery date. If Purchaser does not notify, a delivery date of six (6) months, unless otherwise specified by Huber, after notice to proceed and/or approval of submittals is agreed. For any delays by Purchaser after commencement of manufacturing, a finance charge of 1.5 % per month of the contract value will be assessed to Purchaser.

Huber reserves the right to substitute suitable alternative materials and components where necessary.

Where the services are to be performed on Purchaser's premises, Purchaser agrees to provide Huber on a timely basis with such access, machine downtime, utilities and equipment as Huber shall reasonably require in order to perform the services in accordance with the Agreement. If Purchaser fails to perform its obligations or shall fail to perform them in a timely manner, Purchaser acknowledges and agrees that Huber shall be entitled to delay performance of the services, without penalty or liability of any kind, until such time as Purchaser has complied in all respects with its obligations and to increase the price for the services to reflect any increased cost to Huber caused by Purchaser's failure to perform or late performance.

If delivery is delayed or deferred by Purchaser beyond the scheduled date, payment shall be due in full when Huber is prepared to ship the goods or perform the services. The goods may thereafter, at Huber's option, be stored at the risk and expense of Purchaser.

Huber may at certain times provide goods or services to Purchaser prior to the issuance, delivery and acceptance of a corresponding purchase order. In such cases, Huber will notify Purchaser that these Terms and Conditions shall apply to such transactions and Purchaser shall be deemed to have accepted such Terms and Conditions upon Huber's delivery of goods or performance of services.

**7. GOODS ACCEPTANCE.**

It is Huber's intent to deliver complete orders in good condition to the final destination dictated

by the Purchaser. All equipment and components delivered to the receiving location must be duly inspected upon receipt. Any visible damages must be noted on way-bill and followed up with a full inspection within a period of seven (7) days from delivery date. If a written report is not submitted to Huber within this period it is assumed that the equipment was received in good condition, meets the specifications of the purchase order, constitutes unqualified acceptance by the Purchaser, and Purchaser waives any rights to rejection or remediation of delivered equipment.

**8. FIELD SERVICE.**

"Field Service" refers to the services of a Huber factory-trained representative at the site of end-use for initial installation, inspection, start-up observation and operator training. "Field Service" refers also to any subsequent investigations of warranty issues, operational difficulties, Purchaser complaints, or requests for post-warranty service. Purchaser acknowledges that Huber Field Service representatives shall make all arrangements necessary with labor unions for their presence on the site. No contractual warranty or indemnity relating to Field Service is extended by Huber, nor are its Field Service representatives authorized to bind Huber with any oral representations or statements in conflict with or addition to the governing contract terms or any manual or instructions provided by Huber. This paragraph shall apply to any and all initial and subsequent Field Service provided by Huber relating to the Goods sold to the Purchaser. Any field service work performed at site after expiration of the initial warranty period is warranted for sixty (60) days after the work has been completed.

**9. SHIPMENT/RISK OF LOSS.**

Huber will use commercially reasonable efforts to meet delivery dates stated in advance of actual shipment of goods or performance of services, but in no event shall such quoted delivery dates be deemed to represent fixed or guaranteed delivery dates. Under no circumstances will Huber be liable for any direct, or indirect, consequential, incidental, liquidated or other damages for delay in delivery. Method and route of shipment will be at the discretion of Huber unless specified otherwise by Purchaser and agreed by Huber, and any additional expense of the method or route of shipment specified by Purchaser shall be borne by Purchaser. Claims for shortage or other quantity errors must be made in writing to Huber within seven (7) days after receipt of shipment. Failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Purchaser.

Huber, in its sole discretion, may accommodate Purchaser requests for delivery of goods in installments if such requests are confirmed in writing by Huber. Such installment deliveries, when separately invoiced, shall be paid for when due per invoice without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Purchaser of its obligations to accept remaining deliveries.

**10. GOVERNMENT STANDARDS.**

Huber applies quality standards in our manufactured equipment that are designed to meet and comply with federal government occupational safety, noise, sanitation and health standards. The Purchaser is solely responsible for compliance of the equipment and its operation with any state or local laws, codes, ordinances, or regulations, unless otherwise specified by Huber in its proposal.

**11. LIMITED WARRANTY.**

Huber warrants that the equipment and components furnished will be free from defects in workmanship and materials and perform the general process function intended, solely under the conditions defined by Huber for a period of (a) twelve (12) months from completion of installation, start-up or owner acceptance of the equipment assuming the equipment is accepted by the owner within 6 months of delivery or (b) eighteen (18) months from the date of delivery to Purchaser, whichever date comes first. Huber will replace, modify or repair, at its sole option, any such defective component or equipment at no charge provided that Huber is notified promptly in writing of any claimed defect. If requested by Huber, any such defective part or component shall be returned to Huber, freight prepaid. Huber will provide on-site Field Service when reasonably assured of payment therefore if this warranty does not apply or when such service is required in its judgments. This warranty does not apply to any defect or malfunction arising out of failure to store, install, operate or maintain the equipment in accordance with instructions by Huber. Warranty shall be voided for any misuse of equipment; operation under conditions other than those defined by Huber in its operation and maintenance (O&M) manuals for said equipment, or gross operator negligence. Any unauthorized modification or alteration of the equipment or repair or replacement of components may void this warranty, at the sole option of Huber. For any billable repairs completed outside of the initial warranty period, a sixty (60) day guarantee on work performed and parts supplied will apply.

HUBER TECHNOLOGY INC. MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, WITH REGARD TO THE DESIGN, SALE, MERCHANTABILITY OR FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE OR USE EXCEPT AS EXPRESSLY SET FORTH IN HUBER'S TERMS AND CONDITIONS. HUBER IS NOT SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR WARRANTY, TORT CLAIMS INCLUDING NEGLIGENCE AND STRICT LIABILITY, OR ANY OTHER THEORIES OF LAW. HUBER IS UNDER NO EVENT LIABLE FOR ANY SPECIFIC, INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGES, EXPENSE, INJURY, DISMEMBERMENT, OR DEATH OF ANY KIND WHATSOEVER.

**12. EXCLUSIVE REMEDIES.**

Purchaser acknowledges that its sole and exclusive remedies for breach of the Limited Warranty shall be replacement or repair by Huber of any defective part or component, and payment of the

reasonable out of pocket costs incurred in connection with replacement or repair if such costs are approved in advance by Huber, or refund of 80% of the purchase price if Huber in its sole discretion concludes the equipment cannot be repaired or replaced. This remedy excludes any other consequential, incidental, special or other form of damages. It also excludes any extraordinary costs for removal or re-installation of Huber equipment, such as crane rental, structural alteration, or demolition, which are necessitated by factors over which Huber has no control such as building design or configuration.

**13. LIMITATION OF LIABILITY/INDEMNITY.**

Huber's liability on any claim for loss or damage arising out of any transactions under this Agreement or from the performance or breach thereof or connected with any goods or services supplied hereunder, or the sale, resale, operation or use of goods, whether based on agreement, warranty, tort (including negligence) or other grounds, shall not exceed the price allocable to such goods or services or part thereof involved in the claim, regardless of cause or fault. Purchaser's remedies are limited to the return of non-conforming goods and repayment of the price or to the repair and replacement of non-conforming. This limitation of liability and remedies reflects a deliberate and bargained-for allocation of risks between Huber and Purchaser and constitutes the basis of the parties' bargain, without which Huber would not have agreed to the price or terms of this transaction.

HUBER SHALL NOT IN ANY EVENT BE LIABLE WHETHER AS A RESULT OF BREACH OF AGREEMENT, WARRANTY, TORT (INCLUDING NEGLIGENCE) OR OTHER GROUNDS FOR INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF GOODS OR ASSOCIATED PRODUCTS, BUSINESS INTERRUPTION, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES OR SERVICES, DOWNTIME COSTS, OR CLAIMS OF PURCHASERS OF PURCHASER FOR SUCH DAMAGE. In addition, if Huber furnishes Purchaser with advice or other assistance regarding any goods or services supplied hereunder, or any system or equipment in which any such goods may be installed, and which is not required pursuant to this transaction, the furnishing of the advice or assistance will not subject Huber to any liability, whether based on agreement, warranty, tort (including negligence) or other grounds.

In the event Purchaser modifies Huber goods or incorporates Huber goods into another product or component part, Purchaser agrees to hold harmless and indemnify Huber from any and all claims, liabilities, losses, costs and expenses (including reasonable attorneys' fees) involving personal injury or property damage. Purchaser also agrees to hold harmless and indemnify Huber from any patent or other intellectual property claims related to (i) any Huber goods made in accordance with Purchaser's designs or specifications; or (ii) the use of any drawings provided to Huber by Purchaser for use in the manufacture, production or assembly of such goods.

**14. TITLE.**
Notwithstanding delivery, installation or start-up, title to all equipment furnished shall remain solely with Huber until the full purchase price is paid by Purchaser. Until such time, Huber may enter the premises where such equipment is then located and repossess and remove such equipment by any lawful means as this is the property of Huber Technology. Purchaser agrees to do all acts deemed necessary or desirable or requested by Huber to maintain Huber's rights in, and title to such equipment.

**15. WAIVER**.
The failure of Huber to insist in any one or more instances, upon the performance of any of the Terms and Conditions as set forth herein or the failure of Huber to exercise any of its rights hereunder shall not be construed as a waiver or relinquishment of any such terms, conditions or rights and shall not effect Huber's right to insist on strict performance and compliance with regard to any future performance of these Terms and Conditions.

**16. CHOICE OF LAW.**
This Contract shall be exclusively governed by the laws of the State of North Carolina, without regard to its conflict of law provisions. Huber and Purchaser further consent to the exclusive personal jurisdiction of any applicable court in the city of Charlotte, in the county of Mecklenburg, North Carolina for any legal action or proceeding brought to enforce, construe or interpret these Terms and Conditions. Venue is proper only in the United States District Court of North Carolina. Each party hereto irrevocably submits to the jurisdiction of each court in each such action or proceeding.

**17. DISPUTE RESOLUTION/ATTORNEYS' FEES.**
Any controversy or claim arising out of or relating to this Contract or its breach shall be settled by arbitration conducted in Huntersville, North Carolina in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association and North Carolina law and judgment on the award rendered by the arbitrator(s) may be entered in any court of competent jurisdiction. The arbitrator shall award attorneys' fees, costs, witness costs, expert witness fees, arbitrator compensation, arbitrator fees, exhibit fees, travel costs and other amounts deemed reasonable to the prevailing party as defined by North Carolina General Statute §44A et al.

**18. ASSIGNMENT, WAIVER, ENTIRE AGREEMENT, SEVERABILITY.**
Neither party shall assign or delegate any of its rights or obligations under this Agreement without the prior written consent of the other party, which such consent shall not be unreasonably withheld, except that either party may assign or delegate its rights or obligations hereunder to an Affiliate without the other party's consent. As used herein, the term "Affiliate" shall mean any entity that directly, or indirectly through one or more intermediaries, controls or is controlled by, or is under common control with the entity specified. Huber may terminate this

**HUBER TECHNOLOGY, INC. STANDARD TERMS AND CONDITIONS OF SALE**

Agreement upon written notice to Purchaser without any further liability to Purchaser if there is a change of control of Purchaser. The Agreement constitutes the entire agreement between the parties with respect to its subject matter, and supersedes all prior oral or written representations or agreements by the parties with respect to the subject matter of this Agreement. Neither the Agreement nor any of its provisions may be modified, amended or waived, whether orally, through the parties' course of performance, course of dealing or course of conduct, or manifested in any other way, unless in writing and signed by an authorized officer of Huber. It is the express intention of the parties that such requirement for written modifications, amendments or waivers be strictly enforced notwithstanding judicial precedent or statutory provisions to the contrary. Any provision found invalid or unenforceable will not affect the validity or enforceability of any other provision and the invalid provision may be judicially modified to the extent enforceable.

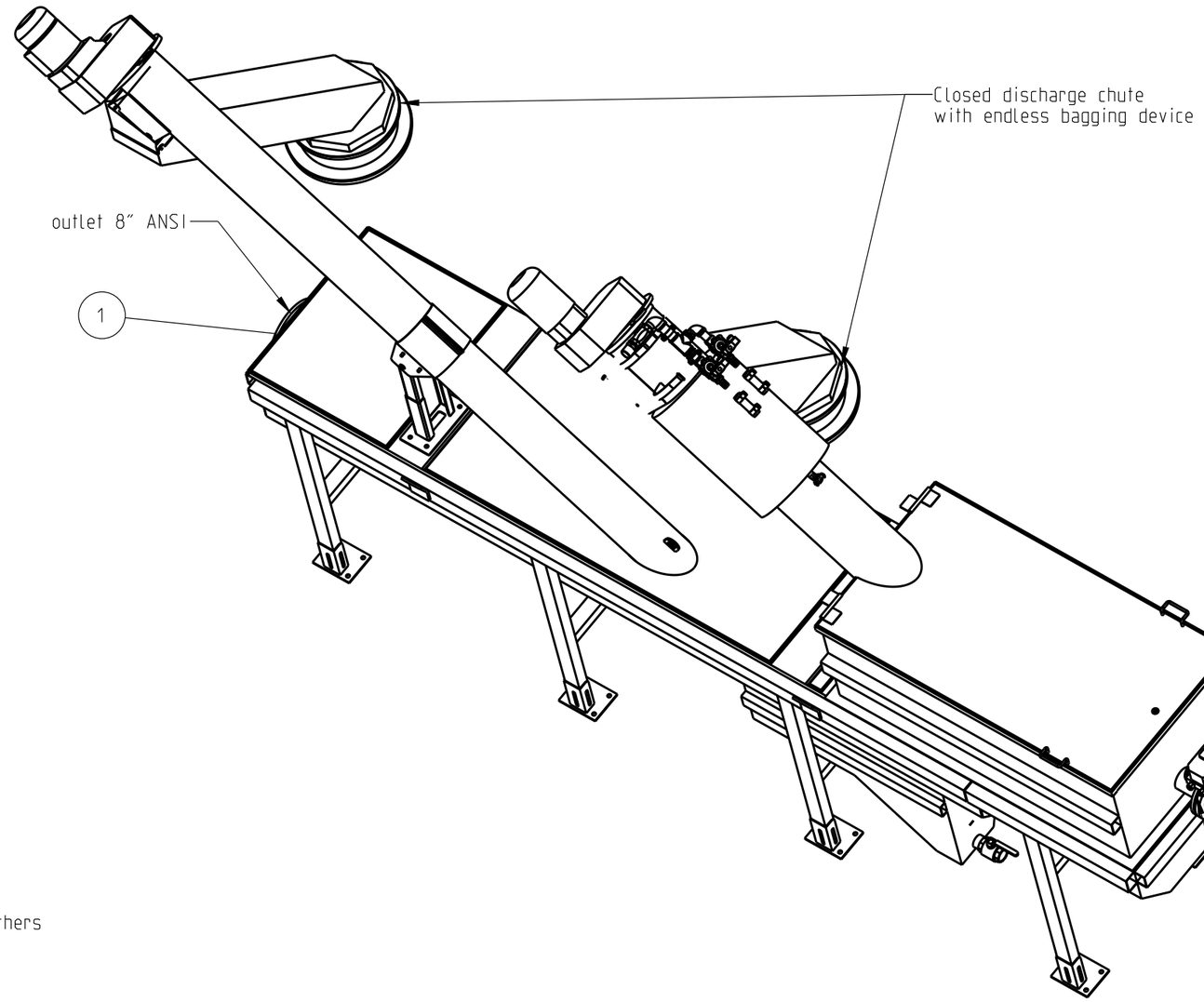
Fall protection to be supplied by client (type of protection acc. to Country specific regulations). (Also valid for planned or existing Covers of channels > 3' - 7 1/4 inches height)

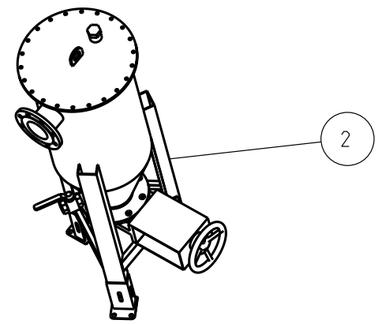
WARNING: Moving machine parts. Protection against accidental contact to be supplied by client according to country specific regulations.

Material of construction = 316L stainless steel

Motor and Solenoids = Class 1, Division 1

FIRM STANDING OF THE PLANT IS ONLY GUARANTEED AFTER DOWELLING !




| Pos. No. | Quantity | Description |
|---|---|---|
| 1 | 1 | **HUBER Sludge Acceptance Plant ROTAMAT® Ro3.3 Ro1 780/** |
| 2 | 1 | **Stone trap DN400 -** |

Note:
ALL Piping by others

Note!
ALL Building dimensions, Item Locations and positions are APPROXIMATE ONLY !
Dimensions and locations must be field measured / verified for accuracy of install.

Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

| | Name | Date |
|---|---|---|
| Designed: | us-tl | 05/20/2019 |
| Approved: | us-tl | 20.05.2019 |
| Modified: | - | - |
| - | - | |
| Rev. | Modification | |

HUBER TECHNOLOGY
WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

| | | | |
|---|---|---|---|
| HUBER Sludge Acceptance Plant | | | |
| ROTAMAT® Ro3.3 Ro1 780/6 | | | |
| Scale: 1:24 | Fig. No.: 1/6 | Installation sketch | Size: B |
| Orleans MA | | | Drawing No.: 51346278 |

## GENERAL INSTALLATION NOTES:

| | |
|---|---|
| 1. | EQUIPMENT MUST BE LEVEL IN ALL PLANES. |
| 2. | AUTHORIZATION REQUIRED FOR FIELD MODIFICATIONS TO HUBER EQUIPMENT DUE TO SITE INCONSISTANCIES -CONTACT HUBER TECHNOLGY. |
| 3. | REFUSE CONTAINERS SHOWN ON DRAWINGS (IF ANY) ARE FOR REFERENCE ONLY AND ARE SUPPLIED BY OTHERS (UNLESS SPECIFIC TO HUBER's SCOPE OF SUPPLY.) |
| 4. | WELDING: DO NOT WELD UNTIL TEMPORARY MOCK-UP IS VERIFIED AGAINST THE INSTALLATION DRAWINGS AND ALL LEVEL, SQUARENESS, AND/OR ANGLES HAVE BEEN ACHIEVED -REFER TO WELD SPECIFICATIONS THIS DRAWING. |
| 5. | INSTALLATION CONTRACTOR TO VERIFY ALL EXISTING STRUCTURAL DIMENSIONS BEFORE COMMENCEMENT OF WORK. CONTACT ENGINEER AND/OR HUBER IF FIELD DISCREPANCIES PREVENT PROPER INSTALLATION AS SHOWN ON THE INSTALLATION DRAWINGS, AND/OR OPERATIONS AND MAINTENANCE MANUAL. |
| 6. | FIELD VERIFY ALL EXISTING SITE DIMENSIONS AND ELEVATIONS. DIMENSIONS AND ELEVATIONS SHOWN ARE BASED ON ENGINEERING DRAWINGS AVAILABLE AT THE TIME OF DESIGN OR AS BASED ON AVAILABLE PLANT RECORD DRAWINGS -ALL SITE DIMENSIONS SHOWN ON HUBER DRAWINGS ARE FOR "REFERENCE" ONLY. HUBER NOT RESPONSIBLE FOR DISCREPANCIES IN THE FIELD. |
| 7. | INSTALLATION IS BY OTHERS. |
| 8. | ALL REQUIRED ELECTRICAL, FITTINGS, CONDUIT, HAZARDOUS AREA CONDUIT SEALS, WIRING, AND/OR JUNCTION BOXES - ARE SUPPLIED BY OTHERS. |
| 9. | REFER TO PROJECT DRAWINGS OR CONSULT ENGINEER FOR EQUIPMENT CONDUIT RUNS, CONTROL STATION LOCATION, AND FLOOR STUB UPS. |
| 10. | VALVES SUPPLIED SEPARATE (IF ANY) MUST BE FIELD INSTALLED BY INSTALLING CONTRACTOR. ALL PIPE RUNS AND REQUIRED PIPING ARE SUPPLIED BY OTHERS. SEE ENGINEER FOR PIPE LAYOUT/ROUTING. |
| 11. | FLANGE GASKETS, HARDWARE, AUXILLARY PIPING, FITTINGS, OR OTHER RELATED ARE SUPPLIED BY OTHERS (UNLESS SPECIFICALLY INCLUDED AS PART OF HUBER'S EQUIPMENT SUPPLY). |
| 12. | EQUIPMENT ANCHORS AND HARDWARE SUPPLIED BY HUBER ARE METRIC. |
| 13. | REFER TO EQUIPMENT OPERATIONS AND MAINTENANCE MANUAL FOR DETAILED INSTALLATION INSTRUCTIONS AND/OR EQUIPMENT SPECIFIC INFORMATION. |

## WELDING SPECIFICATIONS:

| | |
|---|---|
| 1. | NO AREA GRINDING OF NON-STAINLESS METALS OR IRON WELDS PERMITTED NEAR HUBER EQUIPMENT. CONTRACTOR TO INSPECT HUBER EQUIPMENT FOR "RUST SPECKS" IF IRON DUST IS SUSPECT. ALL "RUST SPECKS" MUST BE EXPEDIENTLY AND PROPERLY CLEANED. |
| 2. | WELD ELECTRODES (USED ON HUBER EQUIPMENT) MUST BE AS FOLLOWS: |
| 2. a | 304L EQUIPMENT USE 308L ELECTRODE OR BETTER. |
| 2. b | 316L EQUIPMENT USE 316L ELECTRODE OR BETTER. |
| 3. | REMOVE ALL BURRS AND SHARP EDGES FROM FIELD WELDS. |
| 4. | ALL WELD AREAS TO BE CLEANED WITH SOLVENT MEK OR EQUIVALENT. |
| 5. | WELDING PER AWS & ASME STANDARDS. |

## ELECTRICAL NOTES:

| | |
|---|---|
| 1. | ELECTRICAL FITTINGS, WIRING, FLEX CONDUIT/POWER CABLE, SO-CORD, JUNCTION BOXES, REQUIRED FOR MOTOR POWER ARE SUPPLIED BY OTHERS AND NOT PROVIDED BY HUBER. |
| 2. | EQUIPMENT MOTORS SHOULD BE DIRECT WIRED UTILIZING CLASS 1, DIVISION 1 APPROVED FLEX CONDUIT OR OTHER AS APPROVED BY THE ENGINEER. |
| 3. | EQUIPMENT MOTORS DO NOT COME PREWIRED AND REQUIRE CLASS 1, DIVISION 1 PROCEDURES. |
| 4. | CONTRACTOR IS RESPONSIBLE FOR ALL APPLICABLE ELECTRICAL CODE PROCEDURES AND STANDARDS GOVERNING THE PROJECT LOCAL. FOR HAZARDOUS AREA ELECTRICAL CLASS 1, DIVISION 1, GROUP D, NEC ARTICLE 501 SHALL GOVERN. |

Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

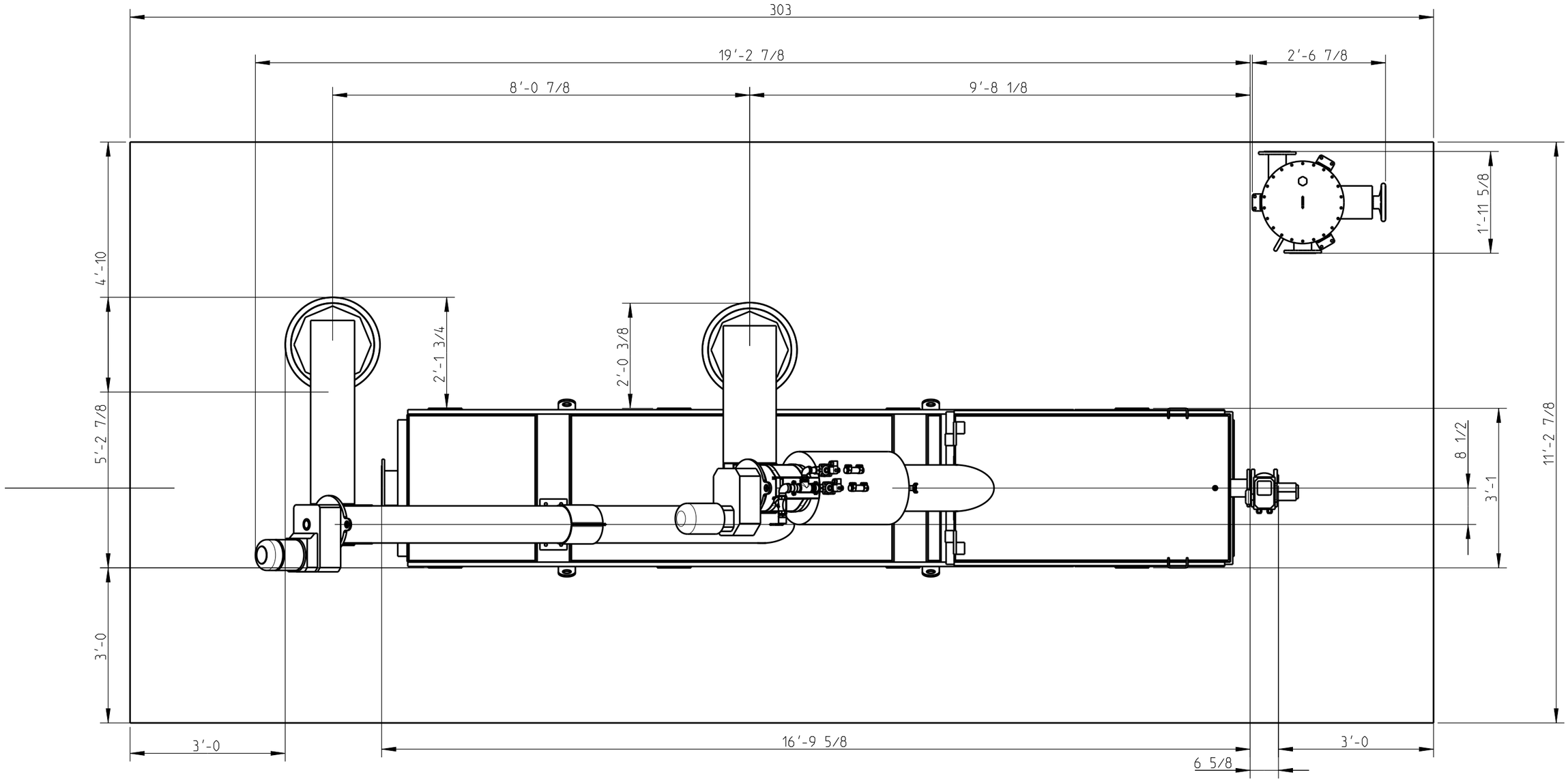
| | Name | Date |
|---|---|---|
| Designed: | us-tl | 05/20/2019 |
| Approved: | us-tl | 20.05.2019 |
| Modified: | - | - |
| - | - | |
| Rev. | Modification | |

HUBER TECHNOLOGY
WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

HUBER Sludge Acceptance Plant

ROTAMAT® Ro3.3 Ro1 780/6

| Scale: | Fig. No.: | | Size: |
|---|---|---|---|
| 1:96 | 2/6 | Installation sketch | B |
| Orleans MA | | | Drawing No.: 51346278 |




Note:
ALL Piping by others

Fall protection to be supplied by client (type of protection acc. to Country specific regulations). (Also valid for planned or existing Covers of channels > 3' - 7 1/4 inches height)

WARNING: Moving machine parts. Protection against accidental contact to be supplied by client according to country specific regulations.

Material of construction = 316L stainless steel

Motor and Solenoids = Class 1, Division 1

FIRM STANDING OF THE PLANT IS ONLY GUARANTEED AFTER DOWELLING !

Note!
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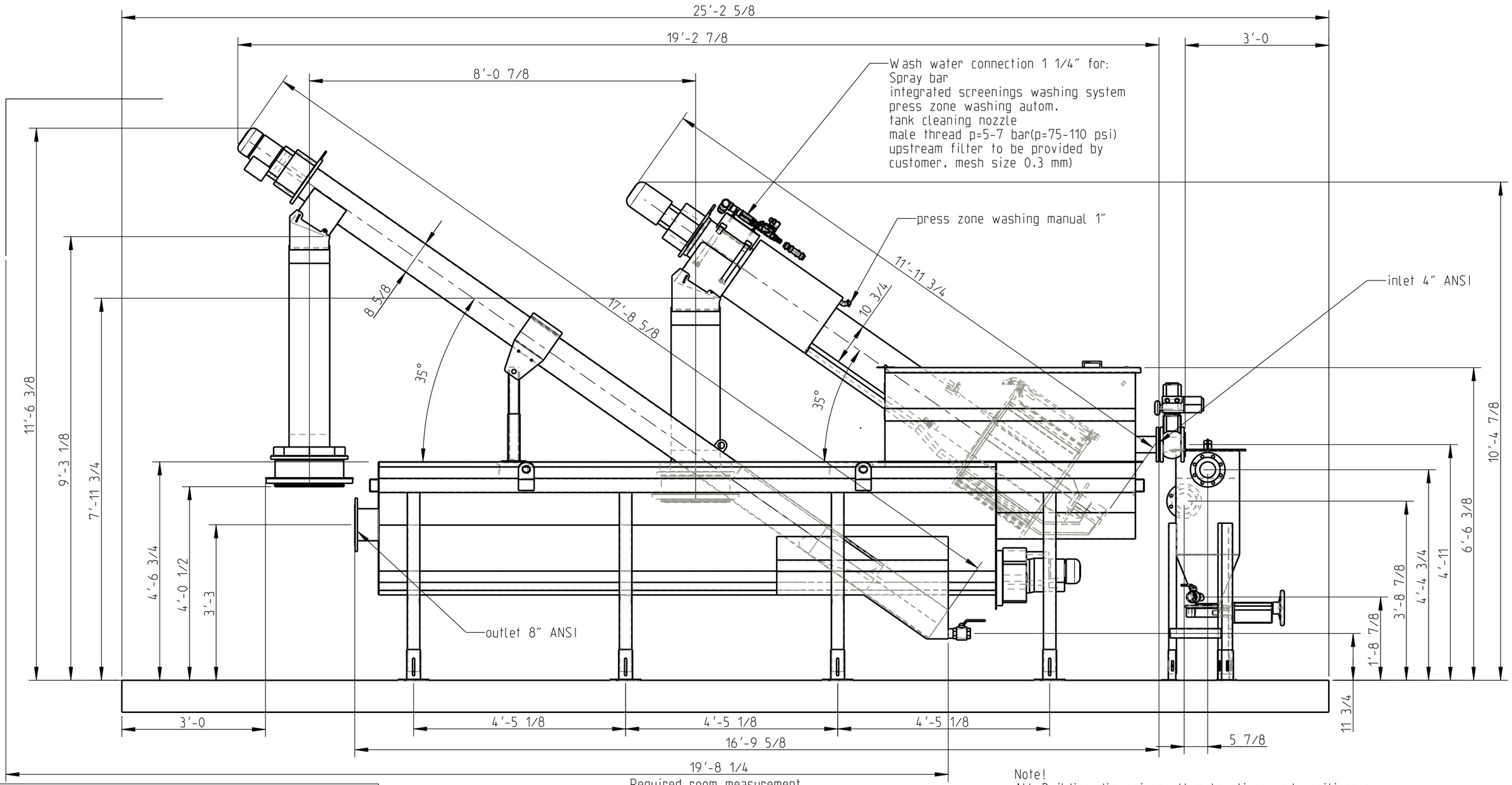
WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

HUBER Sludge Acceptance Plant

ROTAMAT® Ro3.3 Ro1 780/6

| Scale: | Fig. No.: | | Size: |
|---|---|---|---|
| 1:24 | 3/6 | Installation sketch | B |
| Orleans MA | | | Drawing No.: 51346278 |

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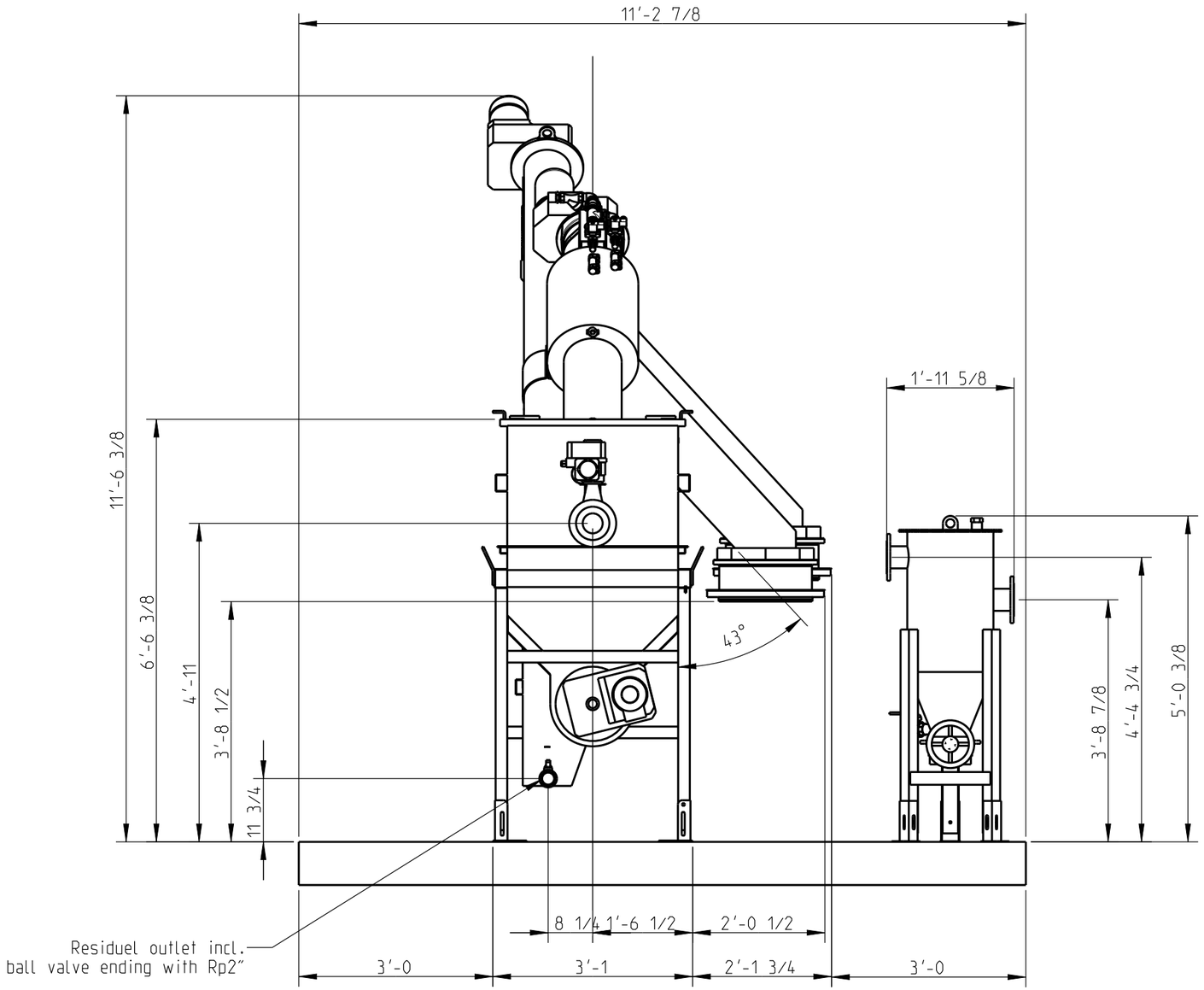
WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

HUBER Sludge Acceptance Plant

ROTAMAT® Ro3.3 Ro1 780/6

| Scale: | Fig. No.: | Installation sketch | Size: |
|---|---|---|---|
| 1:24 | 4/6 | | B |
| Orleans MA | | | Drawing No.: 51346278 |

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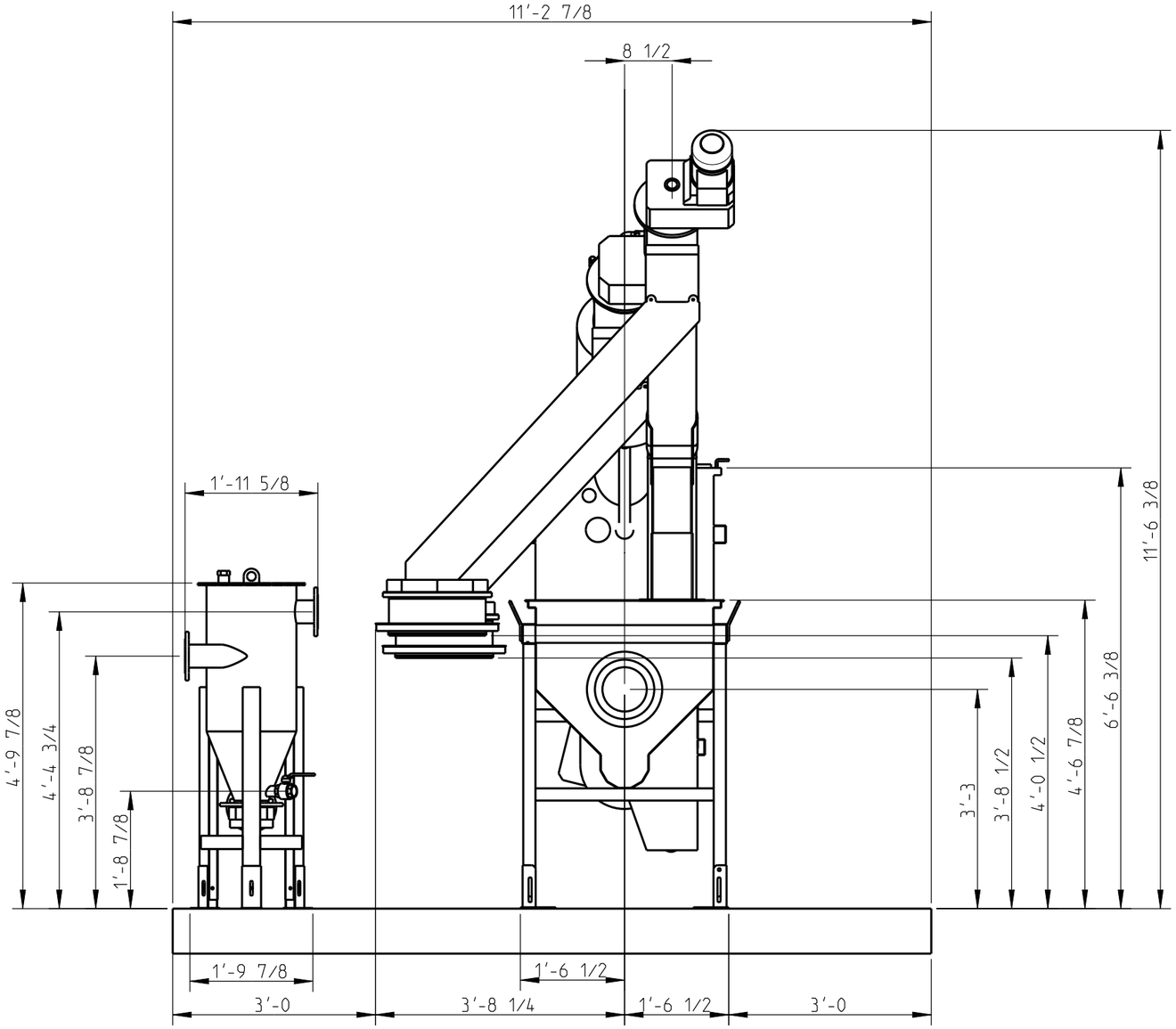
HUBER TECHNOLOGY
WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

HUBER Sludge Acceptance Plant

ROTAMAT® Ro3.3 Ro1 780/6

| Scale: | Fig. No.: | | Size: |
|---|---|---|---|
| 1:24 | 5/6 | Installation sketch | B |
| Orleans MA | | | Drawing No.: 51346278 |

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WASTE WATER Solutions
9735-A Northcross Center Ct. Huntersville, NC

HUBER Sludge Acceptance Plant

ROTAMAT® Ro3.3 Ro1 780/6

| Scale: | Fig. No.: | Installation sketch | Size: |
|---|---|---|---|
| 1:24 | 6/6 | | B |
| Orleans MA | | | Drawing No.: 51346278 |

HUBER TECHNOLOGY
WASTE WATER Solutions

# ROTAMAT® Septage Receiving Stations
# Sludge Screening Equipment

Efficient treatment of septic sludges using the:

- Ro 3.1 Fine Screen with integrated screenings press
- Ro 3.3 Complete Plant with integrated grit trap
- RoFAS Wash Drum

## Huber Technology  Septage Receiving Stations

The complete line of Huber's Septage Receiving Stations are specifically developed for reliable mechanical pre-treatment of septic sludge as well as other sludges such as contents from grease traps.

Septic sludge delivered in tanker trucks will require removal of debris, such as hygienic products and plastic material. Objectives for septage receiving stations are:

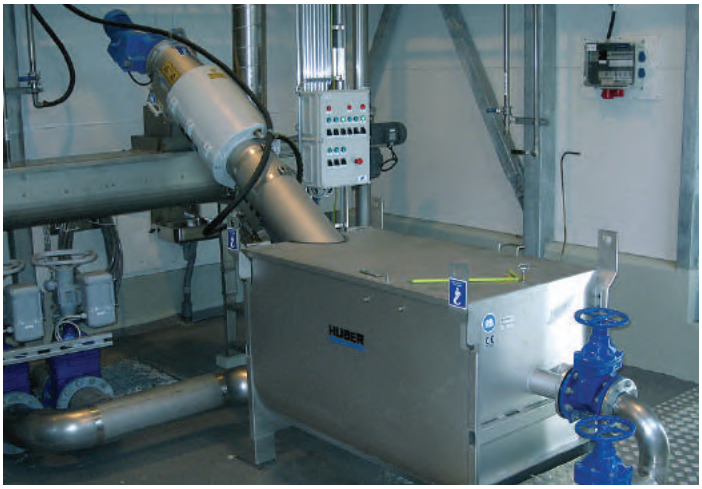
- High capacity to minimize wait times of tanker
- Effective removal of non-degradable material
- Automation to minimize operator attention
- Totally enclosed to provide odor control
- Reliable operation, unimpaired by grit, gravel and grease
- Effective washing and compaction screenings to minimize weight and disposal costs

To meet these objectives Huber Technology has developed these systems.

## ROTAMAT® Ro 3.1 Septage Receiving Station

The Ro 3.1 station is robust and efficient in design providing dependable operation through its entire life cycle.

The heart of our Ro3 series is the ROTAMAT® Ro 1 Cylindrical Bar Screen installed in the tank.



The delivered sludge is fed into the tank. As it flows through the screen, debris and other coarse material are retained. A rake and auger remove the screenings from the screen and pushes them up into and through an auger tube, where the screenings are dewatered and compacted. The integrated screenings press reduces the volume and weight. The compressed screenings are dropped into a container or bagging unit.

An optional screenings washer is available to install prior to dewatering and compaction. The washing will further reduce weight and volume by washing out organics. The wash water is added to the raw wastewater arriving at the treatment. The system is fully enclosed to provide odor control.

## ROTAMAT® Ro 3.3 Sludge Receiving Station with Grit Trap and Grit Classifier

In applications where excessive grit and sand are contained in the septage to be treated, the Ro 3.3 version utilizes an additional integral grit trap that will separate out the grit after screening.

All components are integrated in a single tank providing a compact unit enabling a small footprint.

## ROTAMAT® RoFAS Sludge Receiving Station with Wash Drum

The RoFAS Septage Receiving Station is a severe duty workhorse used for receiving difficult and unpredictable sludge. Its rotating wash drum provides the largest capacity of the series. As the material is conveyed through the slowly rotating perforated drum, sludge drains through its perforations, and the retained solids are conveyed to discharge by robust helical baffles attached to the inside of the drum.

The RoFAS system provides:

- Highest hydraulic and solids capacity
- Simple sturdy design with minimum wear
- Great solids capture due to two-dimensional screening
- Excellent high pressure screenings wash and compaction
- Unimpeded by rags and coarse material

Optional modules available are:

- Ro 6 Grit Trap and Grit Classifier
- WAP Screenings Washer and Compactor

## Port-A-Logics Hauler Station - Identification, metering and data processing

To create a complete integral automated Huber system these septage receiving stations can be equipped with a fully automatic hauler station utilizing Port-A-Logic.

Port-A-Logic is:

- Complete solution for managing transported water and waste. Trucks entering and leaving a restricted area with water or wastewater need additional security and management.
- System utilizing comprehensive features going beyond just access and identification.
- Gathers data about the load while controlling the equipment and valves when the truck is onsite.
- Works with a variety of station applications such as septage receiving, fats-oils-grease (FOG), sludge, and water dispensing.
- Integrate multiple stations and manage them with one software solution.
- Perform customer identification, metering, data recording and data storage as well as invoicing.
- Septage receiving stations can be operated by customers without the need for operator attendance.
- Sludge quality supervision (e.g. by pH measurement) and automatic sample taking can also be incorporated. Such systems either prevent disposal of harmful sludge or record of details of such incidents.


HUBER TECHNOLOGY, Inc.

9735 Northcross Center Court, Suite A - Huntersville, NC 28078
Phone (704) 949-1010 Fax (704) 949-1020
huber@hhusa.net | http://www.huber-technology.com



Subject to technical modification
06 / 03 / 2015

PortALogic
A Product of EleMech, Inc.

# DS-200 Waste Dump Station

## PortALogic Management Software Included

## For Secure Hauler Access

Receiving waste such as septage, fats-oils, grease, and sludge is an essential process in need of critical attention. Managing hauled-in waste irresponsibly could have adverse effects. Without an efficient process in place, it can also be costly. You see firsthand the challenges your facility faces and understand the importance of security, record keeping, and minimizing costs. Ensuring your waste receiving process is successful matters to you and to us.

We are EleMech, we created PortALogic stations to help you manage trucked in waste. Our sole mission with PortALogic is to help facilities manage waste responsibly while decreasing costs through our automated waste receiving stations. Since 2000, facilities have been looking to us to provide stations to meet their unique needs. Get started with us and let us help you meet your goals.

# DS-200

The DS-200 waste dump station is tamper-proof and simple for haulers to use. This station provides secure hauler access by PIN or swipe card. It seamlessly communicates with PortALogic management software.

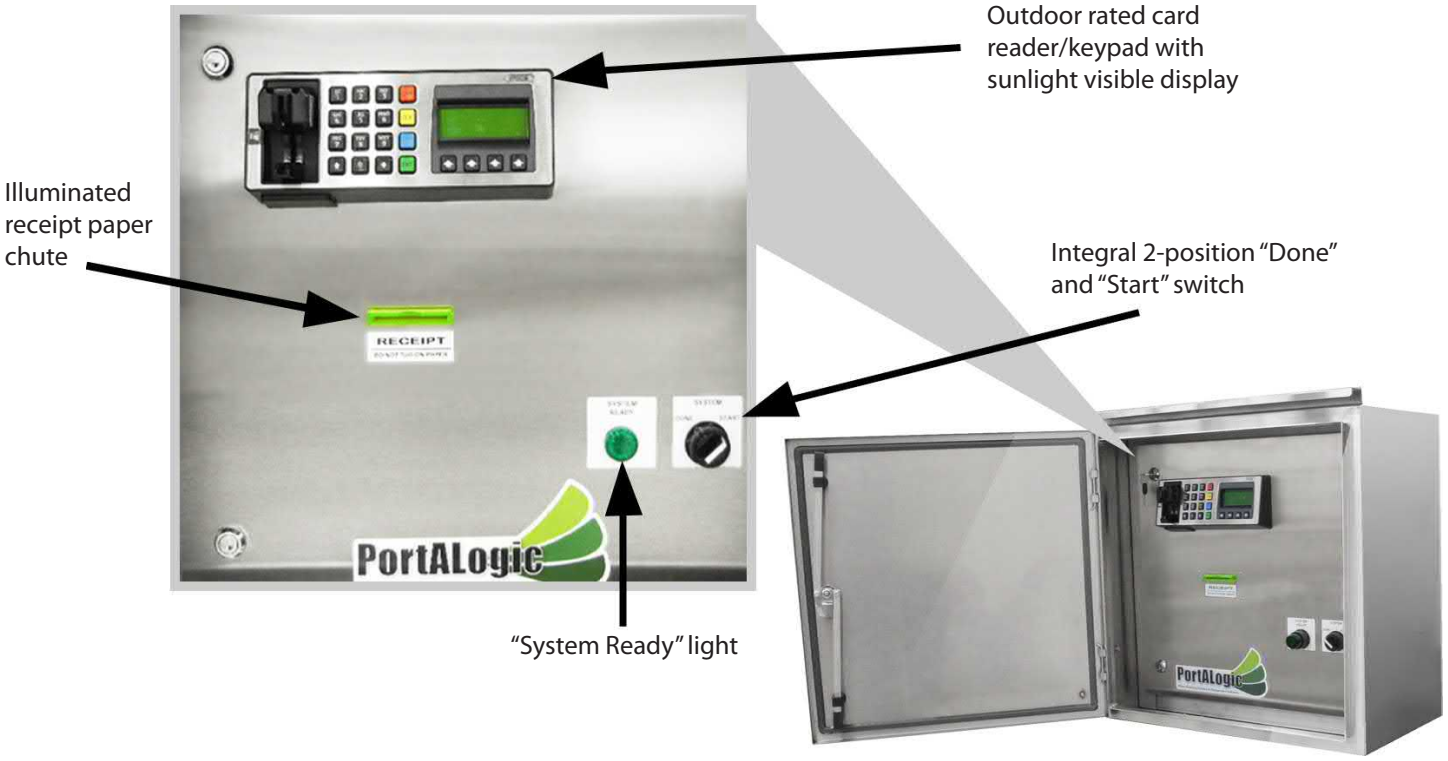
| SPECIFICATIONS | |
|---|---|
| Enclosure | Access door- locking handle, water tight, outdoor rated NEMA 4X, corrosion resistant, stainless steel |
| Hauler Access | Industrial display with card reader and keypad |
| Receipt Printer | Heavy duty kiosk-style printer, illuminated chute, large capacity roll |
| Power | 120VAC, 30 AMP |
| Temperature | Operating temperature range -40°F to 122°F (-40°C to 50°C) |
| Software | Station interfaces with PortALogic management software for record keeping, billing, monitoring, and reporting |
| Certifications | c UL us SA |

| TYPES OF WASTE |
|---|
| Septage |
| Fats-Oils-Grease (FOG) |
| Sludge |
| Frac Water |
| Other Waste |

Warsaw, IN

## WARRANTY

All components furnished in specification are guaranteed for two years from date of shipment. Management software updates and phone support is provided for two years from date of shipment.



## PortALogic Waste Products:

**DS-200**

The DS-200 waste dump station is tamper-proof and simple for haulers to use. This station provides secure hauler access by PIN or swipe card.

**DS-22**

The DS-22 waste dump station is secure and controls the valve. This station includes a pedestal base enclosing an electrically actuated valve.

**DS-25**

The DS-25 waste dump station is secure, controls the valve, and provides metering. This station encloses an electrically actuated valve and flow meter.

**DS-82**

The DS-82 waste dump station is the complete solution for waste receiving. This station encloses an electrically actuated valve, flow meter, sampler, and pH sensor.

PortALogic
A Product of EleMech, Inc.

For more information about PortALogic, please contact an EleMech engineer at 630-499-7080 or visit www.portalogic.info.

EleMech, Inc.
2275 White Oak Circle
Aurora, IL 60502
Office: 630-499-7080
www.portalogic.info
www.elemech.com

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# PortALogic Waste Dump Station - Model DS-200

## OPTIONS

| | |
|---|---|
| Sampler | Refrigerated samplers can be included in the system |
| pH Transmitter | pH monitors can be included in the system |
| Solar Powered | Stations can be powered by solar energy for remote installations |
| Cold Climate Package | Heaters, insulation, and heat tracing can be added to protect the station in cold climates |
| Hot Climate Package | Air conditioners and sunshields can be added to protect the station in hot climates |
| Gate/Door Control | The station can interface with automatic gates and doors if needed |

## HAULER ACCESS STATION OPERATION

| | |
|---|---|
| **1.** | Hauler connects truck to inlet connection |
| **2.** | Hauler turns the switch to "Start" |
| **3.** | Hauler uses wipe card or enters PIN |
| **4.** | Hauler follows display prompts and enters information such as waste type |
| **5.** | Inlet valve opens, "System Ready" light illuminates, and hauler discharges |
| **6.** | Hauler turns the switch to "Done" and a receipt is printed detailing the transaction |

## INSTALLATION

Stations come fully assembled, tested, and ready to install. The station comes with PortALogic management software which can be installed on any number of the facility's PCs.

# Features

**1** **Secure Hauler Login**

- Haulers enter PIN or use swipe card to gain access

**2** **Simple to Use**

- Display guides haulers through process and prompts hauler for information

**3** **Durable and Tamper-Proof**

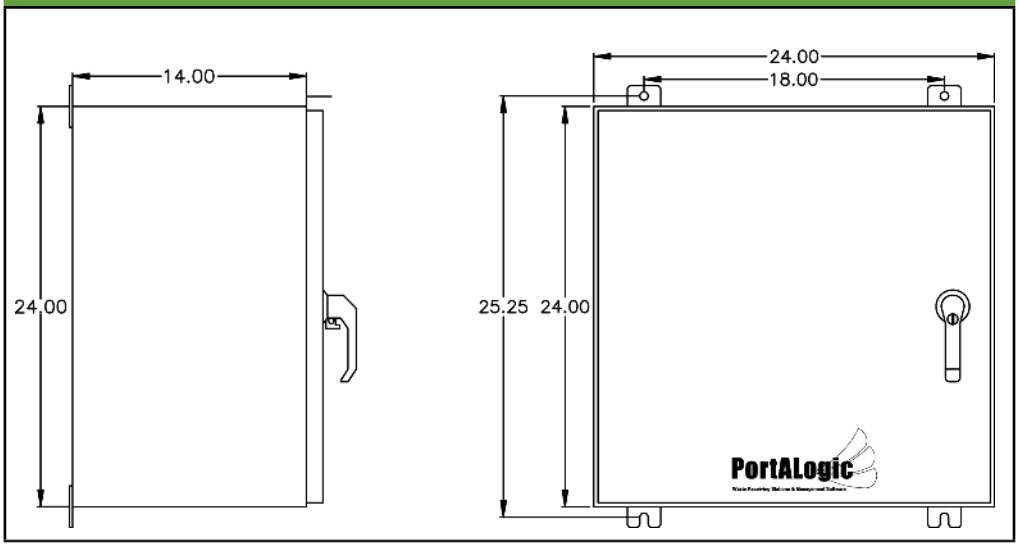
- Stainless steel and built to last
- Lockable doors, tamper-proof card reader/keypad

**4** **Prints Hauler Receipts**

- Once waste is unloaded, a detailed receipt is printed
- Receipts can be emailed too

Grimsby, Ontario

## DIMENSIONS



PortALogic

A Product of EleMech, Inc.

# MANAGEMENT SOFTWARE

## THE POWER BEHIND PORTALOGIC STATIONS

## FOR MANAGING ACCESS, SECURITY, & BILLING

Made in the U.S.A.

## PortALogic was developed specifically for water and waste to automate record keeping. Each time a truck uses your station, the software tracks:

- Date/Time
- Associated Truck Account
- Pickup/Delivery Sites
- Water or Waste Type
- Alarms Triggered (if any)
- Cost
- Volume
- pH (if applicable)
- Receipt number

## Specifications

| | |
|---|---|
| **System** | Web-based Software created for Windows® 7 and Windows® 8<br>1.5 GHz Processor, 2 GB RAM<br>250 GB of available hard disk space |
| **Data Storage** | Data is automatically uploaded into a secure SQL database<br>Data is easily backed-up and restored |
| **Users** | Unlimited number of software users |
| **Networking** | Ethernet, cell modem, or WiFi connection to provide real-time access to data |
| **Development** | Designed and developed by EleMech, Inc. in Aurora, IL. |
| **Integration** | Included with station purchase, this water and waste management software seamlessly communicates with one or more PortALogic Water or Waste Stations and stores the data into one centralized database |
| **Reports** | 10 available preformatted reports including activity reports, customer billing statements, and revenue reports. Reports can be exported as a PDF, into Excel, or accounting software. |
| **Applications** | Water: reuse water, hydrant water, potable water, and frac water<br>Waste: septage, fats-oils-grease (FOG), and sludge |

## Features

- View station usage in real-time
- Create truck accounts
- Enable/disable hauler access privileges
- Establish water/waste type rates
- View account balances and add payments
- Set up prepaid or pay-as-you-go truck accounts
- Add hauler emails so reciepts can be automatically emailed
- Store lab data for each load (if applicable)
- Generate activity reports, revenue reports, and customer billing statements

## For Every Department

### Administrators
Manage accounts & monitor stations

### Accountants
Extract data and generate reports

### Lab Personnel
Enter sample information

## With PortALogic You Can Managing Stations From Your Office

### Ease of Use
Clean comprehensive interface allows facility staff to be trained on the system in less than one day.

### User Privileges
Assign software user privileges to office staff. Levels of access include Read Only, Read/Write, and Admin.

### Communication
Network connection between stations and office computers via Ethernet, cell modem, or WiFi.

**EleMech, Inc**
**2275 White Oak Circle**
**Aurora, IL 60502**
**Phone: +1 630-499-7080**
**www.portalogic.info**

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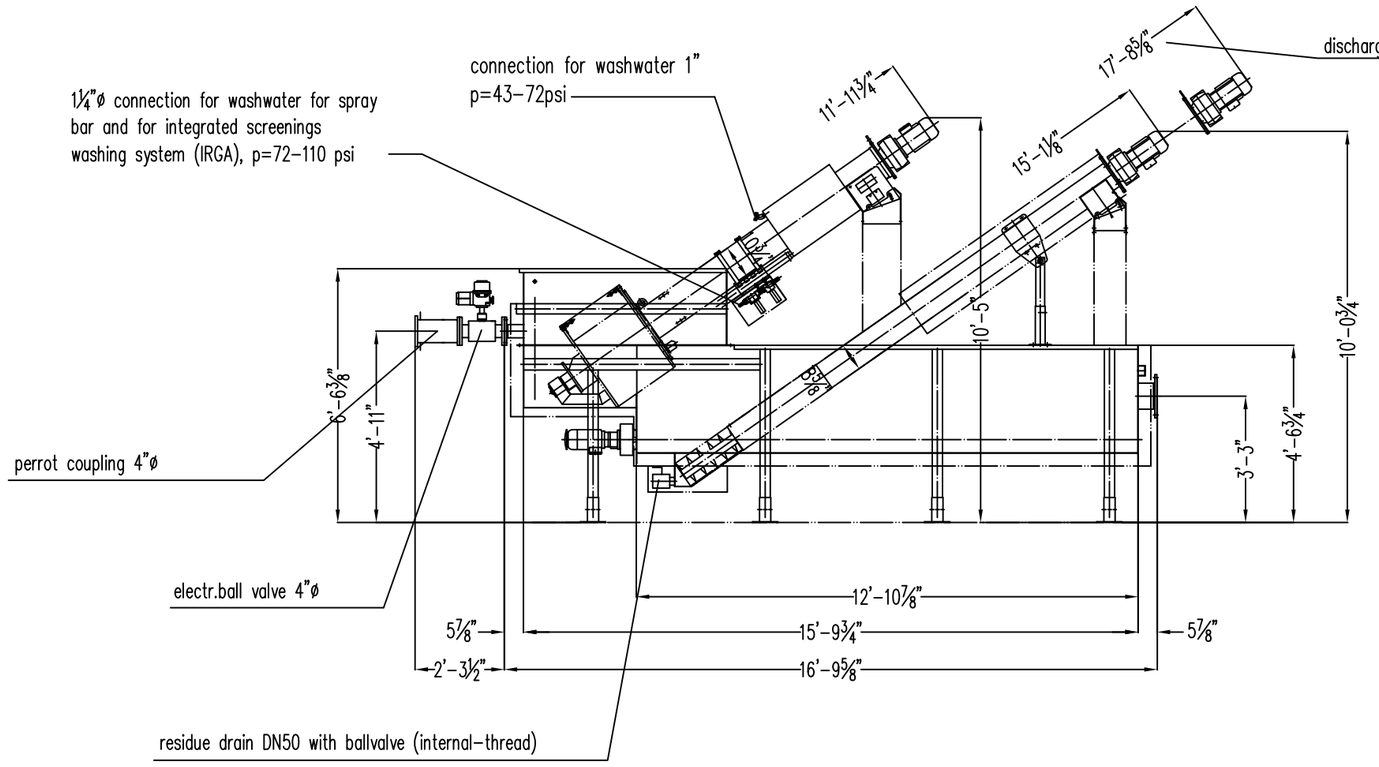
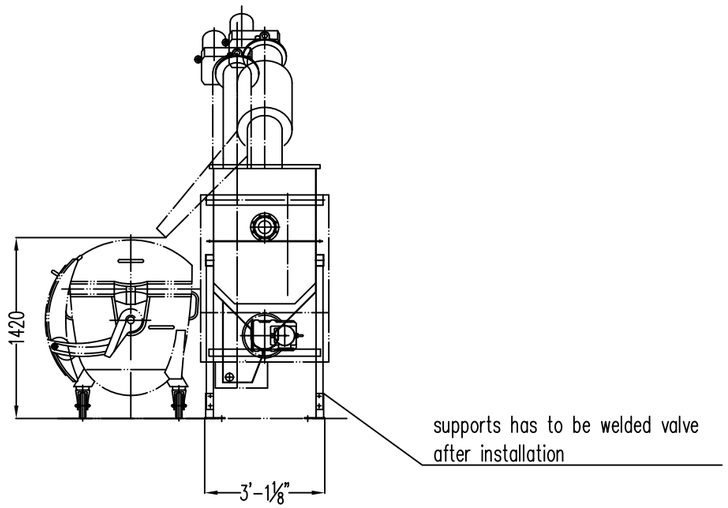
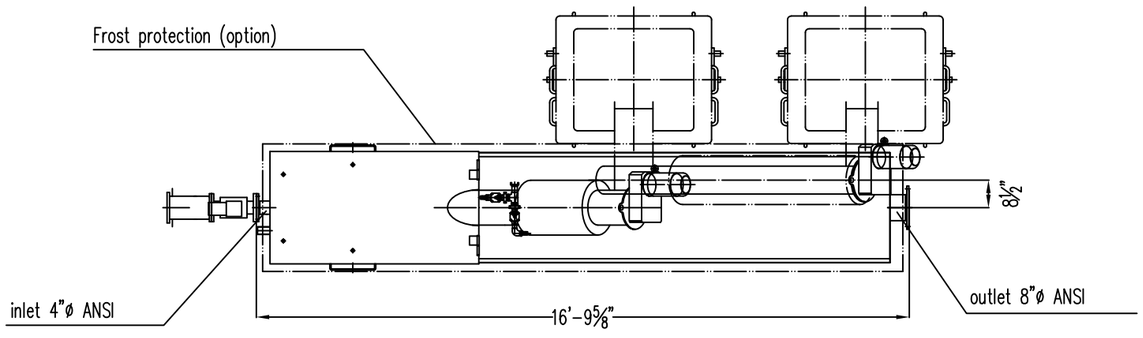
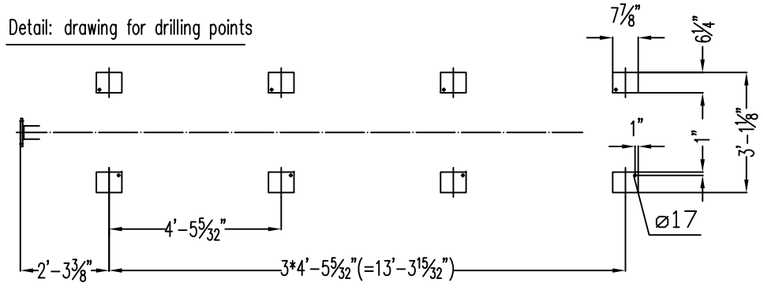



Qmax 100m /h$^3$
measured in mm

free drain of the tank must be guarantee!

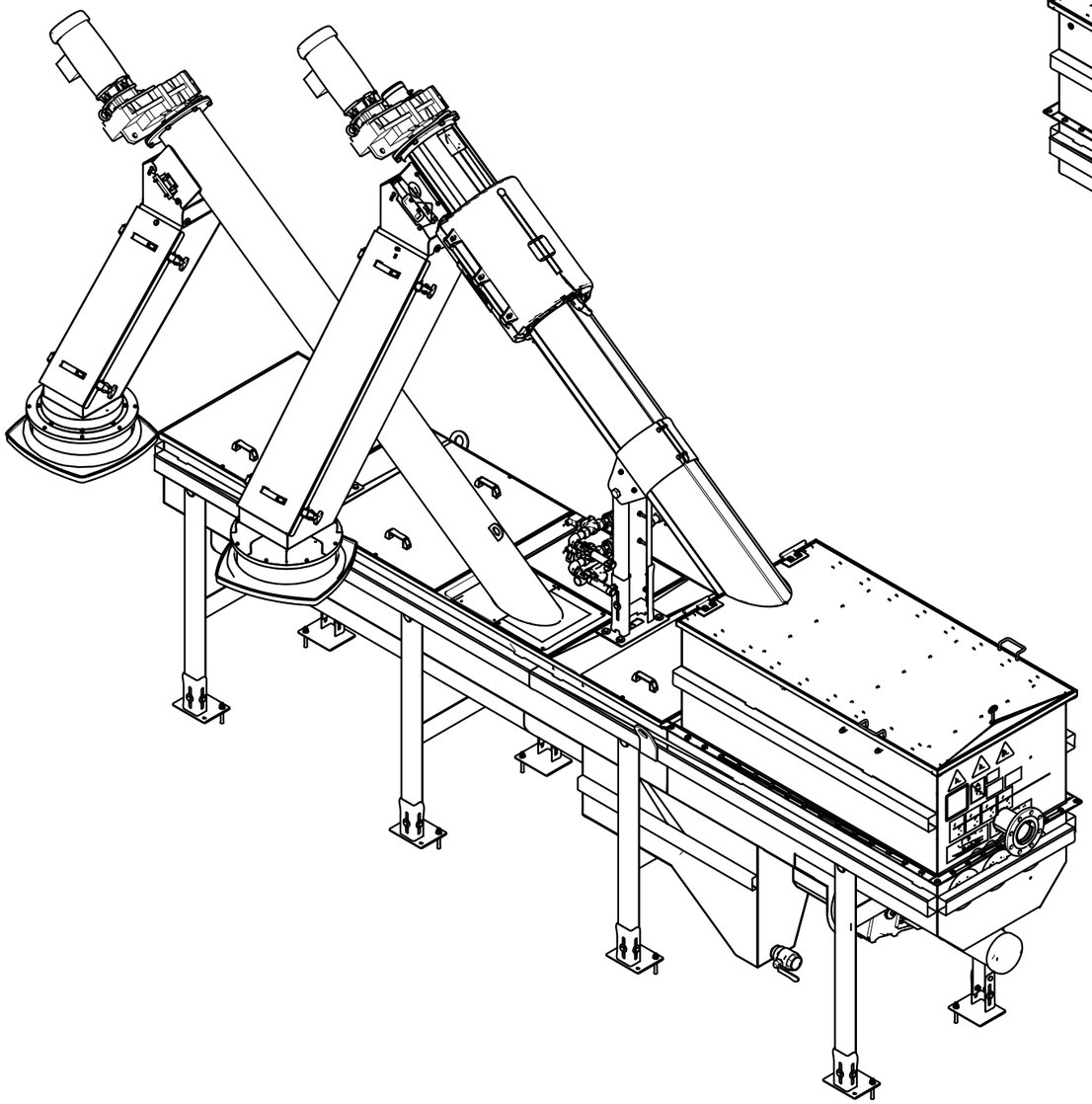
accident prevention acc. GUV and machine directives (railings, maintenance platforms, guards, etc...)
Or country specific regulations on site!

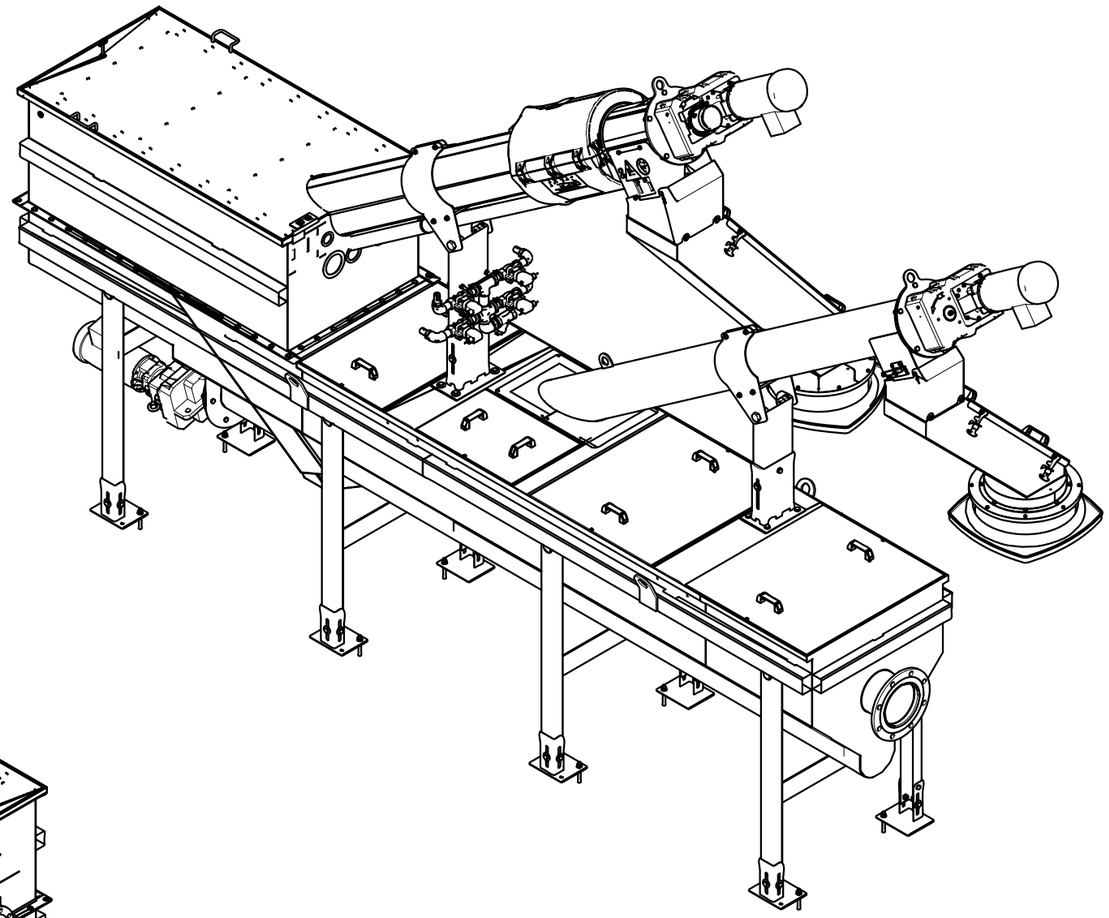
Dimensions are for reference only!
For binding dimensions please refer to the final installation drawings

HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@huber-technology.com

ROTAMAT® Sludge Acceptance Plant
Compact, Ro 3.3, with Ro1 / 780

| Fig No. | | Scale: |
|---|---|---|
| 1/1 | Dimensional Sheet | 1/4" = 1'–0" |
| Project No. | | Dwg No. Ro3.3 w_sand trap_Ro1 780.dwg |





NOTE:
- before starting installation read the O&M manual carefully and follow the instructions strictly
- position of the machine according to the installation drawing

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Technische Aenderungen vorbehalten / Subject to change

ISO 2768-mK

HUBER TECHNOLOGY
D-92334 Berching / Tel.: +49-8462-201-0

| Revision | Aenderung Modified | Tag Date | Name |
|---|---|---|---|
| - | - | - | - |

| | Datum/Date | Name |
|---|---|---|
| Bear./Rev. | 15.07.2015 | kb |
| Gepr./Appr. | " | " |
| Norm. | | |

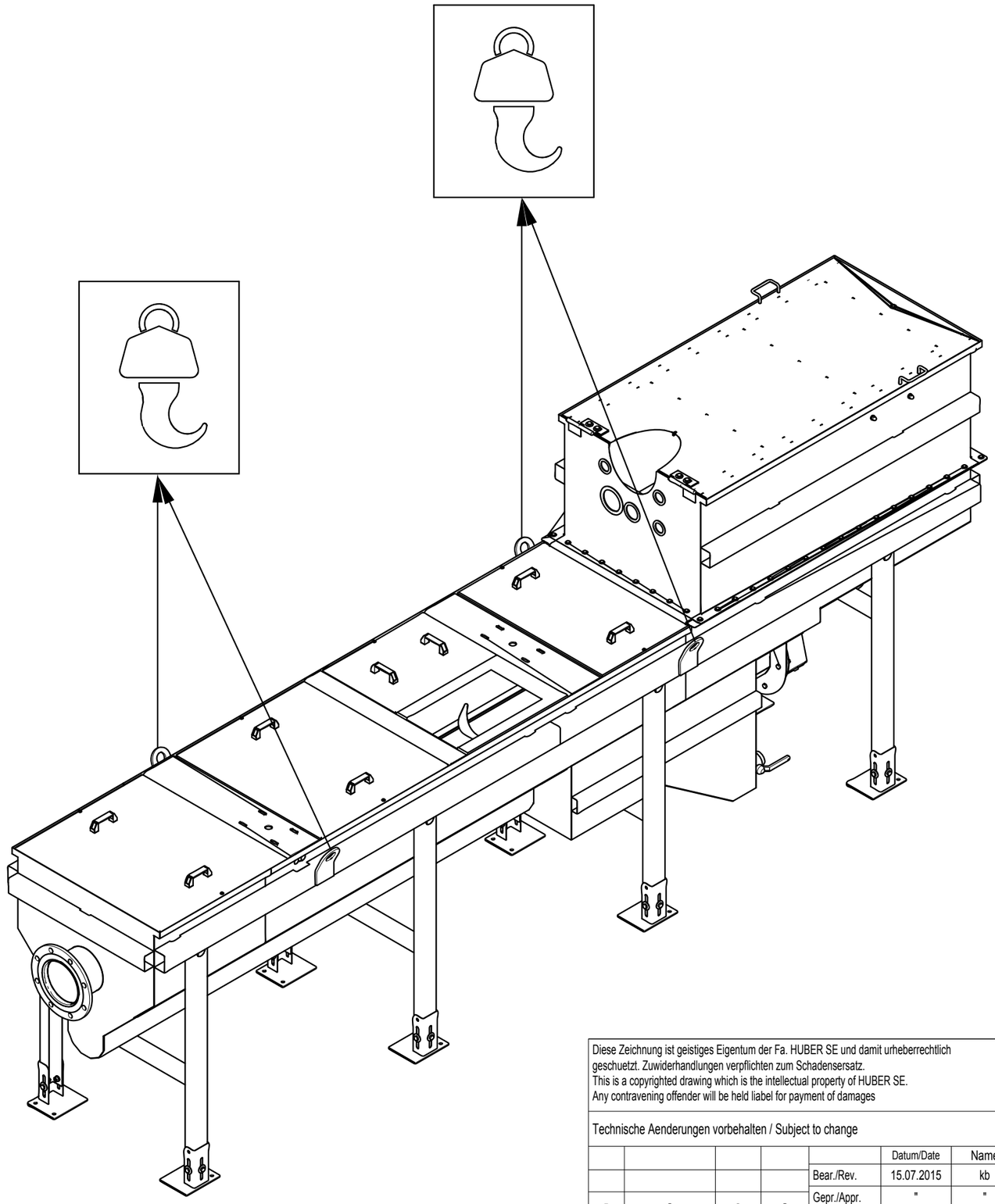
Massstab/Scale: 1: -

Installation Illustration

Ro3.3 incl. Ro1 780/6

Projektbez.:
Project Name:

| Stand.-Art.-Code Standard Item Code | Familie Family | Projekt Project | Art.-Code Item Code | Blatt Sheet |
|---|---|---|---|---|
| | | | 10058339_illu1 | 1/1 |



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|---|---|---|---|
| - | - | - | - |

| | Datum/Date | Name |
|---|---|---|
| Bear./Rev. | 15.07.2015 | kb |
| Gepr./Appr. | " | " |
| Norm. | | |

Massstab/Scale: 1: -

# Installation Illustration

## Ro3.3 incl. Ro1 780/6

Projektbez.:
Project Name:

| Stand.-Art.-Code Standard Item Code | Familie Family | | | Projekt Project | Art.-Code Item Code | Blatt Sheet |
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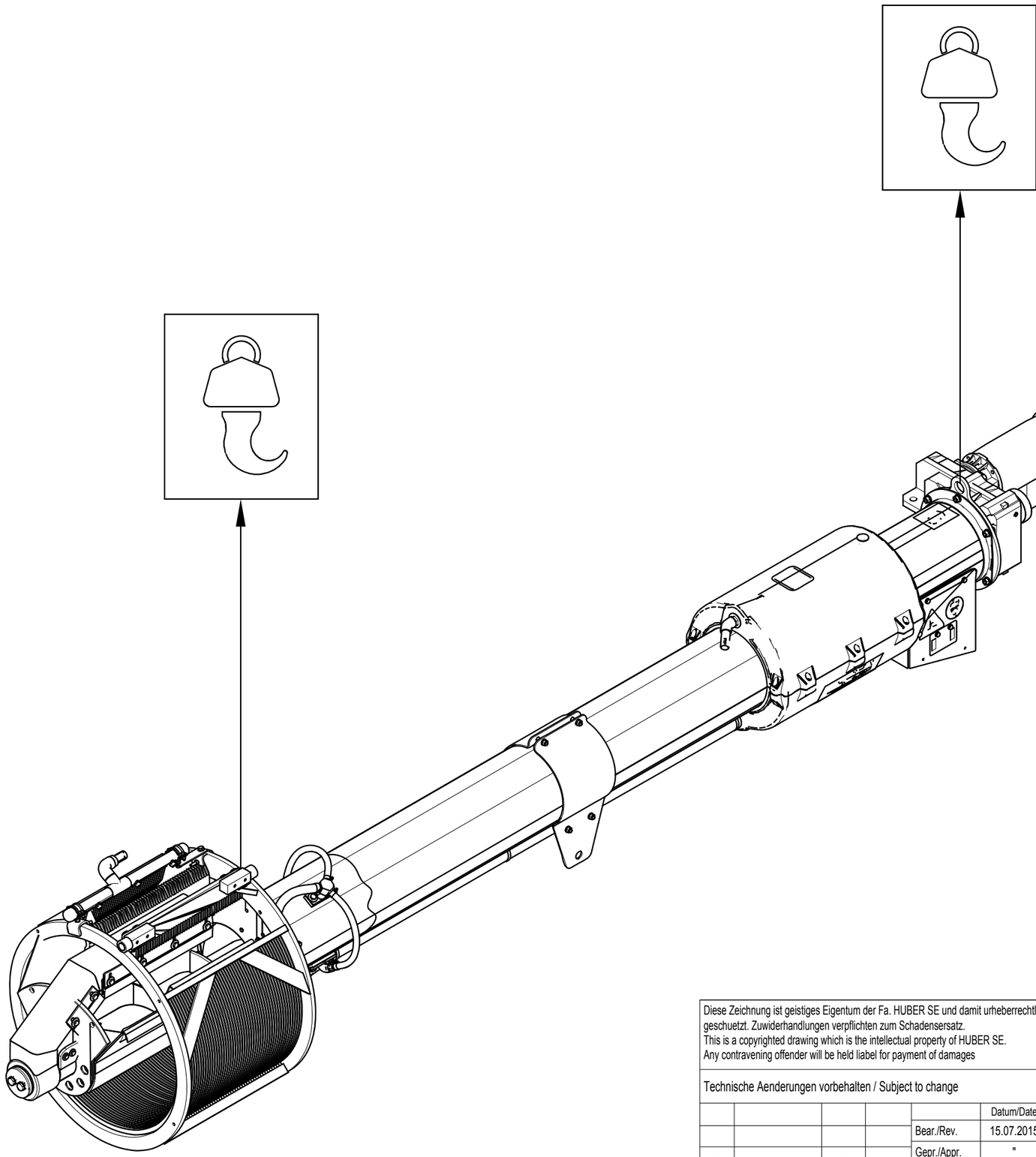
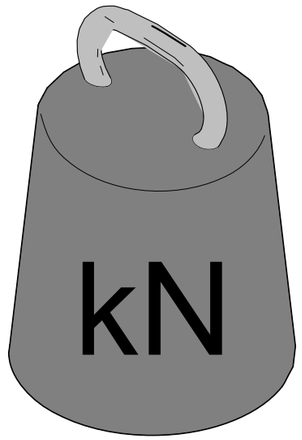
| | | | | | 10058339_illu2 | 1/1 |



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| Revision | Aenderung Modified | Tag Date | Name |
|---|---|---|---|
| - | - | - | - |

| | Datum/Date | Name |
|---|---|---|
| Bear./Rev. | 15.07.2015 | kb |
| Gepr./Appr. | " | " |
| Norm. | | |

Massstab/Scale: 1: -

# Installation Illustration

## Ro3.3 incl. Ro1 780/6

Projektbez.:
Project Name:

| Stand.-Art.-Code Standard Item Code | Familie Family | | | Projekt Project | Art.-Code Item Code | Blatt Sheet |
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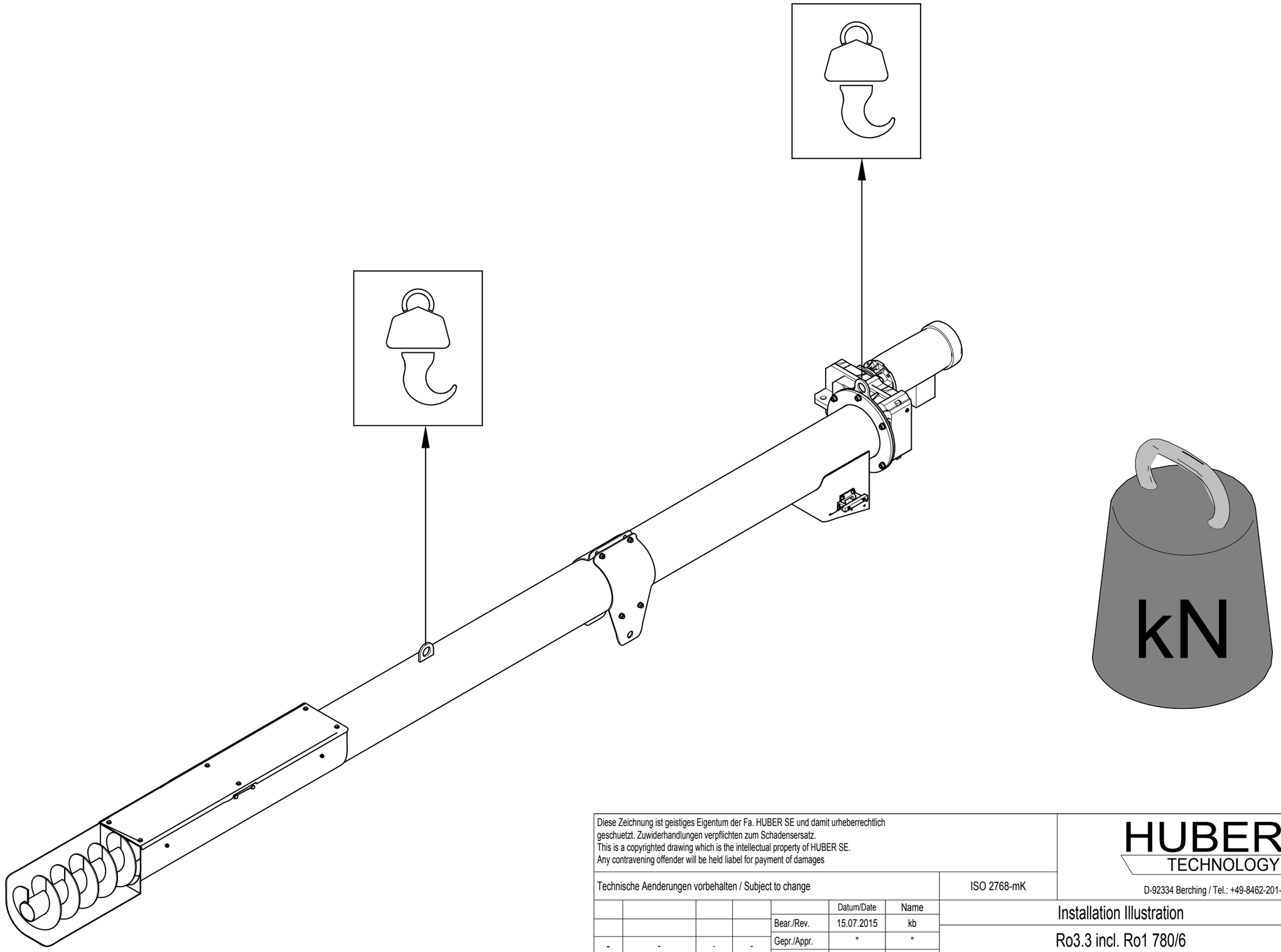




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| Revision | Aenderung Modified | Tag Date | Name |
|---|---|---|---|
| - | - | - | - |

| | Datum/Date | Name |
|---|---|---|
| Bear./Rev. | 15.07.2015 | kb |
| Gepr./Appr. | " | " |
| Norm. | | |

Massstab/Scale: 1: -

# Installation Illustration

## Ro3.3 incl. Ro1 780/6

Projektbez.:
Project Name:

| Stand.-Art.-Code Standard Item Code | Familie Family | | | Projekt Project | Art.-Code Item Code | Blatt Sheet |
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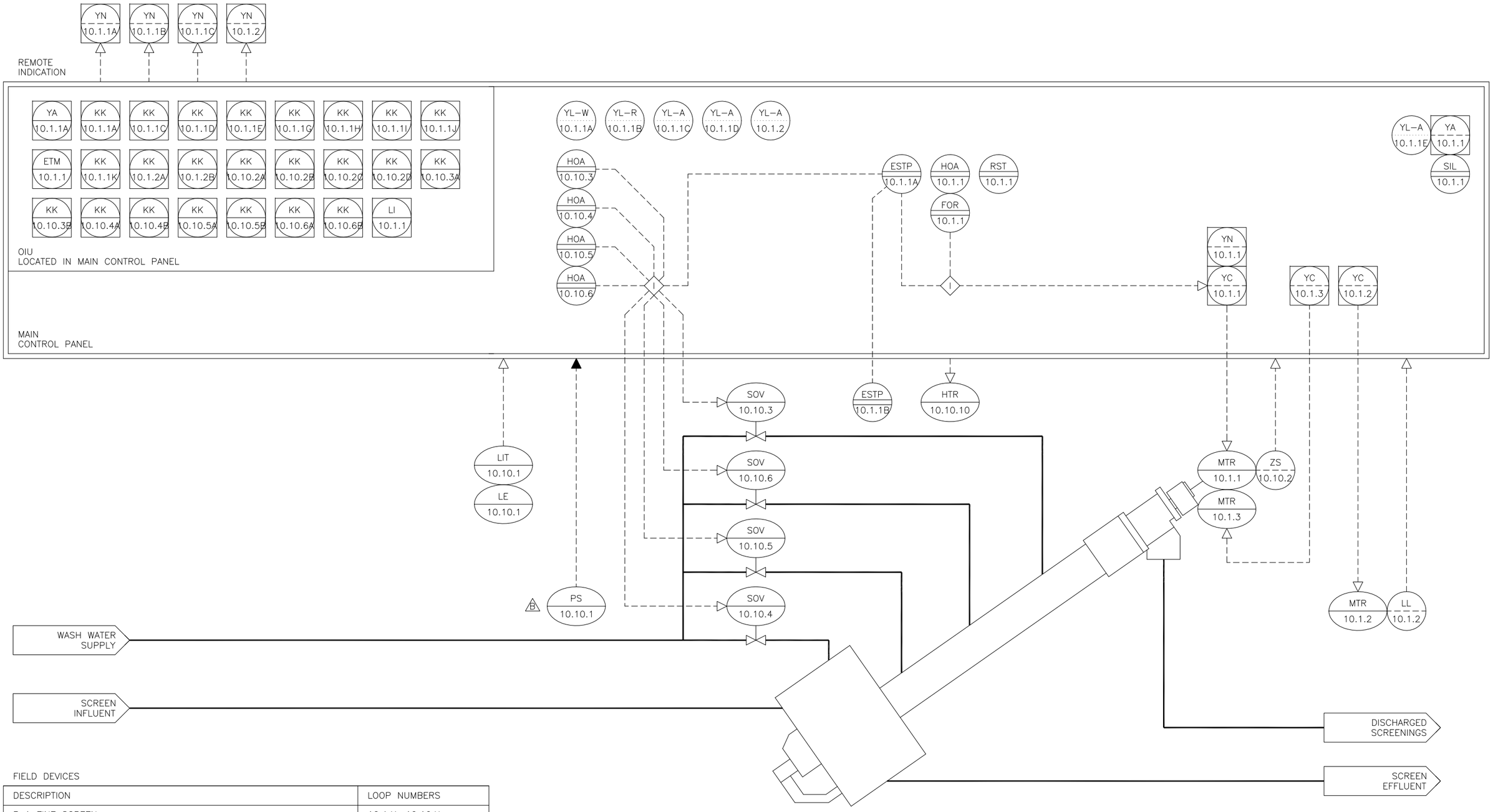


FIELD DEVICES

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro1 FINE SCREEN INSTRUMENTATION AND LOOP DIAGRAM | 10.1.X, 10.10.X |

NOTES:
1. SYMBOLS AND DESCRIPTIONS USED ARE THOSE PUBLISHED IN THE INSTRUMENT SOCIETY OF AMERICA, ISA. PLEASE REFER TO THEIR PUBLICATIONS FOR FURTHER DETAIL.
2. THESE DETAILS ARE BASED ON TYPICAL INSTALLATIONS, AND ARE SUBJECT TO CHANGE BASED ON SPECIFIC PROJECT REQUIREMENTS.

| DATE | REVISION | NO. | BY | CK | APP |
|---|---|---|---|---|---|
| 06/01/10 | UPDATED BORDER INFORMATION | A | SAL | CCC | |
| 02/12/11 | VFD STANDARD AND ADDED PRESSURE SENSOR FOR TANK UNITS | B | MSN | CCC | |
| 08/04/11 | LUBE PUMP OPERATION | C | NOM | CCC | |
| 08/10/12 | ADDED MOTOR THERMOSTAT SEQUENCE NOTES | D | BMG | CCC | |

DESIGNED CCC
DETAILED
CHECKED ALS
APPROVED
DATE 05/01/09


HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
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info@hhusa.net


Ro1 – FINE SCREEN
TYPICAL PID DIAGRAM

OIU DETAIL

SCALE: NONE

PROJECT NUMBER:

DRAWING NO: RO1_PIDA1
SHEET 1 OF 3

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| ESTP 10.1.1A | PUSHBUTTON – PANEL MOUNTED EMERGENCY STOP MUSHROOM HEAD, PUSH–PULL TYPE | PROVIDES OPERATOR WITH PROVISION TO STOP ALL MOTORS AND SOLENOIDS IN THE EVENT OF AN EMERGENCY |
| ESTP 10.1.1B ** | PUSHBUTTON – FIELD MOUNTED EMERGENCY STOP MUSHROOM HEAD, PUSH–PULL TYPE | PROVIDES OPERATOR WITH PROVISION TO STOP ALL MOTORS AND SOLENOIDS IN THE EVENT OF AN EMERGENCY |
| FOR 10.1.1 | SELECTOR SWITCH SCREEN FOR–OFF–REV FOR CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT FORWARD, OFF, OR REVERSE WHILE OPERATING THE SCREEN IN HAND |
| HOA 10.1.1 | SELECTOR SWITCH SCREEN HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HOA 10.10.3 | SELECTOR SWITCH PRESS ZONE WASH HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HOA 10.10.4 ** | SELECTOR SWITCH SPRAY BAR HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO NOT AVAILABLE ON TANK MOUNTED UNITS |
| HOA 10.10.4 ** | SELECTOR SWITCH TANK WASH HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO ONLY AVAILABLE ON TANK MOUNTED UNITS |
| HOA 10.10.5 | SELECTOR SWITCH WASH NO.1 HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HOA 10.10.6 ** | SELECTOR SWITCH WASH NO.2 HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HTR 10.10.10 ** | HEATER SCREEN HEAT TRACING 600 WATTS MAX | PROVIDES SCREEN WITH FROST PROTECTION INCLUDES PANEL MOUNTED OR FIELD MOUNTED THERMOSTAT |
| B LE 10.10.1 ** | CHANNEL SCREENS ULTRASONIC LEVEL TRANSMITTER SEE PS 10.10.1 FOR TANK UNITS | LEVEL ELEMENT PART OF MILLTRONICS POINTEK – STANDARD REQUIRED FOR CHANNEL MOUNTED SCREENS |
| B LIT 10.10.1 ** | CHANNEL SCREENS ULTRASONIC LEVEL TRANSMITTER SEE PS 10.10.1 FOR TANK UNITS | PROVIDES START AND HIGH LEVEL SIGNALS STANDARD SENSOR: MILLTRONICS POINTEK REQUIRED FOR CHANNEL MOUNTED SCREENS |
| LL 10.1.2 ** | LEVEL INDICATOR LOW GREASE LEVEL | PROVIDES LOW GREASE LEVEL INDICATION TO MAIN CONTROL PANEL |
| MTR 10.1.1 | SCREEN DRIVE MOTOR | |
| MTR 10.1.2 ** | SCREEN LUBRICATION PUMP | |
| MTR 10.1.3 ** | SCREEN BRAKE MOTOR | |
| B PS 10.10.1 ** | PRESSURE SENSOR LIQUID LEVEL PRESSURE SENSOR SEE LIT 10.10.1 FOR CHANNEL UNITS | DETERMINES THE CURRENT LIQUID LEVEL STANDARD RANGE: 0–2PSI REQUIRED FOR TANK MOUNTED SCREENS |
| RST 10.1.1 | PUSHBUTTON SYSTEM RESET FLUSH HEAD, MOMENTARY | PROVIDES OPERATOR WITH PROVISION TO RESET SYSTEM FAULTS |
| SIL 10.1.1 ** | PUSHBUTTON ALARM SILENCE EXTENDED HEAD, MOMENTARY | PROVIDES OPERATOR WITH PROVISION TO SILENCE AN ALARM ONCE THE ALARM HORN SOUNDS |
| SOV 10.10.3 | SOLENOID VALVE PRESS ZONE | PROVIDES WASH WATER TO PRESS ZONE OF THE SCREEN |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro1 FINE SCREEN INSTRUMENTATION AND LOOP DIAGRAM | 10.1.X, 10.10.X |

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| SOV 10.10.4 ** | SOLENOID VALVE SPRAY BAR WASH | PROVIDES WASH WATER TO CLEANING RAKE NOT AVAILABLE ON TANK MOUNTED UNITS |
| SOV 10.10.4 ** | SOLENOID VALVE TANK WASH | PROVIDES WASH WATER TO CLEAN TANK ONLY AVAILABLE ON TANK MOUNTED UNITS |
| SOV 10.10.5 | SOLENOID VALVE WASH NO.1 | PROVIDES WASH WATER TO WASH ZONE NO.1 |
| SOV 10.10.6 ** | SOLENOID VALVE WASH NO.2 | PROVIDES WASH WATER TO THE WASH ZONE NO.2 TYPICALLY USED ON LARGER SCREENS |
| YA 10.1.1 ** | HORN COMMON ALARM HORN | PROVIDES AUDIBLE INDICATION OF SYSTEM FAULT |
| B YC 10.1.1 | SCREEN CALL TO RUN VARIABLE FREQUENCY DRIVE | PROVIDES SCREEN WITH CALL FORWARD AND CALL REVERSE COMMANDS |
| YC 10.1.2 ** | LUBE PUMP CALL TO RUN 120VAC SIGNAL NO MOTOR STARTER | PROVIDES LUBE PUMP WITH CALL TO RUN SIGNAL |
| YC 10.1.3 ** | SCREEN BRAKE CALL TO RUN 120VAC SIGNAL NO MOTOR STARTER | PROVIDES SCREEN BRAKE WITH CALL TO RUN SIGNAL |
| YL–W 10.1.1A | INDICATOR LIGHT – WHITE CONTROL POWER ON | PROVIDES OPERATOR INDICATION THAT CONTROL POWER IS PRESENT AND ALL SAFTEY INTERLOCKS ARE ENABLED |
| YL–R 10.1.1B | INDICATOR LIGHT – RED SCREEN RUNNING | PROVIDES OPERATOR INDICATION THAT THE SCREEN IS RUNNING |
| YL–A 10.1.1C | INDICATOR LIGHT – AMBER SCREEN OVERLOAD | PROVIDES OPERATOR INDICATION THAT THE SCREEN HAS SHUTDOWN DUE TO AN OVERLOAD |
| YL–A 10.1.1D ** | INDICATOR LIGHT – AMBER HIGH LEVEL | PROVIDES OPERATOR INDICATION THAT THE LEVEL OF MATERIAL IN THE SCREEN IS ABOVE THE HIGH LEVEL SETPOINT |
| YL–A 10.1.1E ** | INDICATION BEACON – AMBER COMMON ALARM | PROVIDES OPERATOR INDICATION OF A SYSTEM FAULT |
| YL–A 10.1.2 ** | INDICATOR LIGHT – AMBER LOW GREASE LEVEL | PROVIDES OPERATOR INDICATION THAT GREASE LEVEL IN THE LUBE PUMP IS LOW |
| B YN 10.1.1 | CURRENT MONITOR SCREEN HIGH CURRENT | PROVIDES SCREEN OVERLOAD PROTECTION PROVIDED BY VFD |
| YN 10.1.1A | REMOTE INDICATION SCREEN RUNNING | PROVIDE REMOTE INDICATION THAT SCREEN IS RUNNING TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 10.1.1B | REMOTE INDICATION SCREEN OVERLOAD | PROVIDE REMOTE INDICATION THAT SCREEN IS OVERLOADED TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 10.1.1C | REMOTE INDICATION HIGH LEVEL | PROVIDE REMOTE INDICATION THAT SCREEN HAS HIGH LEVEL TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 10.1.2 ** | REMOTE INDICATION LOW GREASE LEVEL | PROVIDE REMOTE INDICATION THAT LUBE PUMP IS LOW ON GREASE TYPICALLY 120VAC, 5AMP DRY CONTACT |
| ZS 10.10.2 | PROXIMITY SWITCH SCREEN HOME SWITCH | DETERMINES THE HOME POSITION OF THE RAKE |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro1 FINE SCREEN INSTRUMENTATION AND LOOP DIAGRAM | 10.1.X, 10.10.X |

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| ETM 10.1.1 | ELAPSED TIMER METER SCREEN RUN TIME | PROVIDES OPERATOR TOTALIZED MOTOR RUN TIME ACCESSIBLE THROUGH OIU |
| LI 10.1.1 ** | LEVEL INDICATION TANK LEVEL | PROVIDES OPERATOR INDICATION OF CURRENT TANK LEVEL ACCESSIBLE THROUGH OIU |
| YA 10.1.1A | ALARM INDICATION SCREEN ALARM | PROVIDES OPERATOR DISCRIPTION OF CURRENT SYSTEM FAULT ACCESSIBLE THROUGH OIU |
| KK 10.1.1A | SETPOINT SCREEN – DIR. CHANGE DWELL TIMER SETPOINT: 2 SEC, RANGE: 1–10 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1C | SETPOINT SCREEN – START LEVEL ON DELAY SETPOINT: 5 SEC, RANGE: 1–10 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1D | SETPOINT SCREEN – OFF DELAY SETPOINT: 5 SEC, RANGE: 5–120 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1E | SETPOINT SCREEN – CLEANING RAKE REV RUN TIME SETPOINT: 60 HUNDREDTHS, RANGE: 1–400 | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1G | SETPOINT SCREEN – PROX SWITCH FAULT TIMER SETPOINT: 15 SEC, RANGE: 1–60 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1H | SETPOINT SCREEN – REPEAT CYCLE OFF TIME SETPOINT: 60 MIN, RANGE: 1–999 MIN | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1I | SETPOINT SCREEN – PASSES BEFORE CLEANING RAKE SETPOINT: 3, RANGE: 1–10 | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1J | SETPOINT SCREEN – ATTEMPTS TO CLEAR FAULT SETPOINT: 1, RANGE: 1–5 | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.1.1K | SETPOINT SCREEN – REVERSE RUN TIME SETPOINT: 1 SEC, RANGE: 1–15 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| B KK 10.10.2A ** | SETPOINT PRESSURE SENSOR – START LEVEL SETPOINT: 10 IN, RANGE: 1–200 IN | SETPOINT ACCESSIBLE THROUGH OIU FOR TANK MOUNTED SCREENS ONLY |
| B KK 10.10.2B ** | SETPOINT PRESSURE SENSOR – HIGH LEVEL SETPOINT: 20 IN, RANGE: 1–200 IN | SETPOINT ACCESSIBLE THROUGH OIU FOR TANK MOUNTED SCREENS ONLY |
| B KK 10.10.2C ** | SETPOINT PRESSURE SENSOR – 4mA SCALING SETPOINT: 0 IN, RANGE: 0–200 IN | SETPOINT ACCESSIBLE THROUGH OIU FOR TANK MOUNTED SCREENS ONLY |
| B KK 10.10.2D ** | SETPOINT PRESSURE SENSOR – 20mA SCALING SETPOINT: 138, RANGE: 0–200 | SETPOINT ACCESSIBLE THROUGH OIU FOR TANK MOUNTED SCREENS ONLY |
| KK 10.10.3A | SETPOINT PRESS ZONE WASH – REPEAT CYCLE ON TIME SETPOINT: 30 SEC, RANGE: 1–300 SEC | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.10.3B | SETPOINT PRESS ZONE WASH – REPEAT CYCLE OFF TIME SETPOINT: 6 HOURS, RANGE: 1–24 HOURS | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.10.4A ** | SETPOINT TANK WASH – REPEAT CYCLE OFF TIME SETPOINT: 6 HOURS, RANGE: 1–24 HOURS | SETPOINT ACCESSIBLE THROUGH OIU |
| KK 10.10.4B ** | SETPOINT TANK WASH – REPEAT CYCLE ON TIME SETPOINT: 30 SEC, RANGE: 1–300 SEC | SETPOINT ACCESSIBLE THROUGH OIU |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro1 FINE SCREEN INSTRUMENTATION AND LOOP DIAGRAM | 10.1.X, 10.10.X |

NOTES:
1. SYMBOLS AND DESCRIPTIONS USED ARE THOSE PUBLISHED IN THE INSTRUMENT SOCIETY OF AMERICA, ISA. PLEASE REFER TO THEIR PUBLICATIONS FOR FURTHER DETAIL.
2. THESE DETAILS ARE BASED ON TYPICAL INSTALLATIONS, AND ARE SUBJECT TO CHANGE BASED ON SPECIFIC PROJECT REQUIREMENTS.
3. * DEVICES THAT MAY BE REMOVED FROM CONTROL PANEL DOOR AND MOUNTED NEAR EQUIPMENT IN A LCS.
4. ** INDICATES OPTIONAL ITEM OR OPTIONAL UPGRADE.

| DATE | REVISION | NO. | BY | CK | APP |
|---|---|---|---|---|---|
| 06/01/10 | UPDATED BORDER INFORMATION | A | SAL | CCC | |
| 02/12/11 | VFD STANDARD AND ADDED PRESSURE SENSOR FOR TANK UNITS | B | MSN | CCC | |
| 08/04/11 | LUBE PUMP OPERATION | C | NOM | CCC | |
| 08/10/12 | ADDED MOTOR THERMOSTAT SEQUENCE NOTES | D | BMG | CCC | |

DESIGNED CCC
DETAILED
CHECKED ALS
APPROVED
DATE 05/01/09

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9735 NorthCross Center Court, Suite A
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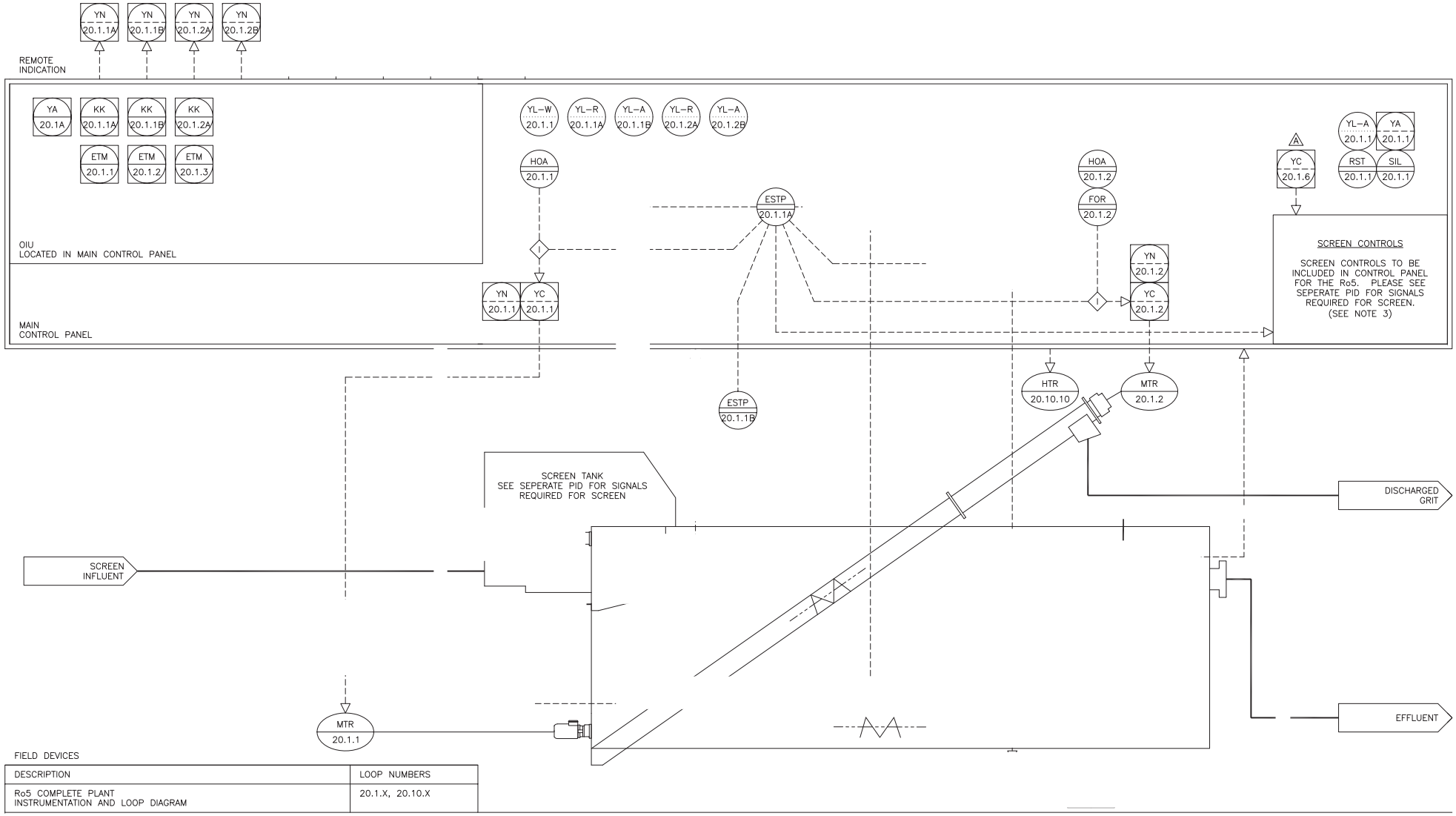
Ro1 – FINE SCREEN
TYPICAL PID DIAGRAM

OIU DETAIL

SCALE: NONE

PROJECT NUMBER:

DRAWING NO: R01_PIDA2




FIELD DEVICES

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro5 COMPLETE PLANT INSTRUMENTATION AND LOOP DIAGRAM | 20.1.X, 20.10.X |

NOTES:
1. SYMBOLS AND DESCRIPTIONS USED ARE THOSE PUBLISHED IN THE INSTRUMENT SOCIETY OF AMERICA, ISA. PLEASE REFER TO THEIR PUBLICATIONS FOR FURTHER DETAIL.
2. THESE DETAILS ARE BASED ON TYPICAL INSTALLATIONS, AND ARE SUBJECT TO CHANGE BASED ON SPECIFIC PROJECT REQUIREMENTS.
3. ANY SIGNALS DUPLICATED WITH THE ADDITION OF THE SCREEN PID WILL BE CONSIDERED AS COMMON. ONLY ONE OF EACH SIGNAL WILL BE PROVIDED FOR THE ENTIRE SYSTEM.

| DATE | REVISION | NO. | BY | CK | APP |
|---|---|---|---|---|---|
| 02/12/11 | GREASE PUMP SEQUENCE UPDATE | A | BMG | CCC | |

| | |
|---|---|
| DESIGNED | CCC |
| DETAILED | |
| CHECKED | ALS |
| APPROVED | |
| DATE | 05/01/09 |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Ro3.3 septage receiving station

TYPICAL PID DIAGRAM

OIU DETAIL

SCALE: NONE

PROJECT NUMBER:

DRAWING NO: RO5_PIDA1

SHEET 1 OF 3

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| ESTP 20.1.1A | PUSHBUTTON – PANEL MOUNTED EMERGENCY STOP MUSHROOM HEAD, PUSH–PULL TYPE | PROVIDES OPERATOR WITH PROVISION TO STOP ALL MOTORS AND SOLENOIDS IN THE EVENT OF AN EMERGENCY |
| ESTP 20.1.1B ** | PUSHBUTTON – FIELD MOUNTED EMERGENCY STOP MUSHROOM HEAD, PUSH–PULL TYPE | PROVIDES OPERATOR WITH PROVISION TO STOP ALL MOTORS AND SOLENOIDS IN THE EVENT OF AN EMERGENCY |
| FOR 20.1.2 | SELECTOR SWITCH GRIT DISCHARGE FOR–OFF–REV FOR CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT FORWARD, OFF, OR REVERSE WHILE OPERATING THE IN HAND |
| HOA 20.1.1 | SELECTOR SWITCH GRIT COLLECTOR HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HOA 20.1.2 | SELECTOR SWITCH GRIT DISCHARGE HAND–OFF–AUTO HOA CAN BE LOCATED IN PANEL OR LCS* | PROVIDES OPERATOR WITH PROVISION TO SELECT HAND, OFF, OR AUTO |
| HTR 20.10.10 ** | HEATER SYSTEM HEAT TRACING 600 WATTS MAX | PROVIDES SYSTEM WITH FROST PROTECTION INCLUDES PANEL MOUNTED OR FIELD MOUNTED THERMOSTAT. |
| MTR 20.1.1 | GRIT COLLECTOR DRIVE MOTOR | |
| MTR 20.1.2 | GRIT DISCHARGE DRIVE MOTOR | |
| RST 20.1.1 | PUSHBUTTON SYSTEM RESET FLUSH HEAD, MOMENTARY | PROVIDES OPERATOR WITH PROVISION TO RESET SYSTEM FAULTS |
| SIL 20.1.1 ** | PUSHBUTTON ALARM SILENCE EXTENDED HEAD, MOMENTARY | PROVIDES OPERATOR WITH PROVISION TO SILENCE AN ALARM ONCE THE ALARM HORN SOUNDS |
| YA 20.1.1 ** | HORN COMMON ALARM HORN | PROVIDES AUDIBLE INDICATION OF SYSTEM FAULT |
| YC 20.1.1 | GRIT COLLECTOR CALL TO RUN NON–REVERSING MOTOR STARTER | PROVIDES SCREW WITH CALL TO RUN FORWARD COMMAND |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro5 COMPLETE PLANT INSTRUMENTATION AND LOOP DIAGRAM | 20.1.X, 20.10.X |

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| YC 20.1.2 | GRIT DISCHARGE CALL TO RUN REVERSING MOTOR STARTER | PROVIDES SCREW WITH CALL TO RUN FORWARD / REVERSE COMMANDS |
| A YC 20.1.6 ** | SCREEN CALL TO RUN SCREENING EQUIPMENT CALL TO RUN | PROVIDES SCREEN WITH CALL TO RUN COMMAND WHENEVER THE GREASE PUMP IS CALLED TO RUN |
| YL–A 20.1.1 | INDICATION BEACON – AMBER COMMON ALARM | PROVIDES OPERATOR INDICATION OF A SYSTEM FAULT |
| YL–W 20.1.1 | INDICATOR LIGHT – WHITE CONTROL POWER ON | PROVIDES OPERATOR INDICATION THAT CONTROL POWER IS PRESENT AND ALL SAFTEY INTERLOCKS ARE ENABLED |
| YL–R 20.1.1A | INDICATOR LIGHT – RED GRIT COLLECTOR RUNNING | PROVIDES OPERATOR INDICATION THAT THE MOTOR IS RUNNING |
| YL–A 20.1.1B | INDICATOR LIGHT – AMBER GRIT COLLECTOR FAULT | PROVIDES OPERATOR INDICATION THAT THE MOTOR HAS SHUTDOWN DUE TO A FAULT |
| YL–R 20.1.2A | INDICATOR LIGHT – RED GRIT DISCHARGE RUNNING | PROVIDES OPERATOR INDICATION THAT THE MOTOR IS RUNNING |
| YL–A 20.1.2B | INDICATOR LIGHT – AMBER GRIT DISCHARGE FAULT | PROVIDES OPERATOR INDICATION THAT THE MOTOR HAS SHUTDOWN DUE TO A FAULT |
| YN 20.1.1 | CURRENT MONITOR GRIT COLLECTOR HIGH CURRENT | PROVIDES EQUIPMENT WITH OVERLOAD PROTECTION |
| YN 20.1.2 | CURRENT MONITOR GRIT DISCHARGE HIGH CURRENT | PROVIDES EQUIPMENT WITH OVERLOAD PROTECTION |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro5 COMPLETE PLANT INSTRUMENTATION AND LOOP DIAGRAM | 20.1.X, 20.10.X |

| TAG | DESCRIPTION | FUNCTION |
|---|---|---|
| YN 20.1.1A | REMOTE INDICATION GRIT COLLECTOR RUNNING | PROVIDE REMOTE INDICATION THAT MOTOR IS RUNNING TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 20.1.1B | REMOTE INDICATION GRIT COLLECTOR FAULT | PROVIDE REMOTE INDICATION THAT MOTOR HAS SHUTDOWN DUE TO A FAULT TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 20.1.2A | REMOTE INDICATION GRIT DISCHARGE RUNNING | PROVIDE REMOTE INDICATION THAT MOTOR IS RUNNING TYPICALLY 120VAC, 5AMP DRY CONTACT |
| YN 20.1.2B | REMOTE INDICATION GRIT DISCHARGE FAULT | PROVIDE REMOTE INDICATION THAT MOTOR HAS SHUTDOWN DUE TO A FAULT TYPICALLY 120VAC, 5AMP DRY CONTACT |

| DESCRIPTION | LOOP NUMBERS |
|---|---|
| Ro5 COMPLETE PLANT INSTRUMENTATION AND LOOP DIAGRAM | 20.1.X, 20.10.X |

NOTES:
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3. * DEVICES THAT MAY BE REMOVED FROM CONTROL PANEL DOOR AND MOUNTED NEAR EQUIPMENT IN A LCS.
4. ** INDICATES OPTIONAL ITEM OR OPTIONAL UPGRADE.

| DATE | REVISION | NO. | BY | CK | APP |
|---|---|---|---|---|---|
| 02/12/11 | GREASE PUMP SEQUENCE UPDATE | A | BMG | CCC | |

DESIGNED CCC
DETAILED
CHECKED ALS
APPROVED
DATE 05/01/09

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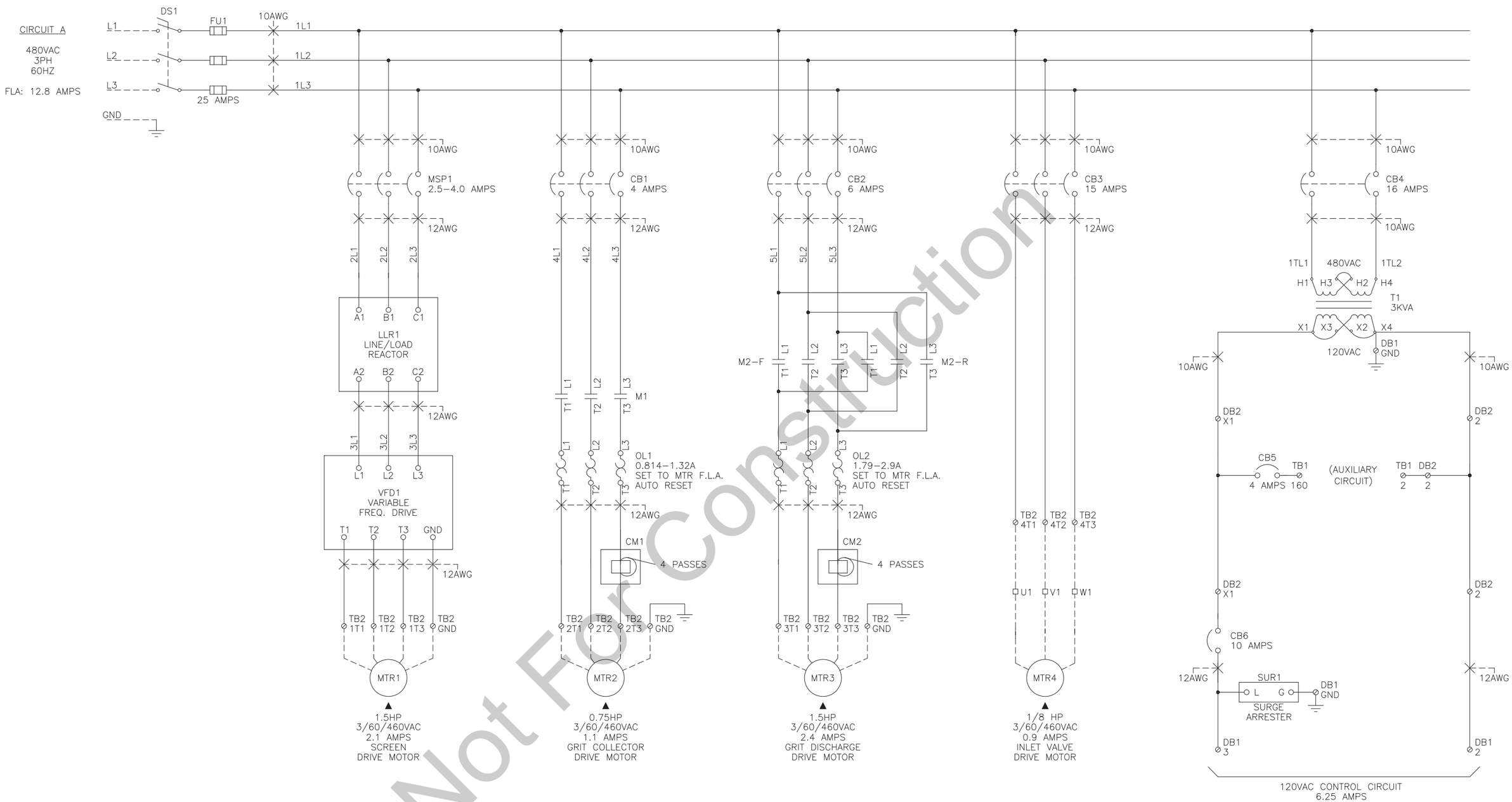
Tel. 704-949-1010
info@hhusa.net

Ro3.3 septage receiving station
TYPICAL PID DIAGRAM
OIU DETAIL
SCALE: NONE
PROJECT NUMBER:
DRAWING NO: RO5_PIDA2
SHEET 2 OF 3

## OPERATIONAL STRATEGY




Not For Construction

WIRE COLORS:
BLK – POWER
BLK – 120VAC HOT
WHT – 120VAC NEUTRAL
RED – 120VAC CONTROL
YEL – REMOTE
GRN – GROUND
BLU – DC POSITIVE/CONTROL
WHT/BLU – DC NEUTRAL

NOTES:
1. ▲ DEVICES LOCATED OUTSIDE CONTROL PANEL.
2. ⊘ TERMINAL BLOCK (TB) OR DISTRIBUTION BLOCK (DB) LOCATED IN CONTROL PANEL.
3. – – FIELD WIRING.
4. NAMEPLATES SHALL BE WHITE WITH BLACK LETTERS.
5. ELEMECH RESERVES THE RIGHT TO CHANGE, AS NECESSARY, THE SPACING, ORIENTATION, AND PHYSICAL LOCATION OF DEVICES IN ORDER TO OPTIMIZE THE DESIGN.
6. LOCAL MOTOR DISCONNECT SWITCHES SHALL BE PROVIDED BY OTHERS IF REQUIRED BY LOCAL REGULATIONS.
7. JUNCTION BOXES ARE NOT SHOWN AND SHALL BE PROVIDED BY OTHERS AS NECESSARY.

| DATE | REVISION | NO. | BY | CK | APP |
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DESIGNED DG
DETAILED
CHECKED CCC
APPROVED
DATE 01/06/15

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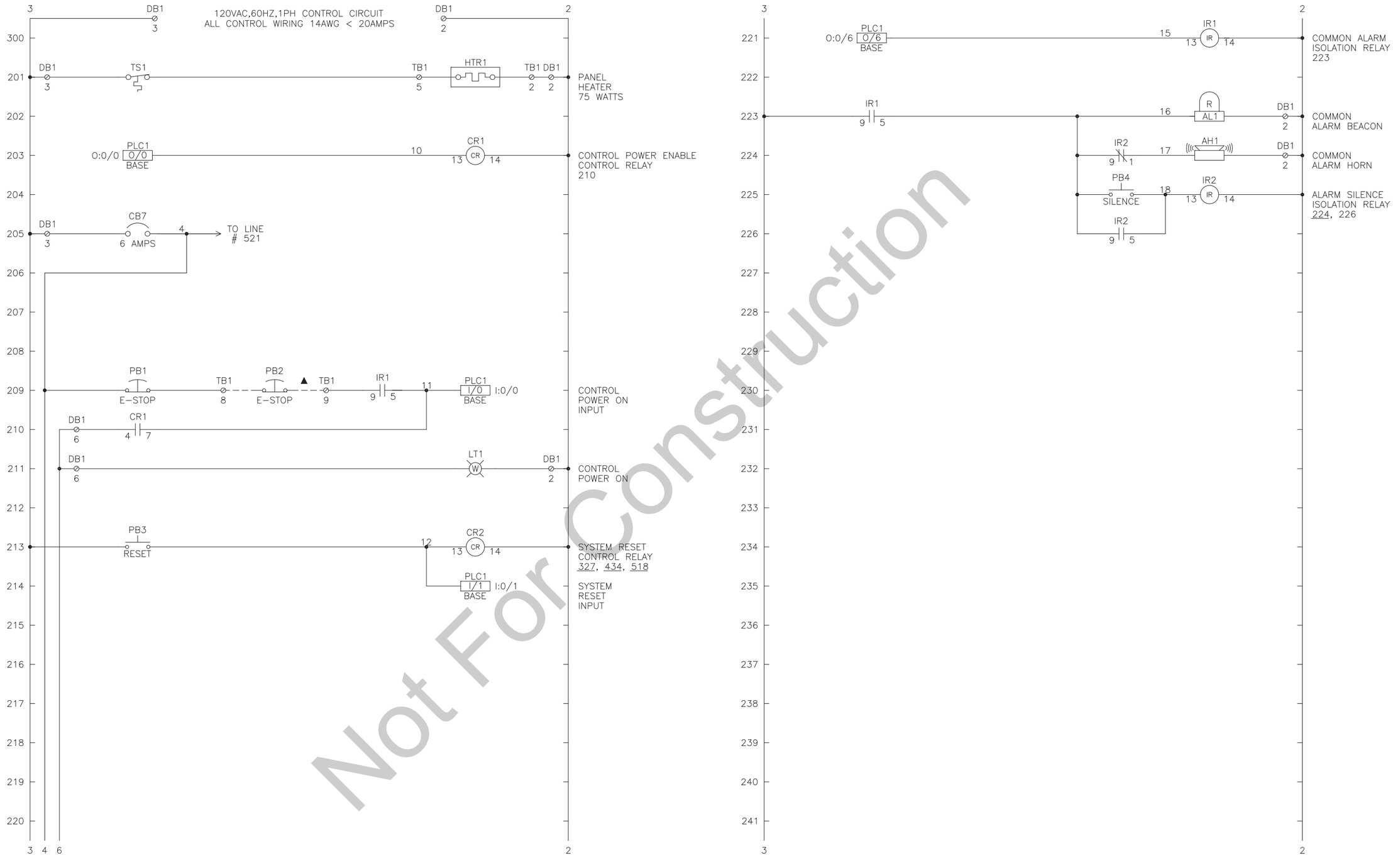
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A01

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| DATE | REVISION | NO. | BY | CK | APP | DATE | 01/06/15 |

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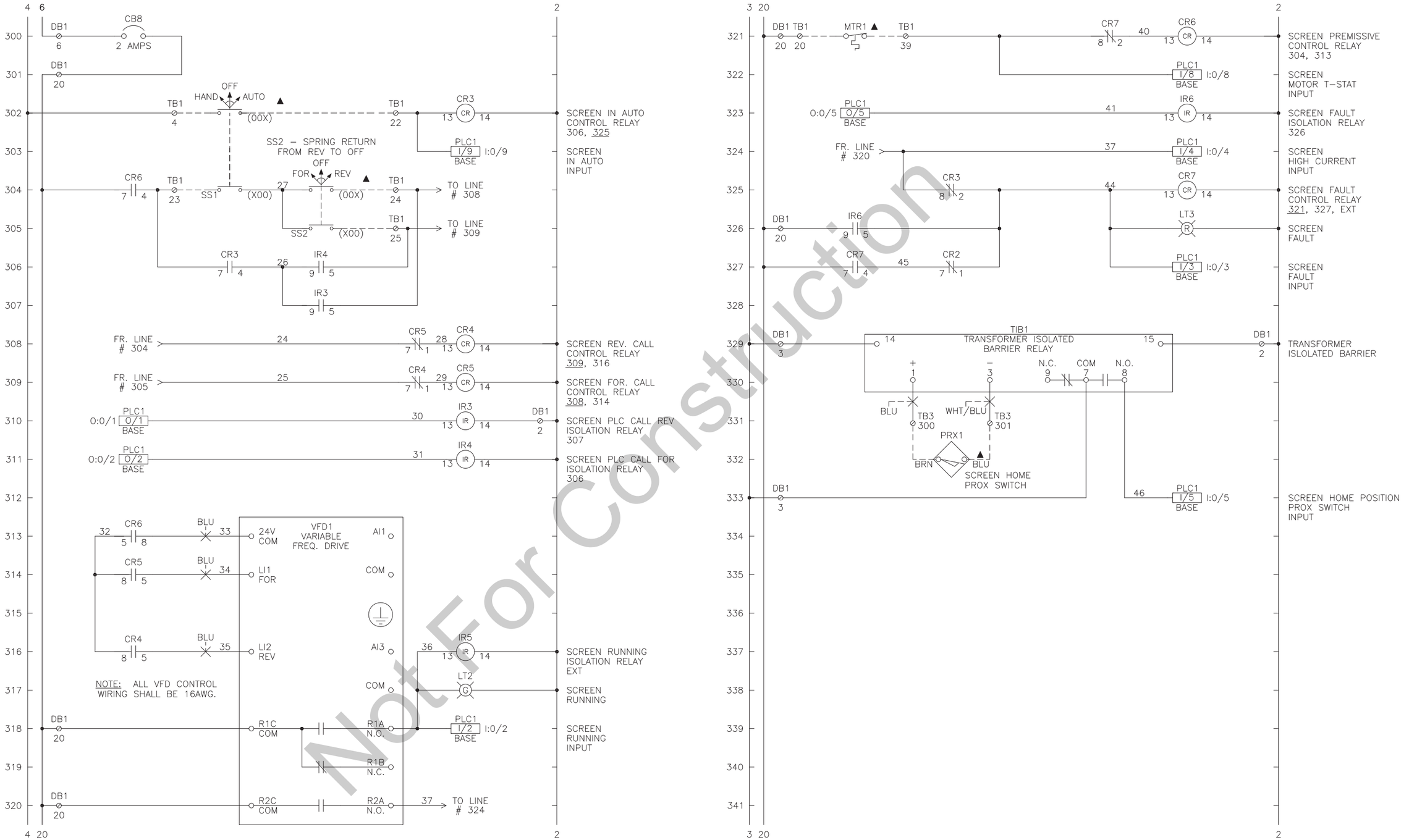
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A02

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| DESIGNED | DG |
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| APPROVED | |
| DATE | 01/06/15 |

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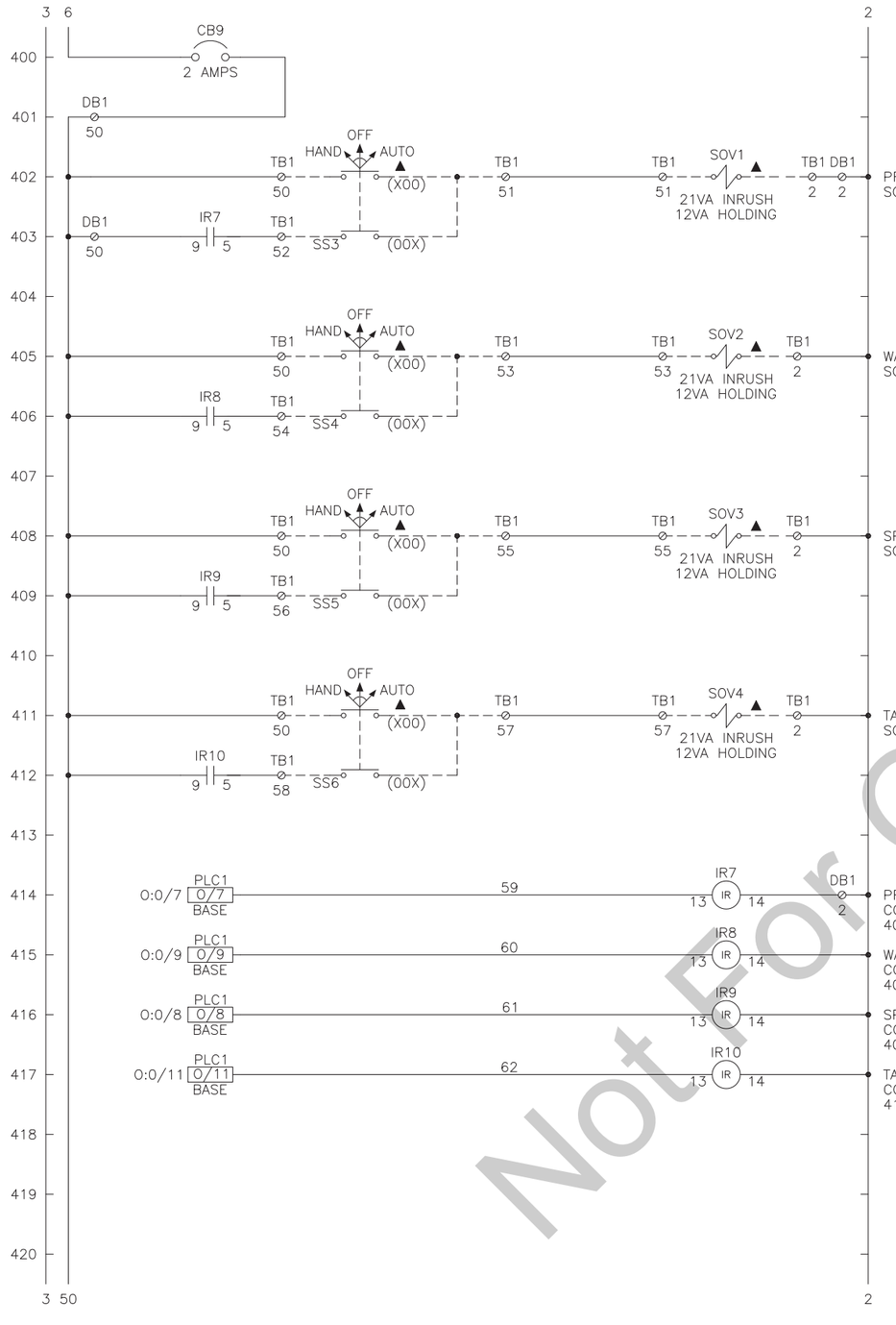
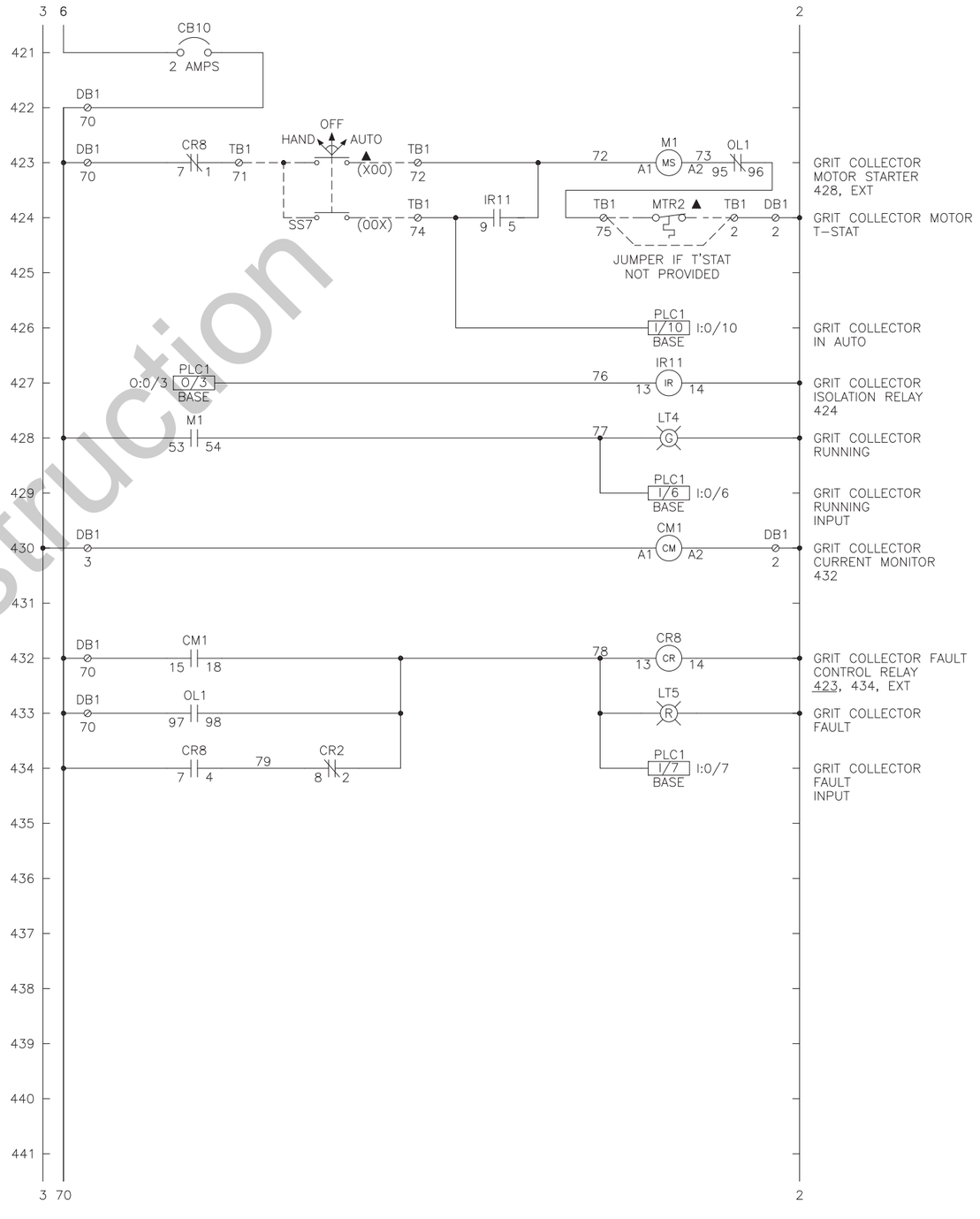
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A03




Not For Construction

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| DATE | REVISION | NO. | BY | CK | APP | DATE | 01/06/15 |

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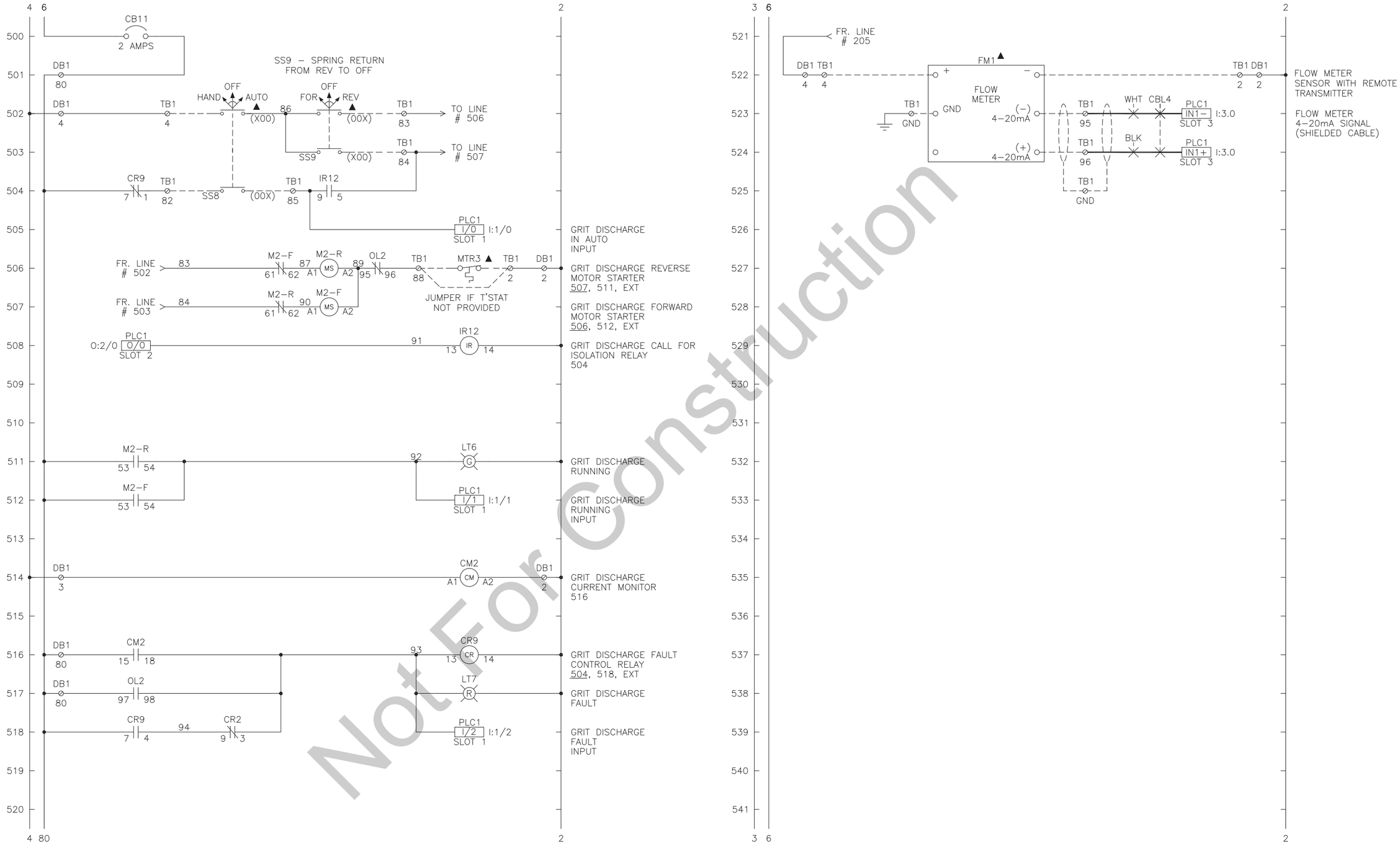
Ro3.3 SEPTAGE RECEIVING
CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A04




Not For Construction

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| | | | | | | APPROVED | |
| DATE | REVISION | NO. | BY | CK | APP | DATE | 01/06/15 |

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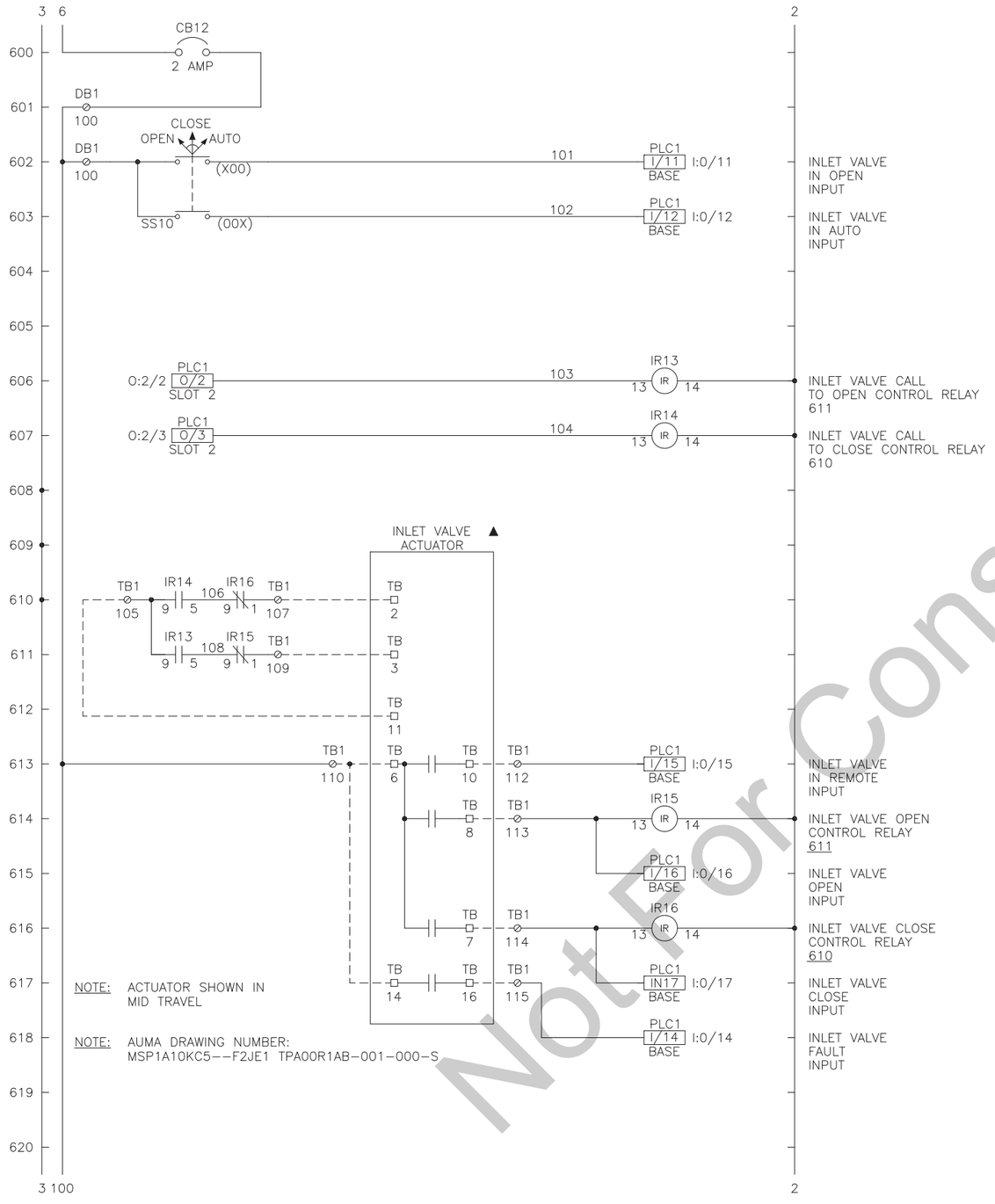
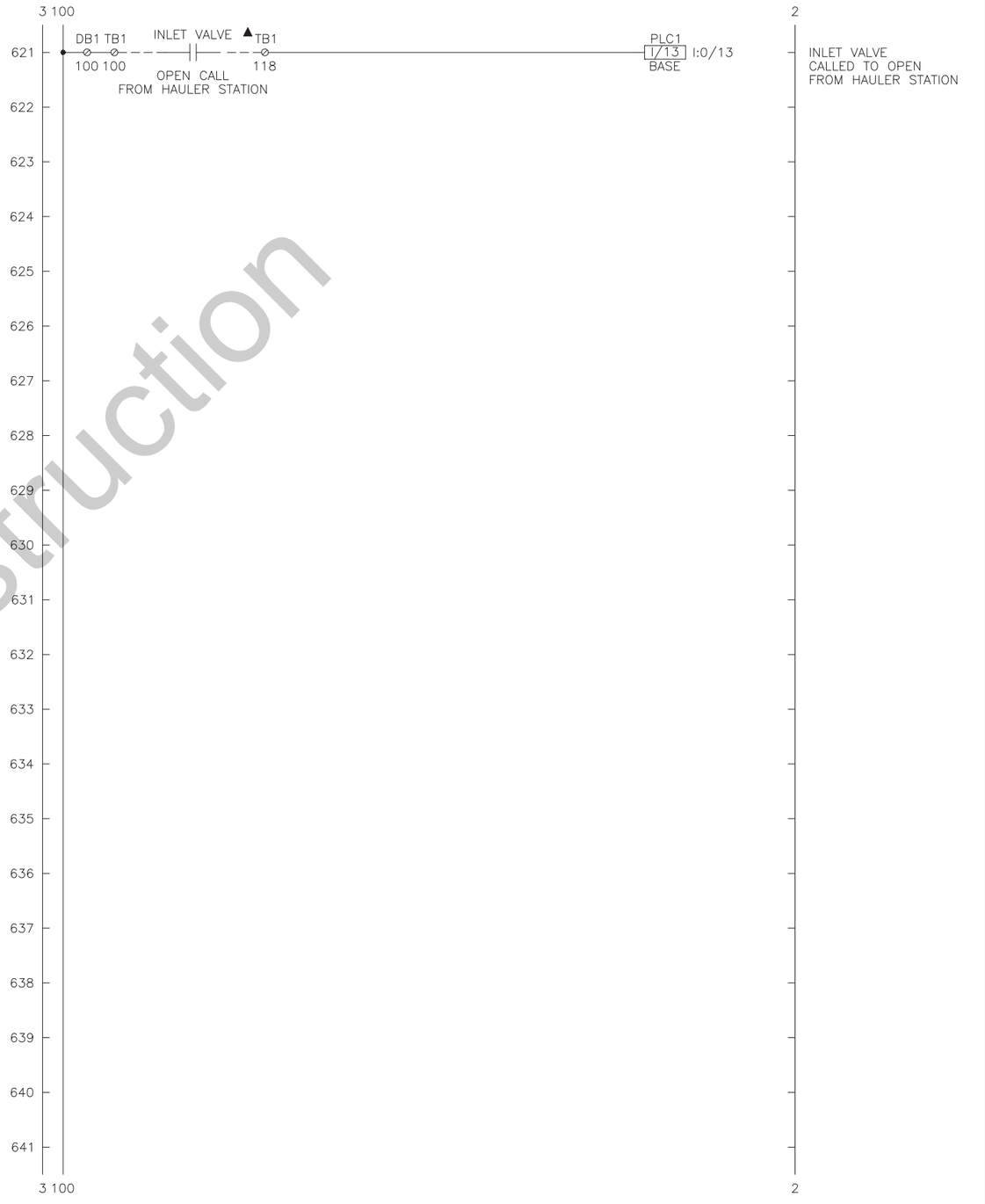
Ro3.3 SEPTAGE RECEIVING
CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A05

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| | | | | | | APPROVED | |
| DATE | REVISION | NO. | BY | CK | APP | DATE | 01/06/15 |

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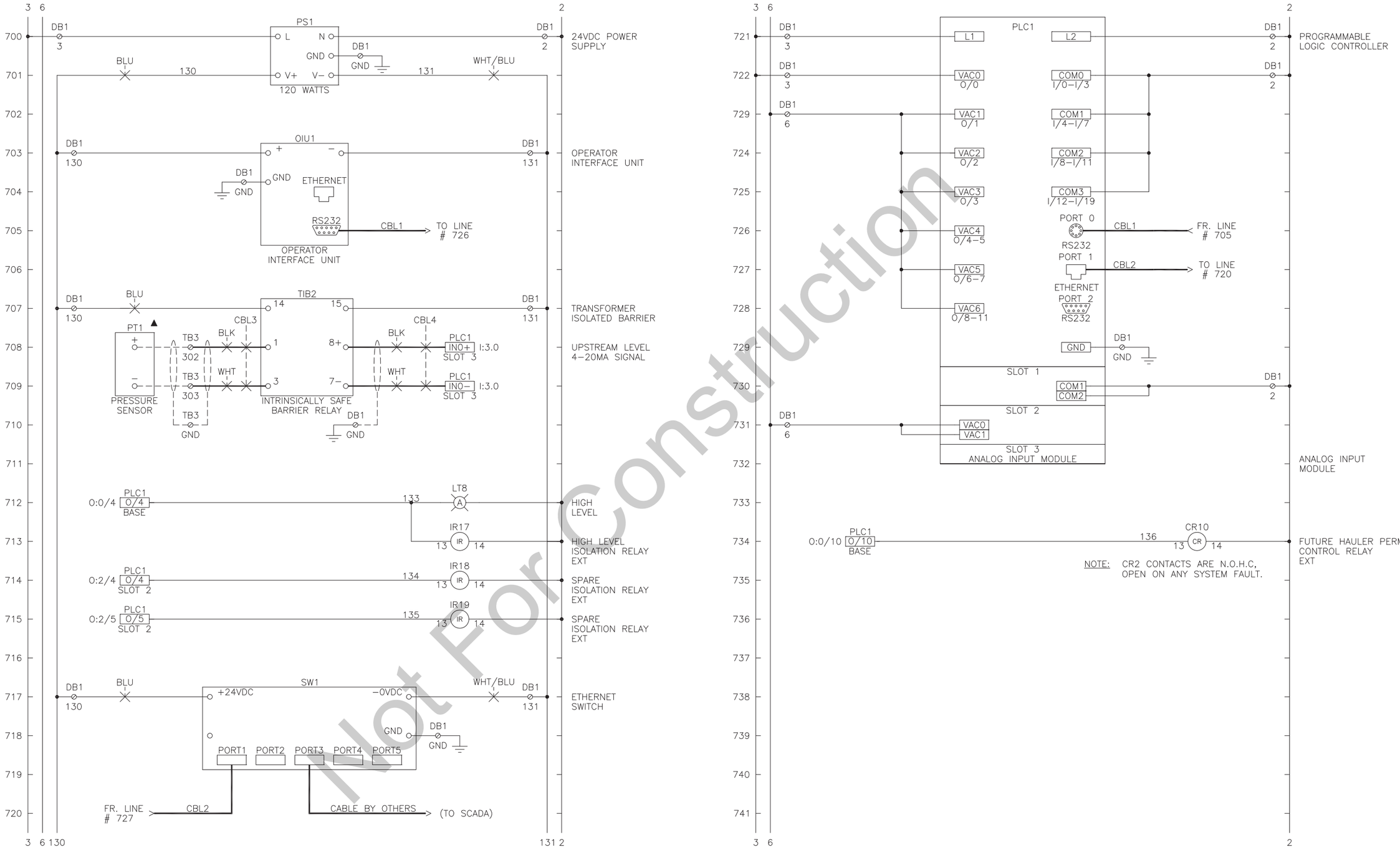
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A06

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DATE 01/06/15

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Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A07

SHEET 7 OF 11

## SEQUENCE OF OPERATION

CONTROL POWER ON–DELAY:
EACH TIME THE CONTROL PANEL POWER SUPPLY IS CYCLED, THE PROGRAMMABLE LOGIC CONTROLLER (PLC1) WILL ALLOW ALL SOLID STATE DEVICES TO BECOME FULLY ENERGIZED BEFORE ENABLING THE CONTROL POWER CIRCUIT.

SCREEN MODES OF OPERATION:
HAND: WHEN THE SCREEN SELECTOR IS IN THE HAND POSITION, THE SCREEN WILL CYCLE ON AND OFF WITH THE SCREEN FOR–OFF–REV SELECTOR.
FOR: WHEN THE SCREEN SELECTOR IS IN THE HAND POSITION AND THE FORWARD DIRECTION IS SELECTED, THE SCREEN WILL CYCLE IN THE FORWARD DIRECTION. THIS SWITCH WILL SPRING RETURN FROM FOR TO OFF.
REV: WHEN THE SCREEN SELECTOR IS IN THE HAND POSITION AND THE REVERSE DIRECTION SELECTED, THE SCREEN WILL CYCLE IN THE REVERSE DIRECTION. THIS SWITCH WILL SPRING RETURN FROM REV TO OFF.
AUTO: WHEN THE SCREEN SELECTOR IS IN THE AUTO POSITION THE SCREEN WILL BEGIN TO CYCLE DUE TO ANY ONE OF THE FOLLOWING CONDITIONS:

- THE LEVEL OF THE MATERIAL HAS RISEN AND REMAINED ABOVE THE START LEVEL SETPOINT FOR THE TIME SET IN LEVEL START DELAY TIMER
- SCREEN HAS REMAINED OFF FOR THE TIME SET IN THE SCREEN OFF TIMER
- SYSTEM RESET PUSHBUTTON PRESSED AND HELD FOR 3 SECONDS

SCREEN CYCLE:
WHEN A SCREEN CYCLE IS INITIATED, THE SCREEN WILL RUN IN THE FORWARD DIRECTION UNTIL THE HOME SWITCH IS REACHED. AFTER THE FIRST REVOLUTION, THE RAKE WILL BE CLEANED. ONCE CLEANED, THE SCREEN WILL MAKE AN ADJUSTABLE NUMBER OF COMPLETE REVOLUTIONS BEFORE THE RAKE IS CLEANED AGAIN. THE SCREEN WILL CONTINUE TO REPEAT THE MULTIPLE REVOLUTIONS THEN CLEAN THE RAKE UNTIL THE LEVEL DROPS AND REMAINS BELOW THE START LEVEL SETPOINT FOR THE TIME SET IN THE PLC. ONCE THE CYCLE IS COMPLETE, THE SCREEN WILL FINISH THE LAST FORWARD CYCLE, CLEAN THE RAKE, AND THEN PARK AT THE HOME POSITION UNTIL NEXT CYCLE.

CLEANING THE RAKE:
WHEN CLEANING THE RAKE, THE SCREEN MUST BE AT THE HOME SWITCH WHEN OPERATING IN THE FORWARD DIRECTION. THE SCREEN WILL THEN STOP AND DWELL PRIOR TO OPERATING IN THE REVERSE DIRECTION FOR A TIME SET IN THE PLC. AFTER THE REVERSE RUN TIME HAS EXPIRED, THE SCREEN WILL STOP AND DWELL PRIOR TO OPERATING IN THE FORWARD DIRECTION. THE SCREEN WILL CONTINUE TO OPERATE IN THE FORWARD DIRECTION UNTIL THE NEXT CLEANING CYCLE IS REQUIRED, OR UNTIL IT IS PARKED AT THE HOME POSITION.

PARKING AT HOME:
AFTER EACH OPERATION, THE SCREEN WILL PARK AT THE HOME POSITION IMMEDIATELY AFTER THE LAST CLEANING OF THE RAKE. IF THE SCREEN IS OPERATED IN THE HAND MODE, THE SCREEN CAN BE FORCED TO PARK AT HOME BY RETURNING THE SCREEN SELECTOR TO AUTO AND PRESSING AND HOLDING THE RESET PUSHBUTTON FOR 3 SEC.

PRESS ZONE SPRAY WASH MODES OF OPERATION:
HAND: WHEN THE PRESS ZONE WASH SELECTOR IS IN THE HAND POSITION, THE PRESS ZONE WASH WILL RUN CONTINUOUSLY.
AUTO: WHEN THE PRESS ZONE WASH SELECTOR IS IN THE AUTO POSITION, THE PRESS ZONE WASH WILL CYCLE ON AND OFF, ON TIME FIRST, PER REPEAT CYCLE TIMES SET IN THE PLC, INDEPENDENT OF THE SCREEN OPERATION.

WASH NO.1 MODES OF OPERATION:
HAND: WHEN THE WASH NO.1 SELECTOR IS IN THE HAND POSITION, WASH NO.1 WILL RUN CONTINUOUSLY.
AUTO: WHEN THE WASH NO.1 SELECTOR IS IN THE AUTO POSITION, WASH NO.1 WILL CYCLE ON AND OFF, ON TIME FIRST, PER REPEAT CYCLE TIMES SET IN THE PLC, ANY TIME THE SCREEN IS OPERATING IN THE FORWARD DIRECTION.

TANK WASH MODES OF OPERATION:
HAND: WHEN THE TANK WASH SELECTOR IS IN THE HAND POSITION THE TANK WASH WILL RUN CONTINUOUSLY.
AUTO: WHEN THE TANK WASH SELECTOR IS IN THE AUTO POSITION THE TANK WASH WILL CYCLE ON AND OFF, ON TIME FIRST, PER REPEAT CYCLE TIMES SET IN THE PLC, INDEPENDENT OF THE SCREEN OPERATION.

SPRAY BAR MODES OF OPERATION:
HAND: WHEN THE SPRAY BAR SELECTOR IS IN THE HAND POSITION, THE SPRAY BAR WILL RUN CONTINUOUSLY.
AUTO: WHEN THE SPRAY BAR SELECTOR IS IN THE AUTO POSITION, THE SPRAY BAR WILL SPRAY ANYTIME THE SCREEN IS CALLED TO RUN AND NOT OPERATING IN THE FORWARD DIRECTION.

## SEQUENCE OF OPERATION

GRIT COLLECTOR MODES OF OPERATION:
HAND: WHEN THE GRIT COLLECTOR SELECTOR IS IN THE HAND POSITION, THE GRIT COLLECTOR WILL RUN CONTINUOUSLY.
AUTO: WHEN THE GRIT COLLECTOR SELECTOR IS IN THE AUTO POSITION, THE GRIT COLLECTOR WILL CYCLE OFF AND ON, OFF TIME FIRST, PER THE GRIT COLLECTOR REPEAT CYCLE TIMER.

GRIT DISCHARGE MODES OF OPERATION:
HAND: WHEN THE GRIT DISCHARGE SELECTOR IS IN THE HAND POSITION, THE GRIT DISCHARGE WILL CYCLE PER THE GRIT DISCHARGE FOR–OFF–REV SELECTOR.
FOR: WHEN THE GRIT DISCHARGE SELECTOR IS IN THE FORWARD POSITION, THE GRIT DISCHARGE WILL RUN IN THE FORWARD DIRECTION. THIS SWITCH WILL SPRING RETURN FROM FOR TO OFF.
REV: WHEN THE GRIT DISCHARGE SELECTOR IS IN THE REVERSE POSITION, THE GRIT DISCHARGE WILL RUN CONTINUOUSLY, IN THE REVERSE DIRECTION. THIS SWITCH WILL SPRING RETURN FROM REV TO OFF.
AUTO: WHEN THE GRIT DISCHARGE SELECTOR IS IN THE AUTO POSITION, THE GRIT DISCHARGE WILL RUN WHEN THE GRIT COLLECTOR STARTS AND WILL CONTINUE TO RUN AFTER THE GRIT COLLECTOR SHUTS DOWN FOR THE TIME SET ON THE GRIT DISCHARGE OFF DELAY TIMER.

NOTES:
1. THE GRIT DISCHARGE WILL ONLY CYCLE AUTOMATICALLY IN THE FORWARD DIRECTION.
2. THE GRIT WASH SOLENOID WILL BE CALLED TO RUN WHENEVER THE GRIT DISCHARGE IS CALLED TO RUN.

NOTE: THE INLET VALVE WILL BE OPEN IF THE SCREEN IS IN AUTO, NOT FAULTED AND HIGH LEVEL IS NOT PRESENT.

EMERGENCY STOP:
WHEN ANY OF THE E–STOP PUSHBUTTONS ARE PRESSED THE SCREEN AND SPRAY WASHES WILL STOP IMMEDIATELY, THE CONTROL POWER ON LIGHT WILL DE–ENERGIZE. TO RESET, INSURE ALL E–STOPS ARE ENABLED, AND PRESS THE SYSTEM RESET PUSHBUTTON.

NOTE: IF THE POWER TO THE PANEL IS INTERRUPTED, THE EQUIPMENT MAY CYCLE IMMEDIATELY ONCE THE POWER IS RESTORED. PRESSING THE SYSTEM RESET PUSHBUTTON AFTER A POWER OUTAGE WILL NOT BE REQUIRED.

OIU – INFORMATION:
1. THE OIU WILL DISPLAY THE ELAPSED MOTOR RUN TIME.
2. ALL ADJUSTABLE SETPOINTS CAN BE ACCESSED AND ADJUSTED THROUGH THE OIU.
3. THE PRESENT FAULT WILL BE DISPLAYED ON THE OIU.
4. THE HISTORY OF ALL PAST FAULTS CAN BE ACCESSED THROUGH THE OIU.

## SEQUENCE OF OPERATION

FAULTS:
SCREEN MOTOR OVERLOAD – WHEN THE SCREEN MOTOR OVERLOAD IS TRIPPED THE SCREEN WILL STOP IMMEDIATELY AND THE SCREEN FAULT LIGHT WILL BE ENERGIZED.

SCREEN OVERLOAD SHUTDOWN – IF HIGH CURRENT IS MEASURED WHILE THE SCREEN IS OPERATING IN THE FORWARD DIRECTION, THEN THE SCREEN WILL TRY TO CLEAR THE FAULT. TO CLEAR THE FAULT THE SCREEN WILL STOP AND DWELL, RUN IN REVERSE, STOP AND DWELL, THEN CONTINUE ITS CYCLE. IF THE HIGH CURRENT PERSISTS, THE SCREEN WILL CONTINUE TO TRY AND CLEAR THE FAULT. IF THE NUMBER OF ATTEMPTS TO CLEAR THE FAULT EXCEEDS THE NUMBER ALLOWED WITHIN 5 MINUTES, THEN THE SCREEN WILL SHUTDOWN IMMEDIATELY AND THE SCREEN FAULT PILOT LIGHT WILL BE ENERGIZED. NOTE: IF HIGH CURRENT IS MEASURED WHILE THE SCREEN IS OPERATING IN THE REVERSE DIRECTION OR WHILE IN HAND, THE SCREEN WILL SHUTDOWN IMMEDIATELY AND THE SCREEN FAULT PILOT LIGHT WILL BE ENERGIZED.

PROXIMITY SWITCH MALFUNCTION – IF THE SCREEN IS RUNNING AND THE PROXIMITY SWITCH IS NOT SENSED WITHIN THE TIME SET IN THE PLC, THEN THE PROXIMITY SWITCH MALFUNCTION ALARM WILL BE DISPLAYED ON THE OIU. THE SCREEN WILL OPERATE CONTINUOUSLY IN THE FORWARD DIRECTION AS LONG AS THERE IS A LEVEL CALL TO RUN. OTHERWISE THE SCREEN WILL STOP OPERATING UNTIL NEXT CALL TO RUN. NOTE: DURING THIS FAULT THE CLEANING CYCLE AND PARK AT HOME LOGIC WILL BE DISABLED.

SCREEN CALL FOR NOT RUNNING – IF THE SCREEN IS READY AND PLC HAS CALLED THE SCREEN TO RUN BUT DOES NOT RECEIVE RUNNING CONFIRMATION WITHIN 3 SECONDS. SCREEN WILL STOP IMMEDIATELY AND THE SCREEN FAULT LIGHT WILL BE ENERGIZED.

GRIT COLLECTOR MOTOR OVERLOAD – WHEN THE GRIT COLLECTOR MOTOR OVERLOAD IS TRIPPED, THE GRIT COLLECTOR WILL STOP IMMEDIATELY AND THE GRIT COLLECTOR FAULT LIGHT WILL ENERGIZE.

GRIT COLLECTOR HIGH CURRENT – WHEN THE GRIT COLLECTOR CURRENT MONITOR SENSES HIGH CURRENT, THE GRIT COLLECTOR WILL STOP IMMEDIATELY AND THE GRIT COLLECTOR FAULT LIGHT WILL ENERGIZE.

GRIT DISCHARGE MOTOR OVERLOAD – WHEN THE GRIT DISCHARGE MOTOR OVERLOAD IS TRIPPED, THE GRIT DISCHARGE WILL STOP IMMEDIATELY AND THE GRIT DISCHARGE FAULT LIGHT WILL ENERGIZE.

GRIT DISCHARGE HIGH CURRENT – WHEN THE GRIT DISCHARGE CURRENT MONITOR SENSES HIGH CURRENT, THE GRIT DISCHARGE WILL STOP IMMEDIATELY AND THE GRIT DISCHARGE FAULT LIGHT WILL ENERGIZE.

ALL OF THE ABOVE FAULTS CAN BE RESET BY PRESSING THE SYSTEM RESET PUSHBUTTON.

ALARM HORN:
WHEN ANY OF THE ABOVE ALARMS OCCUR THE ALARM HORN WILL BE ENERGIZED. THE ALARM SILENCE PUSHBUTTON CAN BE PRESSED AT ANY TIME TO SILENCE THE ALARM. NOTE: PRESSING THE ALARM SILENCE PUSHBUTTON WILL NOT RESET THE FAULT.

ALARM BEACON:
WHEN ANY OF THE ABOVE ALARMS OCCUR THE ALARM BEACON WILL BE ENERGIZED. THE BEACON WILL REMAIN ENERGIZED UNTIL THE FAULT HAS BEEN ADDRESSED AND THE SYSTEM RESET HAS BEEN PRESSED.

HIGH LEVEL LIGHT:
IF THE LEVEL RAISES ABOVE THE HIGH LEVEL SETPOINT SET IN THE PLC, THE HIGH LEVEL LIGHT WILL BE ENERGIZED. THE LIGHT WILL REMAIN ENERGIZED UNTIL THE LEVEL DROPS BELOW THE HIGH LEVEL SETPOINT.

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DESIGNED DG
DETAILED
CHECKED CCC
APPROVED
DATE 01/06/15

HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

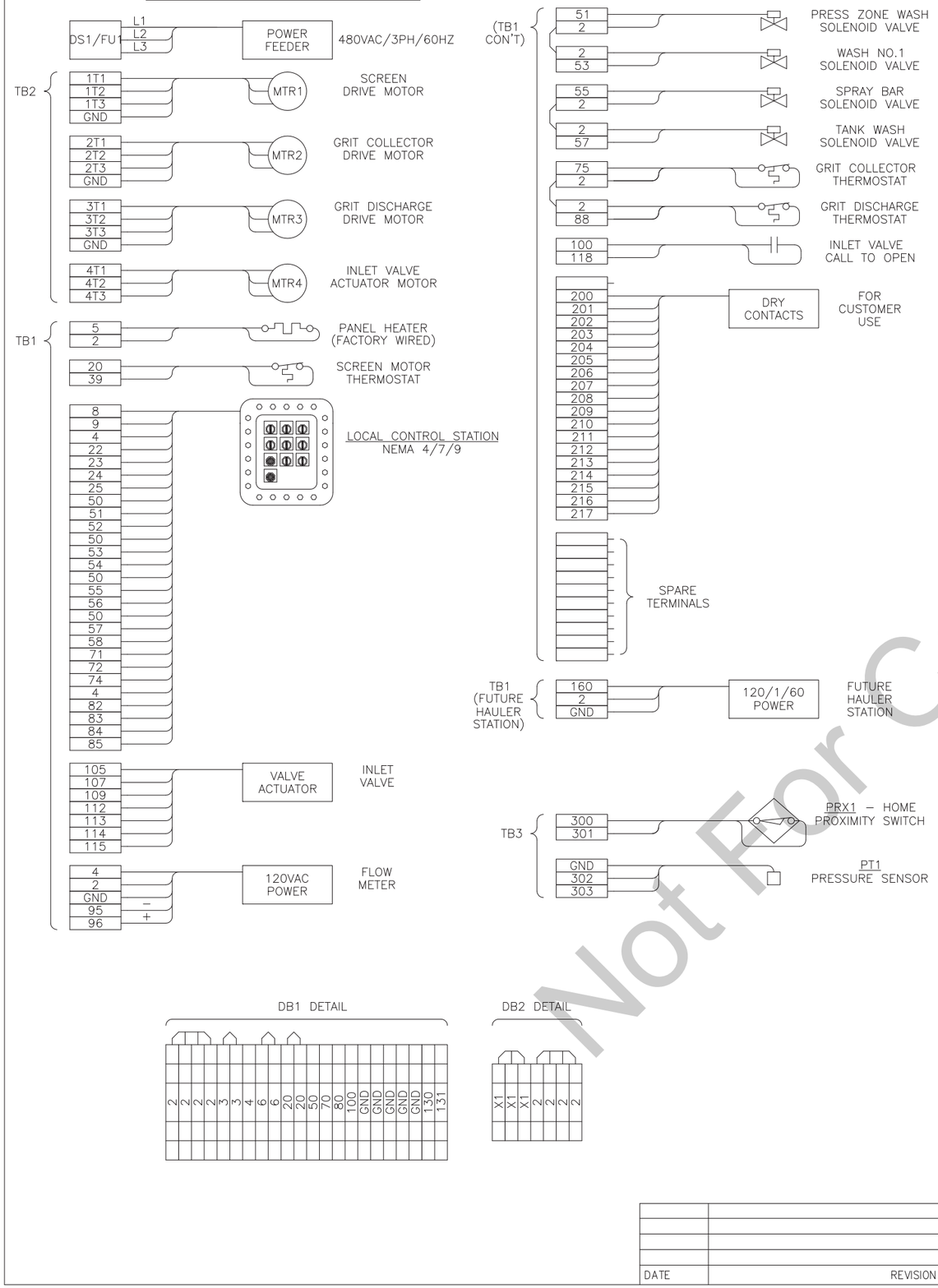
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A08

# FIELD WIRING DIAGRAM



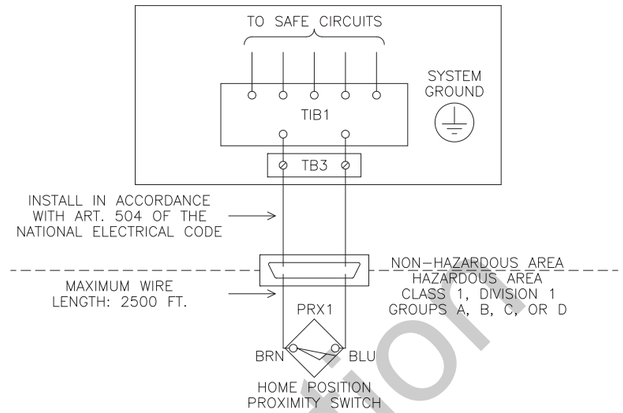

DB1 DETAIL




DB2 DETAIL

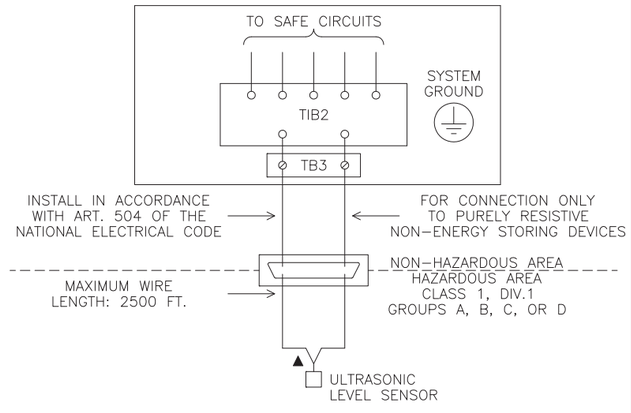



# TIB1 WIRING DETAIL

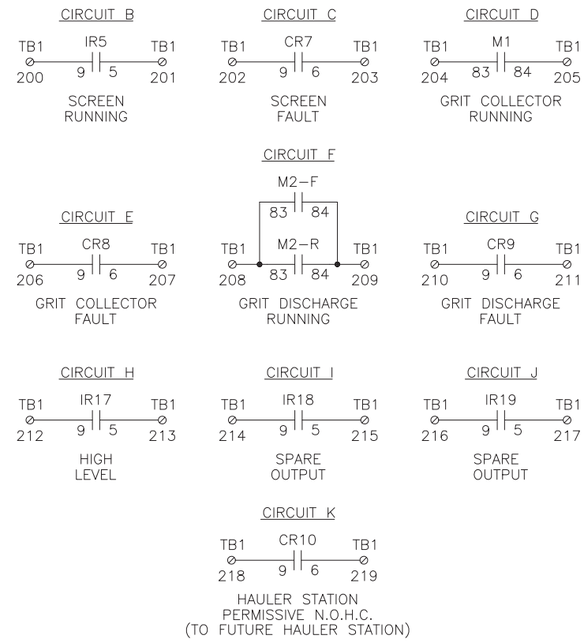



NOTES:
1. ENSURE CONTROL PANEL IS CONNECTED TO GROUND.
2. CAUTION: MAINTAIN SEPARATION BETWEEN INTRINSICALLY SAFE WIRING AND OTHER WIRING.

# TIB2 WIRING DETAIL




NOTES:
1. ENSURE CONTROL PANEL IS CONNECTED TO GROUND.
2. CAUTION: MAINTAIN SEPARATION BETWEEN INTRINSICALLY SAFE WIRING AND OTHER WIRING.




MAX. CONTROLLED LOAD: 10A @ 120VAC

NOTE: BRANCH CIRCUIT PROTECTION PROVIDED BY OTHERS PER N.E.C.

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|---|---|
| DESIGNED | DG |
| DETAILED | |
| CHECKED | CCC |
| APPROVED | |
| DATE | 01/06/15 |

**HUBER TECHNOLOGY**
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Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A09

# DEVICE SETTINGS

## PLC – I/O

ALLEN–BRADLEY
MICROLOGIX 1400

IN

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | 5 | 7 | 8 | 10 | 13 | 15 | 17 | 19 |
| 1 | 3 | 4 | 6 | 9 | 11 | 12 | 14 | 16 | 18 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 7 | 8 | 10 |
| 5 | 6 | 9 | 11 | | | | |

OUT

☐ POWER
☐ RUN
☐ FAULT
☐ FORCE
☐ COM0
☐ DCOMM

### PLC INPUTS

| | |
|---|---|
| I/0 | CONTROL POWER ON |
| I/1 | SYSTEM RESET |
| I/2 | SCREEN RUNNING |
| I/3 | SCREEN FAULT |
| I/4 | SCREEN HIGH CURRENT |
| I/5 | SCREEN HOME SWITCH |
| I/6 | GRIT COLLECTOR RUNNING |
| I/7 | GRIT COLLECTOR FAULT |
| I/8 | SCREEN MOTOR T–STAT |
| I/9 | SCREEN IN AUTO |
| I/10 | GRIT COLLECTOR IN AUTO |
| I/11 | INLET VALVE IN OPEN |
| I/12 | INLET VALVE IN AUTO |
| I/13 | INLET VALVE CALL (HAULER) |
| I/14 | INLET VALVE FAULT |
| I/15 | INLET VALVE IN REMOTE |
| I/16 | INLET VALVE OPEN |
| I/17 | INLET VALVE CLOSE |
| I/18 | SPARE |
| I/19 | SPARE |

### PLC INPUTS – SLOT NO.1

| | |
|---|---|
| I/0 | GRIT DISCHARGE IN AUTO |
| I/1 | GRIT DISCHARGE RUNNING |
| I/2 | GRIT DISCHARGE FAULT |
| I/3 | SPARE |
| I/4 | SPARE |
| I/5 | SPARE |
| I/6 | SPARE |
| I/7 | SPARE |

### PLC OUTPUTS

| | |
|---|---|
| O/0 | CONTROL POWER ENABLED |
| O/1 | SCREEN REVERSE CALL |
| O/2 | SCREEN FORWARD CALL |
| O/3 | GRIT COLLECTOR CALL TO RUN |
| O/4 | HIGH LEVEL |
| O/5 | SCREEN FAULT |
| O/6 | COMMON ALARM |
| O/7 | PRESS ZONE WASH CALL TO RUN |
| O/8 | SPRAY BAR CALL TO RUN |
| O/9 | WASH NO.1 CALL TO RUN |
| O/10 | SPARE |
| O/11 | TANK WASH CALL TO RUN |

### PLC OUTPUTS – SLOT NO.2

| | |
|---|---|
| O/0 | GRIT DISCHARGE CALL TO RUN |
| O/1 | SPARE |
| O/2 | INLET VALVE CALL TO OPEN |
| O/3 | INLET VALVE CALL TO CLOS |
| O/4 | SPARE OUTPUT |
| O/5 | SPARE OUTPUT |
| O/6 | SPARE |
| O/7 | SPARE |

### PLC ANALOG INPUTS – SLOT NO.3

| | |
|---|---|
| IN0 | SCREEN LEVEL |
| IN1 | FLOW METER |
| IN2 | SPARE |
| IN3 | SPARE |

## TIB1,2 – TRANSFORMER ISOLATED BARRIER

| DIP SWITCH | SET AT |
|---|---|
| S1 | II |
| S2 | I |
| S3 | I |

## HTR1

| | |
|---|---|
| HEATER ON/OFF | 40 °F |

# DEVICE SETTINGS

## PLC1 – COMMUNICATIONS SETUP

| PARAMETER | VALUE |
|---|---|
| IP ADDRESS | 10.0.0.1 |
| SUBNET MASK | 255.255.255.0 |
| GATEWAY ADDRESS | |

## OIU1 – COMMUNICATIONS SETUP

| PARAMETER | VALUE |
|---|---|
| IP ADDRESS | 10.0.0.2 |
| SUBNET MASK | 255.255.255.0 |
| GATEWAY ADDRESS | |

NOTES:
1. THE PLANT SYSTEMS ADMINISTRATOR SHALL PROVIDE UPDATED COMMUNICATION SETTINGS FOR THE ETHERNET PORT ON THE PLC PRIOR TO FABRICATION. IF THIS INFORMATION IS NOT PROVIDED BY THE RELEASE FOR FABRICATION THE PLC SHALL BE SHIPPED WITH THE ABOVE LISTED CONFIGURATION.

## PLC1

| REGISTER NUMBER | DESCRIPTION | FACTORY SETTING | RANGE |
|---|---|---|---|
| N7:0 | SCREEN – START LEVEL ON DELAY | 5 SEC. | 1–10 SEC |
| N7:1 | SCREEN – REPEAT CYCLE OFF TIME | 60 MIN. | 1–999 MIN |
| N7:2 | SCREEN – OFF DELAY | 5 SEC. | 5–120 SEC |
| N7:3 | SCREEN – REVERSE RUN TIME | 2 SEC. | 1–10 SEC |
| N7:4 | SCREEN – DIR. CHANGE DWELL TIMER | 2 SEC. | 1–10 SEC |
| N7:5 | SCREEN – ATTEMPTS TO CLEAR FAULT | 1 | 1–5 |
| N7:6 | SCREEN – PROX SWITCH FAULT DELAY | 15 SEC. | 1–60 SEC |
| N7:7 | SCREEN – CLEANING RAKE REV RUN TIME | 60 * | 1–400 * |
| N7:8 | SCREEN – PASSES BEFORE CLEANING RAKE | 3 | 1–10 |
| N7:9 | PRESS ZONE WASH – REPEAT CYCLE ON TIME | 30 SEC. | 1–300 SEC |
| N7:10 | PRESS ZONE WASH – REPEAT CYCLE OFF TIME | 6 HOURS | 1–24 HRS |
| N7:11 | WASH NO.1 – REPEAT CYCLE ON TIME | 4 SEC. | 1–60 SEC |
| N7:12 | WASH NO.1 – REPEAT CYCLE OFF TIME | 2 SEC. | 1–60 SEC |
| N7:13 | TANK WASH – REPEAT CYCLE ON TIME | 30 SEC. | 1–300 SEC |
| N7:14 | TANK WASH – REPEAT CYCLE OFF TIME | 6 HRS. | 1–24 HRS |
| N7:15 | GRIT COLLECTOR – OFF TIME | 60 MIN. | 1–999 MIN |
| N7:16 | GRIT COLLECTOR – ON TIME | 5 SEC. | 1–120 SEC |
| N7:17 | GRIT DISCHARGE – OFF DELAY | 5 SEC. | 1–120 SEC |
| F8:12 | SCREEN LEVEL – 4mA SCALING | ** | ** |
| F8:13 | SCREEN LEVEL – 20mA SCALING | ** | ** |
| F8:20 | SCREEN START LEVEL | ** | ** |
| F8:21 | SCREEN HIGH LEVEL | ** | ** |

NOTES:
1. THE ABOVE IS A PARTIAL LISTING OF SETPOINTS. ONLY THE SETPOINTS THAT ARE SHOWN ABOVE SHALL BE ALTERED IN THE FIELD.

## PLC1 – SCADA INFORMATION

| REGISTER | DESCRIPTION | DATA TYPE | SIGNAL FUNCTION |
|---|---|---|---|
| N25:0/0 | MAIN PANEL E–STOP PRESSED | BIT | READ |
| N25:0/1 | SCREEN IN AUTO | BIT | READ |
| N25:0/2 | SCREEN RUNNING | BIT | READ |
| N25:0/3 | SCREEN FAULT | BIT | READ |
| N25:0/4 | GRIT COLLECTOR RUNNING | BIT | READ |
| N25:0/5 | GRIT COLLECTOR IN AUTO | BIT | READ |
| N25:0/6 | GRIT COLLECTOR FAULT | BIT | READ |
| N25:0/7 | GRIT DISCHARGE RUNNING | BIT | READ |
| N25:0/8 | GRIT DISCHARGE AUTO | BIT | READ |
| N25:0/9 | GRIT DISCHARGE FAULT | BIT | READ |
| N25:0/10 | SYSTEM RESET | BIT | READ |
| N25:0/11 | INLET VALVE CALL TO OPEN | BIT | READ |
| N25:0/12 | INLET VALVE CALL TO CLOSE | BIT | READ |
| N25:0/13 | INLET VALVE IN REMOTE | BIT | READ |
| F26:0 | UPSTREAM LEVEL | FLOAT | READ |
| F26:1 | FLOW METER | FLOAT | READ |

NOTES:
1. THE ABOVE IS A LISTING OF BITS BEING MESSAGED FROM THE MAIN PANEL TO THE SCADA SYSTEM.

# DEVICE SETTINGS

## VFD1 – ALTIVAR 312

| PARAMTER GROUP | CODE | DESCRIPTION | DEFAULT | VFD1 FACTORY SETTING | VFD2 FACTORY SETTING |
|---|---|---|---|---|---|
| SETTINGS (SEt) | ACC | ACCELERATION | 3 SEC. | 5 SEC. | 5 SEC. |
| | dEC | DECELERATION | 3 SEC. | 5 SEC. | 5 SEC. |
| | LSP | LOW SPEED | 0 HZ. | 60 HZ. | 60 HZ. |
| | HSP | HIGH SPEED | bFr | | |
| | ItH | MOTOR THERMAL CURRENT | ** | 2.1 AMPS | 2.1 AMPS |
| | UFr | IR COMPENSATION | 20% | | |
| | SLP | SLIP COMPENSATION | 100% | | |
| | SP2 | PRESET SPEED 2 | 10 HZ | 60HZ | 60HZ |
| | Ctd | CURRENT THRESHOLD | ** | * | * |
| | SFr | SWITCHING FREQUENCY | 4 kHZ | | |
| | | | | | |
| MTR CONTROL (drC) | bFr | STD. MOTOR FREQUENCY | 50 HZ. | 60 HZ. | 60 HZ. |
| | UnS | RATED MOTOR VOLTAGE | | 480VAC | 480VAC |
| | FrS | RATED MOTOR FREQUENCY | 50 HZ. | NAMEPLATE | NAMEPLATE |
| | nCr | RATED MOTOR CURRENT | | NAMEPLATE | NAMEPLATE |
| | nSP | RATED MOTOR SPEED | | NAMEPLATE | NAMEPLATE |
| | COS | MOTOR 1 COSINUS PHI | | NAMEPLATE | NAMEPLATE |
| | UFt | SENSORLES FLUX VECTOR CONTROL | n | | |
| | nrd | RANDOM SWITCHING FREQUENCY | YES | | |
| | tFr | MAX FREQUENCY | 72 HZ | 60 HZ | 60 HZ |
| | SrF | SPEED LOOP FILTER | nO | | |
| | | | | | |
| I/O CONFIG (I–O) | tCC | 2/3 WIRE CONTROL | 2C | | |
| | tCt | 2 WIRE TYPE | trn | | |
| | rrS | REVERSE ASSIGN | LI2 | | |
| | CrL3 | AI3 MIN VALUE | 4 mA | | |
| | CrH3 | AI3 MAX VALUE | 20 mA | | |
| | AO1t | AO1 TYPE | 0A | 4A | 4A |
| | dO | ANALOG/LOGIC OUTPUT | nO | OFr | OFr |
| | R1 | R1 ASSIGNMENT | FLt | rUn | rUn |
| | R2 | R2 ASSIGNMENT | nO | CtA | CtA |
| | | | | | |
| COMMAND (CtL) | Fr1 | REF 1 CHANNEL | AI1 | AIV1 | AIV1 |
| | Fr2 | REF 2 CHANNEL | nO | AI3 | AI3 |
| | rFC | REF 2 SWITCHING | Fr1 | LI4 | LI4 |
| | | | | | |
| APP FUNC (FUn) | StC–Stt | TYPE OF STOP | rMP | nSt | nSt |
| | PSS–PS2 | 2 PRESET SPEEDS | LI3 | | |

NOTES:
1. THE ABOVE IS A PARTIAL LISTING OF SET–POINTS. REFER TO THE INSTRUCTION MANUAL FOR A COMPLETE PARAMETER LISTING.
2. VERIFY MOTOR NAMEPLATE DATA. ENTER PARAMETERS AS PRINTED ON MOTOR NAMEPLATE.
3. ** INDICATES A DEFAULT SETTING SPECIFIC TO THE VFD SIZE. THE DEFAULT SETTING IS THE NOMINAL DRIVE OUTPUT CURRENT.
4. * INDICATES A PARAMETER THAT MUST BE SET BY THE START–UP TECHNICIAN.

## CM1,2 – CURRENT MONITOR

DIP SETTINGS

| | |
|---|---|
| 1 | ON |
| 2 | OFF |
| 3 | ON |
| 4 | OFF |
| 5 | OFF |
| 6 | ON |

| | |
|---|---|
| HYSTERESIS | MIN |
| LEVEL | MIN |
| DELAY | MIN |

NOTES:
1. THE CURRENT MONITOR DIAL SHALL BE SET TO MINIMUM FROM FACTORY.
2. FIELD CONFIGURATION SHALL BE PERFORMED BY THE STARTUP TECHNICIAN PER THE APPROPRIATE TECHNICAL DOCUMENTS.

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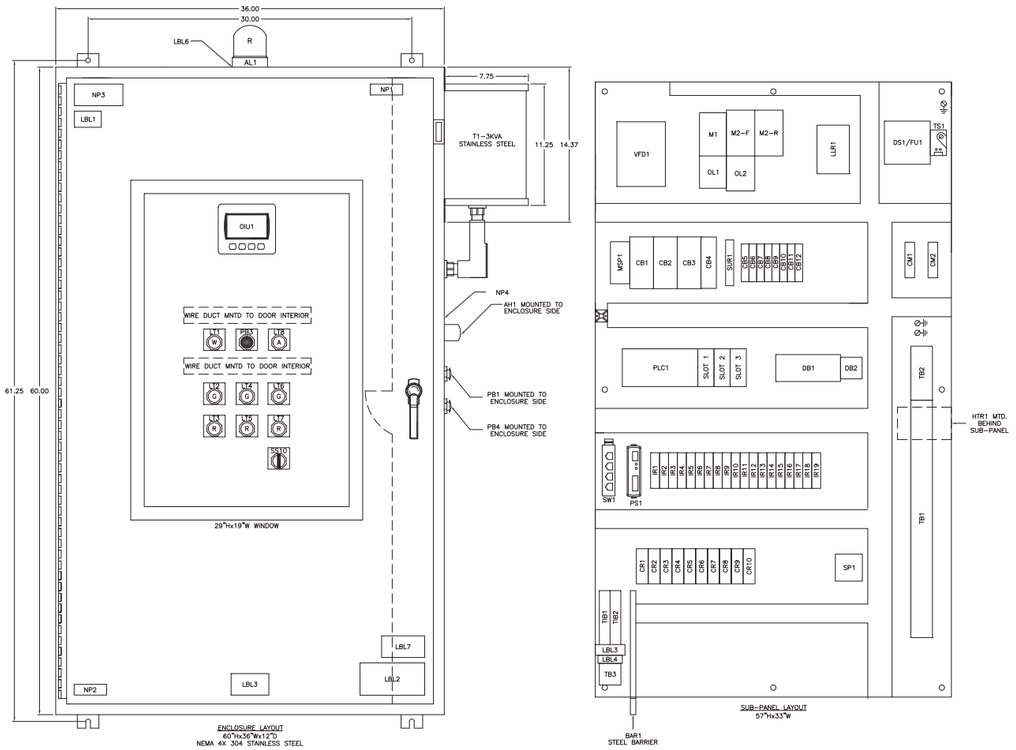
HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

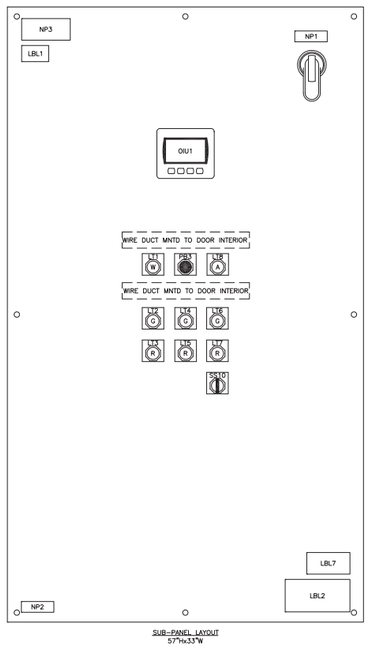
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

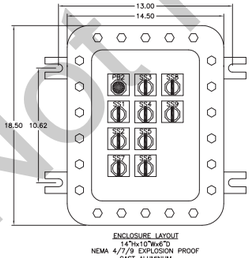
PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A10



PRESSURE SENSOR
RANGE: 0-4.62 FEET
CABLE LENGTH: 25 FEET




ENCLOSURE LAYOUT
14"Hx10"Wx6"D
NEMA 4/7/9 EXPLOSION PROOF
CAST ALUMINUM

1.25" CONDUIT HOLE LOCATIONS:
(3) - CENTERED AT BOTTOM
(3) - CENTERED ON TOP
(1) - CENTERED ON RIGHT SIDE
(1) - CENTERED ON LEFT SIDE

LEGEND PLATES:
LT1 - POWER CONTROL ON
LT2 - SCREEN RUNNING
LT3 - SCREEN FAULT
LT4 - GRIT COLLECTOR RUNNING
LT5 - GRIT COLLECTOR FAULT
LT6 - GRIT DISCHARGE RUNNING
LT7 - GRIT DISCHARGE FAULT
LT8 - HIGH LEVEL
PB1 - EMERGENCY STOP
PB2 - EMERGENCY STOP
PB3 - SYSTEM RESET
PB4 - ALARM SILENCE
SS1 - SCREEN HAND-OFF-AUTO
SS2 - SCREEN FOR-OFF-REV
SS3 - PRESS ZONE WASH HAND-OFF-AUTO
SS4 - WASH NO.1 HAND-OFF-AUTO
SS5 - SPRAY BAR HAND-OFF-AUTO
SS6 - TANK WASH HAND-OFF-AUTO
SS7 - GRIT COLLECTOR HAND-OFF-AUTO
SS8 - GRIT DISCHARGE HAND-OFF-AUTO
SS9 - GRIT DISCHARGE FOR-OFF-REV
SS10- INLET VALVE OPEN-CLOSE-AUTO

NAMEPLATES:
NP1 - 480VAC-3PH-60HZ
NP2 - INTRINSICALLY SAFE CIRCUITS
NP3 - CONTROL PANEL PROVIDES INTRINSICALLY SAFE CIRCUIT EXTENSIONS FOR USE IN CLASS I, GROUPS A, B, C, D; CLASS II, GROUPS E, F, G; CLASS III HAZARDOUS LOCATIONS WHEN CONNECTED PER PEPPERL & FUCHS INSTALLATION DRAWING NO. 116-0145
NP4 - ALARM HORN FRAGILE - DO NOT LIFT PANEL USING HORN

LABEL DESCRIPTIONS:
LBL1 - WARNING: MULTIPLE SUPPLY SOURCES OPEN ALL DISCONNECTS BEFORE SERVICING EQUIPMENT OR OTHER UNIT WIRING.
LBL2 - DANGER HIGH VOLTAGE ENTRY BY QUALIFIED PERSON ONLY
LBL3 - WARNING SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY
LBL4 - INTRINSICALLY SAFE FIELD WIRING TERMINALS
LBL5 - ELEMECH ELECTRICAL CONTROL SYSTEMS
LBL6 - WARNING DAMAGE RESULTING FROM INSTALLATION OF TOP ENTRY CONDUIT WILL VOID WARRANTY
- USE PROPER FITTINGS, MEYERS TYPE 4 OR EQUAL
- PROTECT INTERIOR DEVICES FROM INSTALLATION DEBRIS
LBL7 - DANGER ARC FLASH AND SHOCK HAZARD FOLLOW ALL REQUIREMENTS NFPA 70E FOR SAFE WORK PRACTICES AND FOR PERSONAL PROTECTIVE EQUIPMENTS.

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Tel. 704-949-1010
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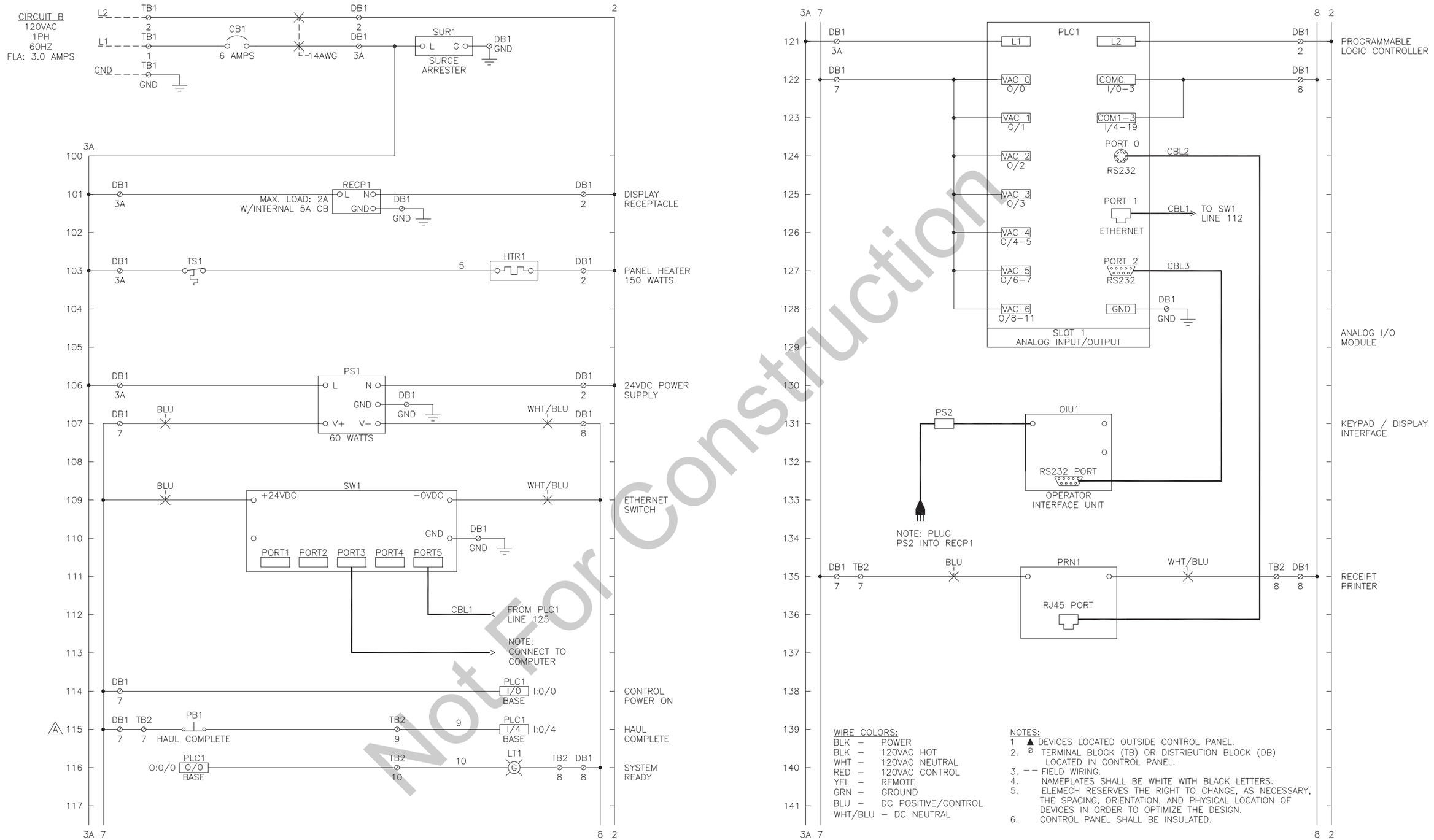
Ro3.3 SEPTAGE RECEIVING CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0009242

DRAWING NO: HBR5940A11




WIRE COLORS:

BLK – POWER
BLK – 120VAC HOT
WHT – 120VAC NEUTRAL
RED – 120VAC CONTROL
YEL – REMOTE
GRN – GROUND
BLU – DC POSITIVE/CONTROL
WHT/BLU – DC NEUTRAL

NOTES:

1. ▲ DEVICES LOCATED OUTSIDE CONTROL PANEL.
2. ⊘ TERMINAL BLOCK (TB) OR DISTRIBUTION BLOCK (DB) LOCATED IN CONTROL PANEL.
3. – – FIELD WIRING.
4. NAMEPLATES SHALL BE WHITE WITH BLACK LETTERS.
5. ELEMECH RESERVES THE RIGHT TO CHANGE, AS NECESSARY, THE SPACING, ORIENTATION, AND PHYSICAL LOCATION OF DEVICES IN ORDER TO OPTIMIZE THE DESIGN.
6. CONTROL PANEL SHALL BE INSULATED.

Not For Construction

| DATE | REVISION | NO. | BY | CK | APP |
|---|---|---|---|---|---|
| 02/19/15 | AS BUILT | A | JAP | CCC | |

DESIGNED DG
DETAILED
CHECKED CCC
APPROVED
DATE 08/27/14

HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

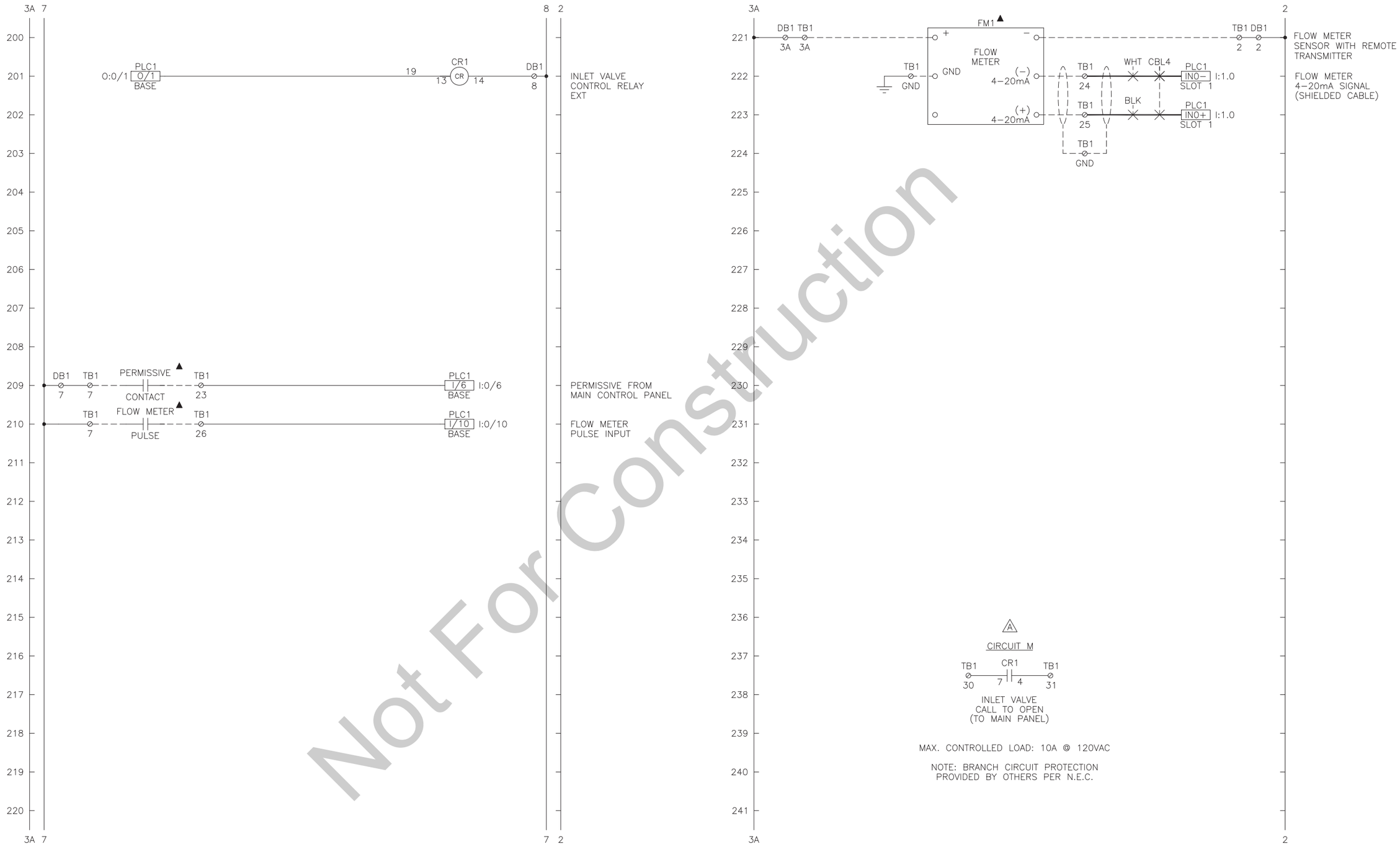
HAULER STATION CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0008830

DRAWING NO: HBR5833B01

SHEET 1 OF 4

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| DESIGNED | DG |
| DETAILED | |
| CHECKED | CCC |
| APPROVED | |
| DATE | 08/27/14 |

**HUBER**
**TECHNOLOGY**
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

HAULER STATION
CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0008830

DRAWING NO: HBR5833B02

## USER INSTRUCTIONS:

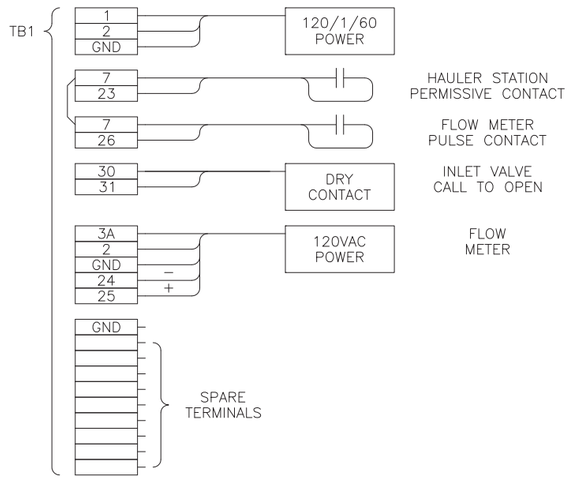
1. INSERT CARD INTO CARD READER.
2. AFTER ENTERING A VALID PIN AND WASTE TYPE, THE VALVE WILL OPEN, AND THE HAULER MAY BEGIN DUMPING
4. WHEN THE LOAD IS COMPLETE, THE USER SHALL PRESS THE HAUL COMPLETE PUSHBUTTON TO INITIATE A LOGOFF SEQUENCE.
5. DURING THE LOGOFF SEQUENCE, THE INLET VALVE WILL CLOSE, THE SYSTEM READY PILOT LIGHT WILL DE-ENERGIZE, AND THE SYSTEM WILL PRINT A RECEIPT FOR THE HAULER SHOWING TOTALIZED GALLONS.
6. THE SYSTEM IS NOW READY TO PROCESS THE NEXT USER'S LOAD.
7. IF A FAULT OCCURS WHEN A LOAD IS IN PROCESS, THE SYSTEM READY PILOT LIGHT WILL DE-ENERGIZE, THE DISPLAY WILL IDENTIFY THE FAULT. THE INLET VALVE WILL CLOSE, AND THE USER WILL BE LOGGED OUT OF THE SYSTEM. THE SYSTEM WILL PRINT A RECEIPT SHOWING THE FAULT ID.

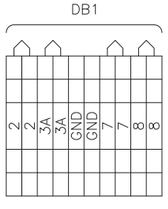
## ⚠ DEVICE SETTINGS

PORTALOGIC SERVER SETUP

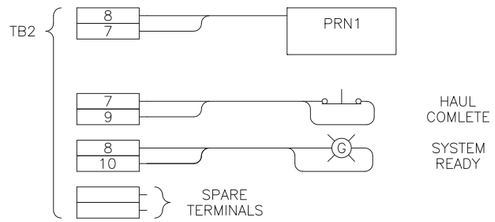
| | DESCRIPTION | FACTORY SETTINGS | FIELD SETTING |
|---|---|---|---|
| GENERAL | IP ADDRESS | 10.0.0.2 | |
| | STATION ID | 1 | |
| | STATION TYPE | DUMP STATION | |
| | REFRESH ORDERS | YES | |
| HAULER LOGIN | LOGIN | STANDARD | |
| | LOGIN TYPE | MAG CARD | |
| | BILL METHOD | METERED | |
| | WATER/WASTE RESTRICTION | NON-RESTRICTED | |
| FLOW METER SETUP | FLOW METER TYPE | PULSE | |
| | MAX FLOW RATE | 1000 | |
| | MIN FLOW RATE | 0 | |
| INSTRUMENT SETUP | DUMP TIMER LIMIT | 60 MIN | |
| | NO FLOW LOG OFF LIMIT | 20 MIN | |
| | INLET VALVE TIMER | 0 SEC | |

## ⚠ FIELD WIRING DIAGRAM




## INNER DOOR WIRING DIAGRAM




## DEVICE SETTINGS

PLC – I/O

ALLEN-BRADLEY
MICROLOGIX 1400

IN

0 2 5 7 8 10 13 15 17 19
1 3 4 6 9 11 12 14 16 18

0 1 2 3 4 7 8 10
5 6 9 11

OUT

☐ POWER
☐ RUN
☐ FAULT
☐ FORCE
☐ COMO
☐ DCOMM

PLC INPUTS

| | |
|---|---|
| I/0 | CONTROL POWER ON |
| I/1 | SPARE |
| I/2 | SPARE |
| I/3 | SPARE |
| I/4 | HAUL COMPLETE |
| I/5 | SPARE |
| I/6 | HAULER STATION PERMISSIVE |
| I/7 | SPARE |
| I/8 | SPARE |
| I/9 | SPARE |
| I/10 | FLOW METER PULSE |
| I/11 | SPARE |
| I/12 | SPARE |
| I/13 | SPARE |
| I/14 | SPARE |
| I/15 | SPARE |
| I/16 | SPARE |
| I/17 | SPARE |
| I/18 | SPARE |
| I/19 | SPARE |

PLC OUTPUTS

| | |
|---|---|
| O/0 | SYSTEM READY |
| O/1 | INLET VALVE CALL TO OPEN |
| O/2 | SPARE |
| O/3 | SPARE |
| O/4 | SPARE |
| O/5 | SPARE |
| O/6 | SPARE |
| O/7 | SPARE |
| O/8 | SPARE |
| O/9 | SPARE |
| O/10 | SPARE |
| O/11 | SPARE |

PLC STATUS BITS

S:1/8 – FAULT OVERRIDE AT POWERUP = 1

PLC ANALOG INPUTS – SLOT NO.1

| | |
|---|---|
| IN0 | FLOW METER |
| IN1 | SPARE |

PLC ANALOG OUTPUTS – SLOT NO.1

| | |
|---|---|
| OUT0 | SPARE |
| OUT1 | SPARE |

PLC – COMMUNICATIONS SETUP

| PARAMETER | VALUE |
|---|---|
| DRIVER | DF1 FULL DUPLEX |
| BAUD RATE | 9600 |
| PARITY | NONE |
| STOP BITS | 1 |
| ERROR DETECTION | CRC |

CHANNEL 1 – SYSTEM

| PARAMETER | VALUE |
|---|---|
| IP ADDRESS | 10.0.0.2 |
| SUBNET MASK | 255.255.255.0 |
| GATEWAY ADDRESS | 0.0.0.0 |
| BOOTP ENABLE | NO |

HTR1

| | |
|---|---|
| HEATER ON/OFF | 40 °F |

FAULT ID CODES

| FAULD ID | DESCRIPTION |
|---|---|
| 1 | MAIN CONTROL PANEL FAULT |
| 2 | HIGH LEVEL ALARM |
| 3 | DUMP TIMER LIMIT EXCEEDED |
| 4 | NO FLOW LOGOFF TIMER LIMIT EXCEEDED |
| 5 | LOW pH (WHERE APPLICABLE) |
| 6 | HIGH pH (WHERE APPLICABLE) |

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DETAILED
CHECKED CCC
APPROVED
DATE 08/27/14

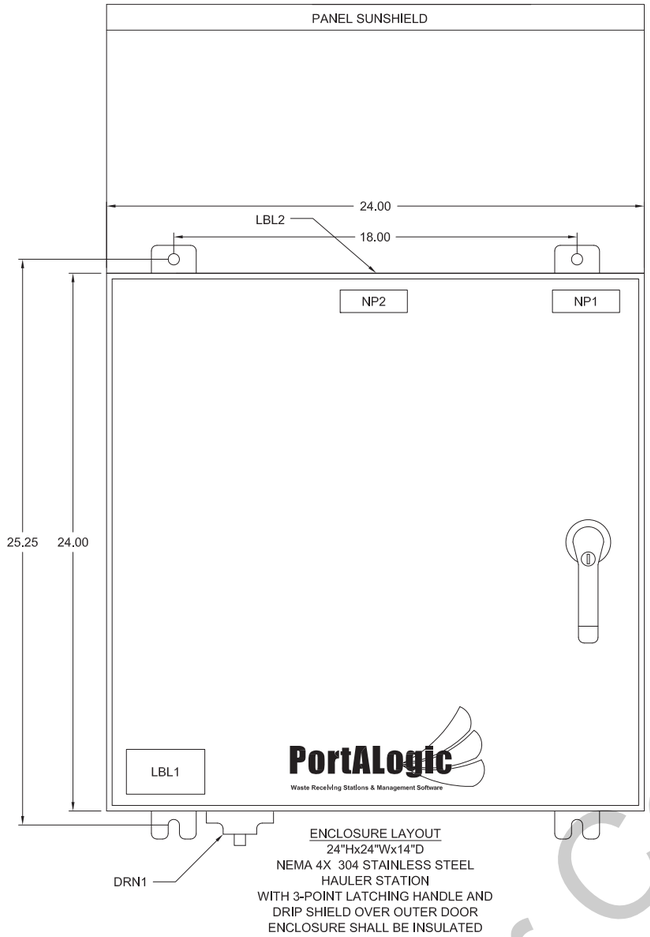
HUBER TECHNOLOGY
9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

HAULER STATION CONTROL PANEL

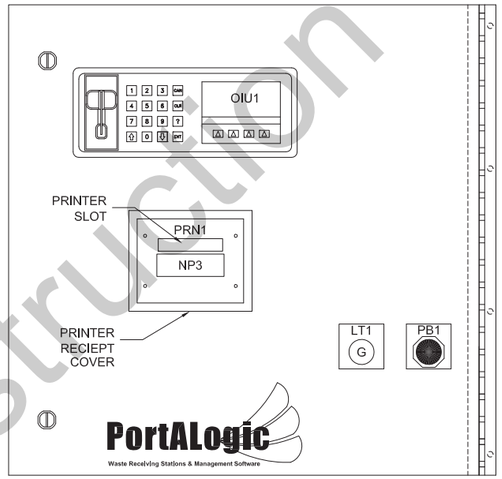
SCALE: NONE

PROJECT NUMBER: J0008830

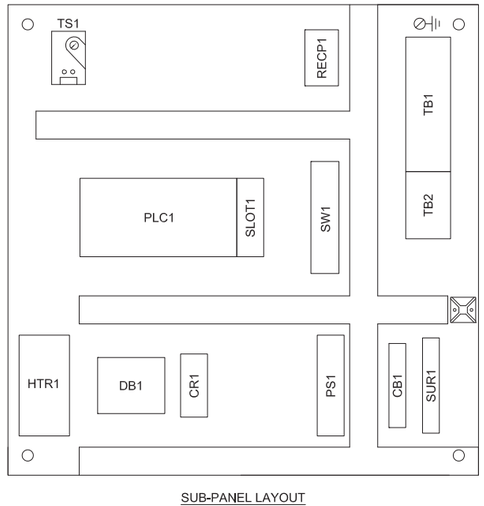
DRAWING NO: HBR5833B03




ENCLOSURE LAYOUT
24"Hx24"Wx14"D
NEMA 4X 304 STAINLESS STEEL
HAULER STATION
WITH 3-POINT LATCHING HANDLE AND
DRIP SHIELD OVER OUTER DOOR
ENCLOSURE SHALL BE INSULATED




INNER DOOR LAYOUT
21"Hx21"W
B




SUB-PANEL LAYOUT
21"Hx21"W

LEGENDPLATES:
LT1 - SYSTEM READY
PB1 - HAUL COMPLETE

NAMEPLATES:
NP1 - 120VAC - 1PH - 60HZ
NP2 - HAULER STATION
NP3 - RECEIPT - DO NOT TUG ON PAPER

LABELS:
LBL1- ELEMECH CONTROL SYSTEMS
LBL2- WARNING DAMAGE RESULTING FROM
INSTALLATION OF TOP ENTRY
CONDUIT WILL VOID WARRANTY
- USE PROPER FITTINGS, MEYERS
TYPE 4 OR EQUAL
- PROTECT INTERIOR DEVICES
FROM INSTALLATION DEBRIS

Not For Construction

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DATE 08/27/14

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9735 NorthCross Center Court, Suite A
Huntersville, NC 28078
Tel. 704-949-1010
info@hhusa.net

HAULER STATION
CONTROL PANEL

SCALE: NONE

PROJECT NUMBER: J0008830

DRAWING NO: HBR5833B04

## RECOMMENDED SPARE PARTS

# Spare Part Recommendations

1) One (1) Complete bottom bearing assembly

2) One (1) Solenoid Valve rebuild kit for each size

3) Five (5) Boxes with 230 ft. endless bags

4) One (1) set of hopper cleaning brushes

HUBER Technology, Inc.
9735 NorthCross Center Court, Suite A · Huntersville, NC 28078 USA
Phone (704) 949-1010 · Fax (704) 949-1020 · huber@hhusa.net · www.huber-technology.com
**A member of the HUBER Group**

## SUMMARY OF EXPERIENCE

**Ro3.3 Reference List**

Annville, PA (WWTP)
675 North Main Street
Annville, PA 17002
Contact: Les Powell, Lead Operator
Ph: (717)867-1992
Cell: (717)821-2618
Email: annvillepa1call@yahoo.com
Installation 06/2013

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Kittery, ME (WWTP)
18 Dennett Road
Kittery, ME 03904
Contact: Timothy Babkirk, Superintendent
Ph: (207) 439-4646
Email: No email at this time.
Installation 10/2015

---

Gloucester, MA (WWTP)
50 Essex Avenue
Gloucester, MA 01930
Contact: Jay Jarosz, Operations Manager
Ph: (978)281-9785
Second #: (978)281-3745
Email: gloucester-ma.gov

---

Oconee County Sewer, SC (WWTP)
623 Return Church Road
Seneca, SC 29678
Contact: Robert C. Winchester, Director
Ph: (864)972-3900
No email at this time.
Installation: 04/2014

---

City of Merced (WWTP)
10260 Gove Road
Merced, CA 95340
Contact: Craig Johnson, Shop Supervisor
Ph: (209)385-6892
Email: publicwks@cityofmerced.org
Installation: 04/2003

## HUBER – AN ORIGINAL SOURCE MANUFACTURER

Known as an innovator, Huber SE is the holder of multiple patents. Huber is the inventor and original manufacturer for the renowned ROTAMAT® rotary screen products and STEP SCREEN® and has proven experience and expertise with over 30,000 installations worldwide.

The company is an industry leader in North America with installations of over 3100 machines in over 1300 waste water treatment plants in the USA and Canada.

Supplying top-quality products to our customers requires not only excellent engineering and design, but also outstanding manufacturing quality. Our employees are well trained and highly motivated. Most of them have started with Huber as apprentices and are certified journeymen; some are certified trade masters. We use the latest manufacturing technologies for highest precision and lowest tolerance.

Our manufacturing is done in our own stainless-steel-only factory to prevent any contamination of our stainless steel products with rust and dust. We have a large in house pickling bath. This passivation process guarantees perfect finishing, highest surface purity and long life.

Production is the focus of our activities and is backed by our highly skilled experts who put their expertise to work and take pride in the superior quality of our products. Modern production machinery and plants, most of them computer-aided, are at their disposal, insuring the high level of accuracy, repeatable and faultless production results that our customers have come to expect.

It is the combination of our expertly trained staff, in conjunction with the latest production machinery, that enables us to offer high-quality products throughout the world.

The products that we manufacture for the environmental sector - machines and plants for water, sewage and sludge - must be extremely reliable. They must run smoothly 24 hours a day and 365 days a year. Our customers must be sure that they can rely on this consistency, which we are determined to provide by maintaining the high quality level of our production. All parts and products are treated in a special pickling solution prior to leaving our company.

Our production, in turn, is backed by an experienced team of design specialists. These design engineers elaborate related technical drawings drawn from their detailed knowledge of the specific application requirements for our products: Products which have been tailor-made to our customers' needs and which reflect our staff's expertise gained by practical experience combined with engineering proficiency.

Among the guide lines of our engineering activities is the "Integrated Product Policy" which means that the optimum use of materials, efficient operation of products, economic use of resources, compliance with environmental requirements with regard to functionality and the results achieved is taken into account right from the onset. The use of stainless steel for all our products therefore contributes to completely recovering resources and to closing the recycling loop.

The entire area of our design and construction services, as well as production, is subject to sustained quality control evidence which is documented by the relevant certificates.

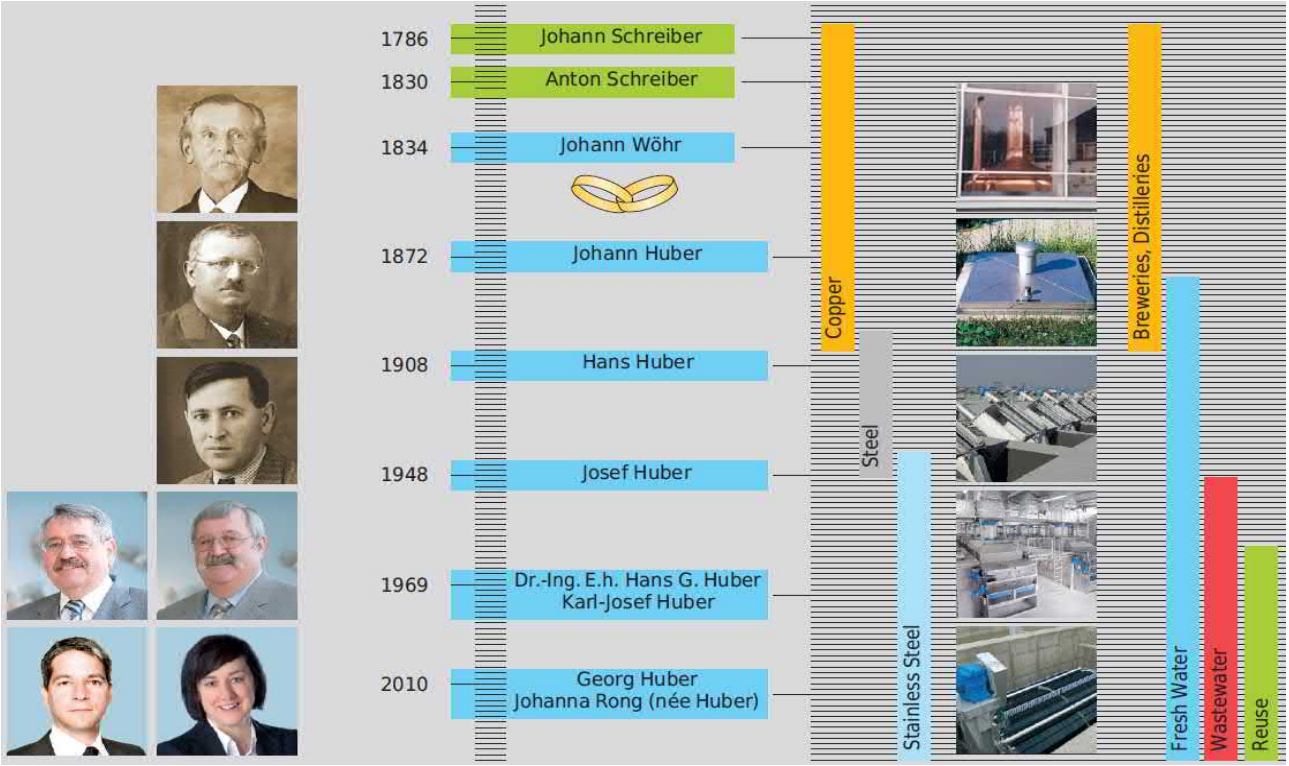
Experience, knowledge and vision provide the foundation of our design and construction activities which, together with our skilled staff, pave the way for optimized manufacturing and products which offer maximum efficiency, security and reliability.

This approach has made us a worldwide renowned manufacturer of quality products and we are committed to this philosophy for the future.

## HUBER – PRIVATELY HELD CORPORATION FOR 5 GENERATIONS

Established in 1872, Huber is an established manufacturer with five generations of craftsmanship to its credit.

Our company has remained a family owned business since its foundation in 1834 which has given us financial independence. This has resulted in a business strategy which has provided the basis for long term planning and development leading to profitable future growth.




**Water, wastewater and energy as a whole**

We offer our customers systems and services together with products that can purify, save and protect water. In addition we have processes that will utilize any beneficial residual materials that are produced.

**Customer Service is a major priority**

The customer's benefit and their satisfaction are the basis of our past and future success.

**Overall Experience**

Our flexibility and independence allow us to ensure customer satisfaction and we are confident that our strength and ability will guarantee the quality of the services we can provide. As an international company we are confident that we can provide the ideal elements within our value chain to attain the maximum benefit for each individual customer.

**Living processes**

As a company we are constantly working to improve our internal workflows and processes to ensure that the structure of our organization is efficient and forward looking. This enables us to continuously develop and enhance the quality of our solutions and products and allow us to provide excellent customer service

**Success through co-operation**

Our company actively encourages co-operation in working relationships and responsible management based on trust and respect. Our company employs highly qualified staff and we ask each and every one of them for a high level of commitment, motivation and professionalism.

**Environmental Responsibility**

Our products and services contribute to protecting the environment and we are committed to ensuring that our products and services act in accordance with the principles of sustainability.

Water is a Global Issue, we here at HUBER are ready to meet the challenges and that is why we are active throughout the world. The experience and suggestions we gather from all over the whole world have been integrated into the solutions we offer and we adapt to suit the specific requirements from our clients.

It is our aim to meet the social responsibility our company has.

RECOGNITION

## Frost & Sullivan Recognizes Huber Technology for the Unparalleled Customer Service it Offers Clients

*Standard service support for its solid/liquid separation equipment includes full maintenance throughout the product life cycle at no additional costs*

MOUNTAIN VIEW, Calif. — September 2013 — Based on its recent analysis of the solid/liquid separation technology market, Frost & Sullivan recognizes Huber Technology, Inc. with the 2013 North American Frost & Sullivan Award for Customer Service Leadership. The company's outstanding customer service sets it apart from competitors in the fragmented and competitive municipal and industrial water and wastewater treatment market. Focus on factors such as service quality, timeliness of service, impact on overall customer value, and mitigating costs that would normally be added to existing contracts by competitors, showcases Huber Technology's unique pursuit of customer service excellence.

Understanding that quality of service and the full support of installed product lines ensures customer satisfaction, ongoing efficiency of its product portfolio, and extended product life cycles, Huber Technology created the Huber Service Edge®. This trademarked menu of services creates value for existing clients. Huber Technology's quality of service commitment includes full support at the design phase, installation, startup, and for ongoing maintenance visits—all at no additional cost.

"This means that for an installed base of 2,600+ units from a broad product portfolio of solid/liquid separation equipment, Huber Technology's field service team supports approximately 1,200+ water and wastewater treatment plants with regular service maintenance visits throughout the year," said Frost & Sullivan Industry Analyst Eric Meliton. "Adding such value to existing contracts ensures that units provided and installed by Huber Technology are maintained with the highest quality standard and optimal operational effectiveness."

Through ongoing interaction with existing clients, either through annual feedback surveys or timely product inspections, Huber Technology continuously enhances its perceived client satisfaction ratings. Annual surveys of relevant respondents in client organizations probe deeply on opinions about product quality, product functions, technology treatment effectiveness, and service support. Analytics from these surveys help the company improve product design, technology features, as well as timeliness and effective service support. The survey results also ensure that validated strengths and extraordinary support services are identified and acknowledged internally.

In particular, clients conveyed a positive perception of Huber's regular onsite inspections. This standard support of existing installed technology by Huber Technology technicians not only allows for continued interaction with clients, but mitigates escalation of service and performance issues. Additionally, having continuous interaction at the client sites ensures that technicians are readily versed in some of the unique challenges at particular treatment facilities, thus improving the response rate and determination of actual solutions.

“Essentially, Huber Service Edge® enables the ongoing development of future sales opportunities and the creation of a positive reputation throughout the industry of Huber Technology’s outstanding value-added client support,” observed Meliton. “Supporting its existing client base at no additional cost is a major marketing initiative for Huber’s diverse product portfolio. In the current economic environment, and considering the level of staffing required to support such an initiative, the decision to not pass on additional operational costs to its clients truly highlights Huber Technology’s service commitment.”

In recognition of these factors, Frost & Sullivan is pleased to present Huber Technology with the 2013 North American Customer Service Leadership Award in the solid/liquid separation technology market. Each year, Frost & Sullivan presents this award to a company that has demonstrated outstanding timeliness and quality in its offering. The award acknowledges the attractive cost of service and the impact of the offering on customer value.

Frost & Sullivan Best Practices Awards recognize companies in a variety of regional and global markets for demonstrating outstanding achievement and superior performance in areas such as leadership, technological innovation, customer service, and strategic product development. Industry analysts compare market participants and measure performance through in-depth interviews, analysis, and extensive secondary research in order to identify best practices in the industry.

## SCHEDULE FOR SUBMITTALS AND EQUIPMENT DELIVERY

# Typical Schedule for Submittals and Delivery

Huber Technology, Inc. uses a standard submittal process of delivering submittal shop drawings 4-6 weeks after acceptance of a written Purchase Order. Operation and Maintenance manuals are delivered prior to start-up.

Huber Technology, Inc. uses a standard equipment delivery schedule of 22-24 weeks after approved submittals or notice to proceed.

HUBER Technology, Inc.
9735 NorthCross Center Court, Suite A · Huntersville, NC 28078 USA
Phone (704) 949-1010 · Fax (704) 949-1020 · huber@hhusa.net · www.huber-technology.com
**A member of the HUBER Group**

**ATTACHMENT A**

**PROPOSAL FORM**

The price for the Septage Receiving Station for the at the Downtown Area Wastewater Treatment Facility, Orleans, Massachuseets shall be as stated herein. The PROPOSER shall submit a price excluding Massachusetts State Sales and Use Taxes. Such price shall be in May 2019 US Dollars and will be adjusted as specified herein.

Furnish and deliver (FOB jobsite, freight allowed) Septage Receiving Station in conformance with the requirements set forth herein, the Binding Cost Proposal [1] of:

Three hundred eighty thousand dollars zero cents
Words

$380,000.00
Number

Equipment Delivery Lead Time [2]

30-34 weeks
Weeks after Receipt of Purchase Order From the General Contractor

Herein the PROPOSER acknowledges receipt and inclusion of the following Addenda by filling in the

None
Addenda Number(s)

Notes:

(1) Estimate of lump sum item shall be based on a schedule of values for all of the work which includes quantities and prices of items which when added together equal the Binding Bid Proposal and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of the Work. The schedule shall be submitted with the BID PROPOSAL. The ENGINEER reserves the right to request additional detail for the schedule of values during the BID PROPOSAL evaluation phase.

(2) Delivery lead time from purchase order shall assume four week shop drawing review time by the ENGINEER.

Respectfully submitted:

Date: May 20, 2019

By: _____
(Signature)

Henk-Jan van Ettekoven
(Name – Typed or Printed)

President
(Title)

Huber Technology, Inc.
(Business Name)

58-2462455
(Federal ID Number)

9735 NorthCross Center Court, Suite A
(Business Address)

Huntersville, NC 28078
(City and State)

(704) 949-1010
(Telephone Number)

HUBER TECHNOLOGY, INC. CORPORATE SEAL 2014 NORTH CAROLINA

(SEAL - if bid is by a corporation)

**ATTACHMENT D**

**BID BOND**

Any singular reference to Bidder (Proposer), Surety, Owner or other party shall be considered plural where applicable.

BIDDER (PROPOSER) *(Name and Address)*:
Huber Technology, Inc.
9735 NorthCross Center. Ct., Suite A
Huntersville, NC 28078

SURETY *(Name and Address of Principal Place of Business)*:
Travelers Casualty and Surety Company of America
One Tower Square
Hartford, CT 06183

OWNER *(Name and Address)*:

Town of Orleans, MA

19 School Road

Orleans, MA 02653

BID (PROPOSAL)

Bid (Proposal)
Due Date: 5/22/2019

Description *(Project Name and Include Location)*:

REQUEST FOR PROPOSAL FOR SEPTAGE RECEIVING STATION FOR THE DOWNTOWN AREA WASTEWATER TREATMENT FACILITY, ORLEANS, MA

BOND

Bond Number: N/A

Date *(Not earlier than Bid due date)*: 5/22/2019

Penal sum

| Five Percent of Amount Bid | $ 5% of bid |
|---|---|
| (Words) | (Figures) |

Surety and Bidder (Proposer), intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

**BIDDER (PROPOSER)**

Huber Technology, Inc. (Seal)
Bidder's (Proposer's) Name and Corporate Seal

By: Jacqueline Steele
Signature

Jacqueline Steele
Print Name

Secretary
Title

Attest: Jorey Chan
Signature

Contract Administrator
Title

**SURETY**

Travelers Casualty and Surety Company of America (Seal)
Surety's Name and Corporate Seal

By: Catherine Thompson
Signature (Attach Power of Attorney)

Catherine Thompson
Print Name

Attorney-in-Fact
Title

Attest:
Signature

Noah Pierce, Witness
Title

*Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.*

1. Bidder (Proposer) and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder (Proposer) the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's (Proposer's) and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder (Proposer).
2. Default of Bidder (Proposer) shall occur upon the failure of Bidder (Proposer) to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
   a. Owner accepts Bidder's (Proposer's) Bid (Proposal) and Bidder (Proposer) delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   b. All Bids (Proposals) are rejected by Owner, or
   c. Owner fails to issue a Notice of Award to Bidder (Proposer) within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder (Proposer) and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder (Proposer) and within 30 calendar days after receipt by Bidder (Proposer) and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder (Proposer), provided that the total time for issuing Notice of Award to the Selected Proposer including extensions shall not in the aggregate exceed thirty (30) months from the Binding Bid Proposal due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than the bid holding date noted in the Solicitation for Bid Proposals.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder (Proposer) and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Proposal, Bid, or Offer as applicable.

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| TRAVELERS | Travelers Casualty and Surety Company of America<br>Travelers Casualty and Surety Company<br>St. Paul Fire and Marine Insurance Company |
|---|---|

**POWER OF ATTORNEY**

**KNOW ALL MEN BY THESE PRESENTS**: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Catherine Thompson** of **Charlotte** **North Carolina**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

**IN WITNESS WHEREOF**, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd** day of **February, 2017.**

State of Connecticut

City of Hartford ss.

By: _____
Robert L. Raney, Senior Vice President

On this the **3rd** day of **February, 2017**, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

**In Witness Whereof**, I hereunto set my hand and official seal.

My Commission expires the **30th** day of **June, 2021**

Marie C Tetreault
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

**RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

**FURTHER RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

**FURTHER RESOLVED**, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

**FURTHER RESOLVED**, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this 22 day of May, 2019

Kevin E. Hughes, Assistant Secretary

**To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.**
**Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.**

**LIFE CYCLE COST DATA ENTRY FORMS**

**POWER CONSUMPTION**

| | |
|---|---|
| Equipment ID | Septage Receiving Station (11333) |
| Equipment Name | Huber Rotamat Ro3.3 Septage Receiving Station |
| Number of Equipment Units Running | 1 |
| Motor Horsepower (each unit) | Drive Motor (1.5HP) -- Horizontal Grit Screw (0.75HP) -- Inclined Grit Screw (1.5 HP) |
| Motor Power Draw | 2.8 kW TOTAL |
| Daily Equipment Run Time (each unit) | Assumed 24 hours |
| Calculated Daily Power Usage (each unit) (kW-hr) | 67.2 kW-hr |
| Calculated Daily Power Usage (all units) (kW-hr) | 67.2 kW-hr |

Notes

*Note: Fill out as many forms as necessary to include all equipment in scope of supply.*

**LIFE CYCLE COST DATA ENTRY FORMS**

**CHEMICAL USAGE**

| | |
|---|---|
| Chemical Name | N/A |
| Function | N/A |
| Ideal Dosage Rate (mg/L) | N/A |
| Bulk Chemical Concentration (%) | N/A |
| Total Chemical Usage per Day (gallons/day) | N/A |
| Estimated Unit Chemical Cost Delivered to Orleans, MA | N/A |

Notes

*Note: Fill out as many forms as necessary to include all chemicals required for equipment / processes in scope of supply.*

**LIFE CYCLE COST DATA ENTRY FORMS**

**OPERATION / MAINTENANCE STAFFING REQUIREMENTS**

The information provided below shall be based on equipment O&M literature and information from similar size and type equipment currently operating at WWTFs. Estimated labor hours to be provided for items such as equipment preventative maintenance, system operation, cleaning, instrumentation calibration, etc.

| | |
|---|---|
| Equipment No. | Septage Receiving Station (11333) |
| Equipment Name: | Huber Rotamat Ro3.3 Septage Receiving Station |

| Operation / Maintenance Item | Frequency | Estimated Staff Labor Hours / Month |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | Total Staff Labor Hours / Month | |

Notes

*Note: Fill out as many forms as necessary to include all equipment / processes in scope of supply.*

**LIFE CYCLE COST DATA ENTRY FORMS**

**REPLACEMENT PARTS**

The information provided below shall be based on equipment O&M literature and information from similar size and type equipment currently operating at WWTF's. Estimated replacement cost to be provided for the "wear and tear" items which is assumed to occur even when an item is used competently and with care and proper maintenance.

**Equipment No.** _____

**Equipment Name:** _____

| Replacement Part Item | Frequency | Number of Operating Hours | Number of Items | Estimated Cost |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Notes _____

*Note: Fill out as many forms as necessary to include all equipment / processes in scope of supply.*